Biogeosciences Discuss., 11, C666–C674, 2014
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Biogeosciences Discussions

Interactive comment on "Responses of nitrous oxide emissions to nitrogen and phosphorus additions in two tropical plantations with N-fixing vs. non-N-fixing tree species" *by* W. Zhang et al.

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Received and published: 1 April 2014

Responses to the comments

Anonymous Referee 1. Received and published: 9 March 2014

This paper shows differences in N2O emission from N-fixing vs. non-N-fixing dominated forest. A full factorial N, P addition experiment is applied in both forests with the aim to elucidate differences in P limitation and N excess relationships among the forest. The experiment is well designed and a lot of data has been collected. The paper is for most parts well written, though with some language deficits. The discussion could make better use of the data obtained.

Reply: Thank you very much for your helpful comments. Based on your suggestions, we have done a thorough checking and better use of the data to improve the writing and discussion. We have also made many necessary changes to perfect the readability of the revision. Please find as follows our responses to your comments.

Major comments:

(1) From reading a previous paper from the group, I understand that the stands are established on eroded lands and the two types of forest used for restoring forest on degraded lands. This is not at all mentioned in the site description. It is very important and also briefly mentioned in the discussion (l. 378). The land use history need to be described and should also be discussed along with the results.

Answer: Thanks for your excellent comment. You are right, both AA and EU plantations are established on the eroded lands, and used for restoring forest on these degraded lands. We have added the important information for land-use history in the Site description and Discussion sections, which can help the readers well to understand the background of the study site.

We have rewritten the sentence "In this region, most of tree species are Acacia spp., Eucalyptus spp., and some native species (Chen et al., 2011)." as "In this region, most planted tree species are Acacia spp., Eucalyptus spp., and some native species (Chen et al., 2011), especially on eroded and degraded lands.". (Please see Page 4, Lines 79-80).

We have added the sentences of "As a result of long-term disturbances, the soil in this area has eroded, leading to vast areas of degraded lands. The AA and EU plantations are commonly used for promoting forest restoration on the degraded lands in this region." to the Site description section. (Please see Page 5, Lines 113-116).

We have also inserted a phrase of "planted on eroded soils" in the following sentence "and the plantations planted on eroded soils are relatively poor in nutrients compared

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with natural forest soils" of the Discussion section. (Please also see Page 16, Line 462 in this revision).

(2) The full factorial nature of the N and P addition experiment and its analysis (Table 3) is not in full focus by the authors. They discuss many detailed differences between the individual treatments instead of the overall results for N P and the interaction. I suggest focusing more on the overall results in table 3 and reducing some of the details on individual treatments.

Answer: Thank you very much for your constructive comments. We agree with your suggestions. We have rewritten a number of sentences of the second to fourth paragraphs of the Results section, and mainly focused on the overall results (in table 3) of soil available N and P, TN and pH values responding to N, P and NP interaction. We have done the changes as follows:

We have added a sentence of "During the two years, N-addition significantly influenced soil available N (NH4+ and NO3-) contents of both plantations (Table 3)." to the second paragraph of Results section. (Please see Page 9, Lines 224-225).

The sentence of "There were significant increases of soil available P contents following P-addition in both plantations (Table 3)." has been added to the third paragraph of the Results section. (Please see Page 9, Lines 234-235).

We have eliminated the analysis on the individual treatments, such as MN, HN and MP, HP treatments, influenced the indices of soil available N and P from the Results section.

We have deleted the phrase of "significantly increased following N treatment levels" from the second paragraph of the Results section (Please see Page 9, Line 226).

In order to reduce some of the details on individual treatments, we also have deleted the following sentences from the Results section of the revision. "However, N-addition significantly increased soil NO3- and NH4+ contents in the second year (Table 1, all p <

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0.05), but TN did not.", "In both plantations, applications with N and P together tended to increased SOC contents in the second year, but there was no statistical difference (Table 1, all $p < 0.05$)", and "During two years of investigation period, soil TN and pH significant change following NP treatments (Table 2, all $p < 0.05$)". (Please see Page 9).

We have rewritten the sentence "For the AA plantation, P-addition tended to slightly increase soil available N (NO3- and NH4+) contents in the first year, especially in HP treatment plots (Table 1). By contrary, for the EU plantation, P addition significantly decreased soil available N (NO3- and NH4+) contents in the second year (Table 1), while did not in the first year." as "Soil available N (NH4+ and NO3-) contents in EU plantation significantly decreased following P-addition, while the AA stand did not (Table 3).". (Please see Page 9, Lines 235-237).

(3) All soils data in Table 1 and 2 is not used for interpretation of the N2O fluxes in a quantitative way. I would suggest regression analysis to see if the variation soil parameters among plots can explain N2O emission (using the observed gas flux from the measurement closest to the soil sampling).

Answer: Thanks for this excellent comment. Based on your suggestion, we have done a multiple regression analysis. We found that TN, MBC, MBN and litter mass had a very weak contribution for explaining N2O fluxes among the plots. So, we have mainly focused on soil NO3-, NH4+, C:N ratios, and pH values for explaining the different response of N2O emissions to nutrient additions. We have simply described the weak correlations between N2O emissions and litter mass, TN, MBC, and MBN, etc. The aim is to make readers well to understand what factors underlie nutrient additions effect on N2O emissions from thus plantation soils. We have also eliminated the weak interpretations related them from the Discussion section, and made many necessary changes to improve the readability of the revised version.

The sentence of "Multiple regression analysis indicated that there were no significant relationships between N2O emissions and TN or SOC contents" was inserted into the Results section in the revision. (Please see Page 9, Lines 240-241).

We have added the sentence of "Multiple regression analysis showed that there was a weak relationship between litterfall mass and N2O emission." to the section of "3.3 Soil microbial biomass and litterfall mass". (Please see Page 11, Lines 283-284).

The sentence of "Multiple regression analysis indicated the variations of C:N had a potential contribution to N2O fluxes." was inserted into the Discussion section of the revised version. (Please see Page 14, Lines 383-384).

(4) The analysis in Fig. 3 need to be accompanied by information on the relationship between temperature and WFPS, since they are likely highly correlated in a monsoon climate. A regression N2O = a Temp + b WFPS + c could may be show if Temp is the most important or looking at data above a certain threshold WFSP do not affect N2O emission. . .. . .

Answer: Thank you very much for your constructive comments. According to your comments, we have added the following sentences in Discussion section for the interpretations companied with Fig. 3.

The sentence of "There is a covariation between soil temperature and WFPS in the monsoon climate zone of southern China. The interaction of soil temperature and WFPS may constrain the processes of nitrification and denitrification, which mainly controlled the production of N2O emission (Barnard et al., 2005)." has been added to the section of "4.5 Effects of soil temperature and WFPS on N2O emission". (Please see Page 15, Lines 436-439).

We have inserted the sentences "Increasing soil moisture can increase soil microbial activities and therefore N2O production (Rowlings et al., 2012). On the other hand, increased soil moisture under warm conditions would increase denitrification exponentially (Arah and Smith, 1989)." into the section of "4.5 Effects of soil temperature and

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WFPS on N2O emission". (Please see Page 16, Lines 442-445) We have listed the necessary references of "Arah and Smith, 1989" in the reference list. (Please see Page 17, Lines 496-497).

For "A regression N2O = a Temp + b WFPS + c could may be show if Temp is the most important or looking at data above a certain threshold WFSP do not affect N2O emission. . . . . .", we agree with your suggestion that the regression N2O = a Temp + b WFPS + c could be shown clearly the relationships between N2O emission and soil temperature or WFPS. In the previous studies, we had used this regression analysis (N2O = a Temp + b WFPS + c) for fitting the relationships between N2O emissions and soil temperature or WFPS (Zhang et al., 2008; Yan et al., 2014). The previous results showed that there were positive relationships between N2O emission and soil temperature, and stronger with WFPS in the tropical forests of southern China. The result from this study was similar to our previous studies (Zhang et al., 2008; Yan et al., 2014), and was also comparable to other studies from the same climatic zone (Tang et al., 2006; Wang et al., 2010; Wang et al., 2014). Accordingly, we think that the readers have a clear understanding on the correlations between N2O emissions and WFPS and/or soil temperature in tropical forests of southern China. We did not show the results of regression (N2O = a Temp + b WFPS + c) for interpreting the relationships between N2O emission and soil temperature and WFPS. Additionally, the major objective of this study was to elucidate different responses of nutrient (+N, +P) additions on N2O emissions from tropical plantations. So, we would like to remain the existing analysis in the text.

In the original manuscript, we had showed the results of WFPS, soil temperature (including the correlations between N2O emission and soil temperature, WFPS, as well as the interaction) in the Results section. In order to shorten the text, according to the comments from Anonymous Referee 2 for this Discussion version, we had removed the information about soil temperature and WFPS from the Results section, and used them only in Discussion section as evidence to interpret the different responses to N-and P-additions. Please find as follows the comments from the Anonymous Referee 2.

Specific comments 33): A suggestion for reorganizing this manuscript: since this manuscript focuses on N2O emission, I may suggest show the results of N2O emissions only in the Results. . . .. . . The other analyses such as soil temperature, wfps, emission factor, are not necessary showed as results but can be used as evidence to interpret the different responses to P and N additions.

Reference:

Arah, J. R. M. and Smith, K. A. Steady-state denitrification in aggregated soils: a mathematical model. J. Soil Sci., 40:139-149, 1989.

Yan, J. H., Zhang, W., Wang, K. Y., Qin, F., Wang, W. T., Dai, H. T., and Li, P. X. Responses of CO2, N2O and CH4 fluxes between atmosphere and forest soil to changes in multiple environmental conditions. Global Change Biology, 20:300-312, 2014.

Zhang, W., Mo, J., Yu, G., Fang, Y., Li, D., Lu, X., and Wang, H.: Emissions of nitrous oxide from three tropical forests in Southern China in response to simulated nitrogen deposition, Plant Soil, 306, 221-236, 2008.

Tang, X. L., Liu, S. G., Zhou, G. Y., Zhang, D. Q., and Zhou, C. Y. Soil-atmospheric exchange of CO2, CH4, and N2O in three subtropical forest ecosystems in southern China. Global Change Biology, 12:546-560, 2006.

Wang, H., Liu, S. R., Mo, J. M., and Zhang, T. Soil-atmosphere exchange of greenhouse gases in subtropical plantations of indigenous tree species. Plant Soil, 335:213-227, 2010.

Wang, Y. D., Wang, H. M., Wang, Z. L., Ma, Z., Dai, X., Xuefa Wen, X., and Liu, Y. F. Effect of litter layer on soil-atmosphere N2O flux of a subtropical pine plantation in China. Atmospheric Environment, 82:106e112, doi:10.1016/j.atmosenv.2013.10.028, 2014.

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Minor comments:

(5) Nothing is mentioned in Methods on extraction before measuring mineral N

Answer: Thanks for your comments. We have rewritten the sentences as “Soil NH_4^+ and NO_3^- contents were determined by extraction with 2 M KCl solution followed by colorometric analysis on a flow-injection autoanalyzer (Lachat Instruments, Milwaukee, USA).” in the Methods section. (Please see Page 6, Lines 155-157).

(6) When numbers have high variability we do not need accuracy on decimals, see suggestions in attached annotated pdf, but authors please also look critical on this aspect. It will be much easier to read your text and tables if you skip the unneeded details.

Answer: We agree with your helpful comment. We have checked throughout the revision and reduced the decimals of numbers (including Tables 1-4 and Fig. 3).

(7) Text annotations in attached pdf Answer: Thank you for these excellent comments. We found that they are very useful for improving our manuscript. We agree with all of the comments in the text annotations, and made the necessary changes and corrections according to your suggestions.

We added the words as “of N_2O production” following “and clarify the underlying mechanisms of N_2O production”. (Please see Page 4, Line 92).

The sentence of “The result supported the notion that potentially higher N_2O emissions may emit from leguminous tree plantations in tropics and subtropics (Arai et al. 2008; Konda et al. 2008).” was rewritten as “Our result supports the notion that leguminous tree plantations in tropics and subtropics may potentially emit more N_2O (Arai et al., 2008; Konda et al., 2008).”. (Please see Page 12, Lines 340-341).

The following sentences “The presence of leguminous trees resulting in higher initial soil N contents, which was considered to be the main reason for the higher rate of N_2O emission from the AA plantation. Another cause might be higher rates of net

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N-mineralization and nitrification in the AA plantation, which was also supported by the study of Dick et al. (2006)." were rewritten as "The presence of leguminous trees resulting in higher N availability, including higher rates of net N-mineralization and nitrification, which was considered to be the main reason for the higher rate of N2O emission from the AA plantation, and supported by the study of Dick et al. (2006).". (Please see Page 12, Lines 342-345).

For "Consider again here to reduce to two decimals except when below 0.01. . ...." attached with the title of Table 3, we have reduced the decimals of the numbers throughout the text and tables. (Please see the Tables 1-4, and Fig. 3).

In addition, we have also done a thorough checking on all data of the manuscript and found a mistake on calculating soil NO3- and NH4+ contents: the data of blank sample had been forgotten to minus for calculating inorganic N with a colorometric analysis formula. All the data of soil NO3- and NH4+ were generally higher than the true values. We have corrected the data of soil inorganic N contents and the rates of net N mineralization and nitrification in this revision. (Please see the variations of soil NO3-, NH4+ shown in Table 1. Please also see Fig.1, and Page 10, Lines 254, 257, 266, and 267). However, the response patterns of soil NO3- and NH4+ to nutrient additions did not change, similarly, the correlations of NO3-, NH4+ and N2O emissions also did not have any changes. In this study, we mainly focus on the different response patterns of N2O emissions to nutrient additions in plantations with N-fixing vs. non-N-fixing tree species. So, this mistake did not have any effect on the conclusion of our research.

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/11/C666/2014/bgd-11-C666-2014-supplement.zip

Interactive comment on Biogeosciences Discuss., 11, 1413, 2014.