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Biogeosciences
Discussions

Interactive comment on "Contributions of agricultural plants and soils to N_2O emission in a farmland" *by* J. Li et al.

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Response to review comments of Referee 1 on the manuscript

Interactive comment on "Contributions of agricultural plants and soils to N2O emission in a farmland" by J. Li et al.

The manuscript describes a study of the effect of three soils with different crops on the production and consumption of N2O. Contribution of plants to N2O emissions is a very interesting issue, however the manuscript didn't show this, mainly because the methodology. Also, the experiments design and data interpretation have not been treated properly.

The manuscript needs to be carefully reviewed and improved before it is considered for

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publication. Below is a description of the major and minor comments on the manuscript.

[A]: We thank the reviewer for acknowledging the important role of plants in N2O emission assessment but respectfully disagree with his/her statement that we did not quantify this role. In fact, as far as we know, our study was the first attempt at measuring the plant flux in in-situ conditions. We maintained replications for all the three crops throughout the growing season, although in retrospect we could have used more replications to reduce the data noise. The best effort was made to compare the contribution of plants to the total N2O emission of these cropland systems.

The revised manuscript has incorporated all the reviewer's comments.

Major comments:

1. The experiments were not conducted in the best way, the treatments are not comparable for the following reasons:

a. Why was the soybean field not fertilized, is this common practice?

[A]: Yes, this is a common practice in north China because soybean is a legume crop that can fix nitrogen by itself.

b. Why did some measurements in the same field start or finish at different times? (e.g., maize and soybean field).

[A]: In the local farmlands, annual planting systems include winter wheat/summer maize, winter wheat/summer soybean, and fallow/cotton for a rotation within a year. The sowing and harvest dates are different among crops. Our observation schedule was constrained by the farming calendar and availability of chambers

c. The graph showing the experimental results does not allow comparison between treatments in the same experiment.

[A]: The main purpose of Figures 3-5 is to demonstrate temporal variability through the growing season. The reader may also be able to make an order-of-magnitude comparison among the treatments, although we agree with the reviewer that a precise comparison is difficult with these time series plots. Fortunately, these comparisons are made in Table 2.

d. The variability among replicates is extremely high, especially in the maize field.

[A]: Yes, the variability among replicates was large after fertilization. This result can be used to inform future experiment designs (for example, in determining the optimal number of replicates).

e. Nitrification and denitrification are considered processes responsible for N2O production. However, no experiments were conducted to elucidate this, but the authors ensure that both processes were enhanced after the fertilization.

[A]: Though the amounts of N2O produced by nitrification or denitrification were not measured, we may be able to suggest the dominant process of N2O production in the soil based on soil water status. In the cotton field, it rained after fertilization. We suggest that a large amount of N2O may have been produced by denitrification under high soil moisture conditions (Ruser et al., 2001). With the decrease of soil water content over time, nitrification may have become the main process of N2O production in the soil (Pihlatie et al., 2004).

f. Rain is interpreted as responsible for a secondary peak in the maize field. However, there are no comments on why this secondary peak was enhanced by the rain or why the secondary peak was not observed in the cotton field and soybean field.

[A]: There was a heavy rain (51.5 mm) from the night of 6 August to the morning of 7 August, which led to secondary peak of soil N2O release in the maize field (Fig. 4). However, the secondary peak may have been missed in the cotton field because no observation was carried on over there from 6 to 11 August (Fig. 3). Without fertilization in the soybean field, the lack of emission peak after raining may be attributed to the low soil nitrogen content. In response to reviewer's comment, the relevant part was modified as. "...No second peak was evident for the cotton field, although it may have been missed due to lack of observation from 6 and 11 August (Fig. 3). That no emission peak appeared in the soybean field after the rain event may be attributed to low soil nitrogen content as this field was not fertilized..."

2. The discussions are highly speculative about several processes not reviewed methodologically.

[A]: We have modified the relevant parts in section 4.1 and 4.2 according to referee's comments.

Specific comments

3. Page 5507 Line 7-9: The authors mentioned the "hole in the pipe" conceptual model involved in the regulation of N gas production, but they didn't explain anything about the mechanism.

[A]: We cite this conceptual model as one framework for the mechanism on N2O producing processes in the soil and for brevity choose not to offer an expanded discussion here. The original source is cited for the interested reader. We also added a process-based DNDC model (Li, 2000) according to referee's advice.

4. Page 5509 Line 11: Define LAI.

[A]: LAI was defined following the referee's suggestion.

5. Page 5510 Line 5-7: What happened with the temperature inside the dark chamber?

[A]: On referee's suggestion, we add a sentence as follow: "The temperature inside the dark chamber was maintained to be nearly constant (changing by less than 1oC) during the measurements by covering the outside with a thick quilt."

6. Page 5510 Line 25: Change Angilent for Agilent.

[A]: We have corrected it according to the referee's suggestion.

7. Page 5510 Line 26: What is the stainless steel separation cylinder? Is it the liner?

[A]: It is a lone tube (3mm in diameter, 2mm in length) curved like a circle inside the stove of the GC. The gases flew through the pine in different speeds in the separation cylinder. As a result, N2O was separated from the gas sample before it passed the detector (ECD).

8. Page 5511 Line 1-4: The authors ensured that the GC showed a linear response between 250 and 1000 ppbv. How can they claim this with only one point in the calibration curve (320 ppbv)?

[A]: The data on the linear response was given by the Agilent Company and was confirmed by the technician of our project. Please see the reference as follows: Wang, Y. and Wang, Y.: Quick measurement of CO2, CH4 and N2O emission from agricultural ecosystem, Adv. Atmos. Sci., 20, 842–844, 2003.

9. Page 5511 (line 21-22) and Page 5512 (Line 1-12): There is a methodological issue.

[A]: We have moved this portion of the text to the Methods section. Thank you.

10. Page 5513: The fluxes are reported without any variation ( ).

[A]: For clarity of presentation, we choose to leave out information on variability. The reader can find the information in the Figures and Tables cited here.

11. Page 5513 Line 17: The maximum N2O flux in the maize field (1271 μg N2O m-2 d-1) does not match with the maximum flux in figure 4.

[A]: Sorry, it should have been 1321 μgN2O m$-$2 h$-$1. Thank you for your careful reading of the manuscript.

12. Page 5513 Line 18-19: “Afterwards, the soil N2O emission decreased gradually with time”. This is not observed in the figures. A sharp decrease is observed.

[A]: The sentence was deleted

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13. Page 5516 Line 11-13: A correlation with 5 points just at the beginning of the experiment is not representative of a good linear correlation.

[A]: We have modified the relevant part according to the referee's comment as follow: Page 5516 Line 11-13: we have deleted "During . . .. . .under sunlight ($P < 0.01$)."; Line 18: in the end, we have added "In the maize field, the correlation between the plant and the soil N2O flux was not representative of the whole season because the plant flux was only measured five times during the early stage."

14. Page 5516 Line 13-15: What are the implications of beginning the plant flux measurements one month after the beginning of the experiment?

[A]: We had to wait until the plants grew tall enough so the plant chambers could be used without damaging plants. To avoid biased comparison, the data in Table 2 (Fp and Fs) were averages over the time periods when both sets of measurements were available.

15. Page 5516 Lines 15-18: Seems a repetition from the point 3.4.

[A]: We have deleted the repetition part.

16. Page 5516 Lines 21-25: The authors compared their results with other reports. However, the soybean field in the study was not fertilized, so no comparison with the other fertilized fields can be done.

[A]: We have modified the words according to the referee's advice

17. Page 5517 Line 4-5: This is not clear to me, because nitrate and ammonium content in the cotton and maize fields look very similar.

[A]: The nitrate and ammonium content in the cotton field was higher than in the maize fields. Please see table 2.

18. Page 5517 Line 10-11: phrase "So did N2O production by nitrification and denitrification" ????

[A]: It should have been “So did the temperature response of N2O production by nitrification and denitrification”. We have modified it in the text.

19. Page 5517 Line 14: Please define Q10 where needed.

[A]: Q10 was defined on page 5515, line 11.

20. Page 5519 Line 1-2: "After fertilization, the significant correlation between soil and plant N2O fluxes implied.....". What’s the evidence of this?

[A]: This sentence was deleted. Please see the modified paragraph in the text.

21. Page 5523 Line 20-22: Correct Hakata reference.

[A]: Done.

22. Figure 3, 4 and 5: The scale of the graphs doesn’t allow to see differences among treatments in the same field experiment.

[A]: See response to query 1c.

23. Figure 3, 4 and 5: Define the units of fluxes. In the text the unit is ïĄ■g N2O m-2 h-1 while in the figures is mg N2O m-2 h-1.

[A]: It should be ïĄ■g N2O m-2 h-1. The mistake has been corrected on the referee’s suggestion.

24. Table 2: What’s the meaning of “a”?

[A]: Different lowercase letters marked behind the data represent significance at the 0.05 level (this is now explained).

25. Table 4: What’s the meaning of the asterisks?

[A]: * P <0.05; ** P <0.01. We have added this in Table 4.

26. References: Order the references in alphabetical order.

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[A]: On the referee's suggestion, the references are now in alphabetical order now.

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Table 2 Seasonal mean plant and soil N_2O fluxes, soil moisture and available nitrogen content in crop fields.

Item	Cotton field	Maize field	Soybean field
F_{pt}^{*}	75±44 a	15±54 a	-2±27 a
F_{pd}^{*}	33±16 a	0±8 a	34±31 a
F_p	54±43	7±44	16±41
F_s	444±89	34±4	38±12
F_s'	411±82	181±58	76±12
$F_p/(F_s+F_p)$	0.11	0.18	0.29
WFPS	66%	64%	53%
Soil NH_4^+-N	2.46	2.13	2.63
Soil NO_3^--N	31.98	23.13	20.18

F_{pt}: mean plant N_2O flux observed by transparent chambers, representing the daytime flux;

F_{pd}: mean plant N_2O flux observed by dark chambers, representing the nighttime flux;

F_p: weighting average of plant N_2O flux for the whole day, $F_p=(1.16F_{pt}+F_{pd})/2.16$;

F_s: mean soil N_2O flux in the period corresponding to plant flux;

F_s': mean soil flux over the whole observation period;

All fluxes were "average ± spatial standard error" ($\mu gN_2O\ m^{-2}\ h^{-1}$).

WFPS was the percentage of soil pore volume filled with water at the depth of 0–5 cm;

Soil NO_3^--N and NH_4^+-N content was the average at the depth of 0–40 cm ($mg\ kg^{-1}$).

In the maize field, plant flux measurement was limited in the early growing stage.

*: Different lowercase letters represent significance at the 0.05 level.

Fig. 1.

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Table 4 Coefficients of linear correlation between soil and plant N_2O flux, between plant flux under sunlight and darkness.

Crop	Item	Coefficient	
		Light plant flux	Dark plant flux
Cotton	Dark plant flux	0.20	
	Soil flux	0.70**	0.44*
Soybean	Dark plant flux	0.53	
	Soil flux	0.04	0.00

* $p<0.05$;

** $p<0.01$.

Fig. 2.

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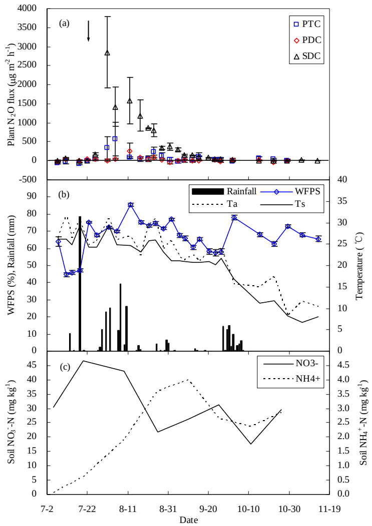

Fig. 3 Seasonal variation of plant and soil N_2O fluxes, air temperature (T_a), soil temperature at depth of 5 cm (T_s), the percentage of soil pore volume filled with water at the depth of 0–5 cm (WFPS), soil NO_3^--N and NH_4^+-N content (0–40 cm) in a cotton field. PTC: plant flux observed with transparent chambers; PDC: plant flux observed with dark chambers; SDC: soil flux observed with dark chambers. Arrow indicates fertilizer application.

Fig. 3.

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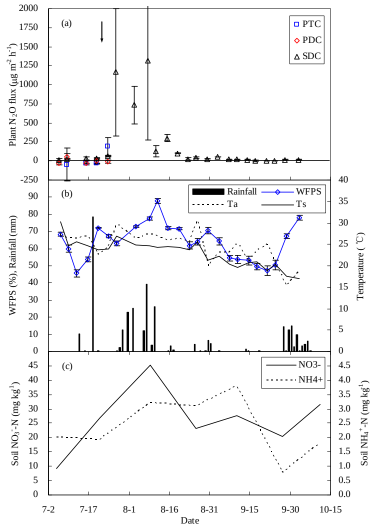

Fig. 4 Seasonal variation of plant and soil N_2O fluxes, air temperature (T_a), soil temperature at depth of 5 cm (T_s), the percentage of soil pore volume filled with water at the depth of 0–5 cm (WFPS), soil NO_3^--N and NH_4^+-N content (0–40 cm) in a maize field. The meaning of PTC, PDC and SDC is the same as Figure 3. Arrow indicates fertilizer application.

Fig. 4.

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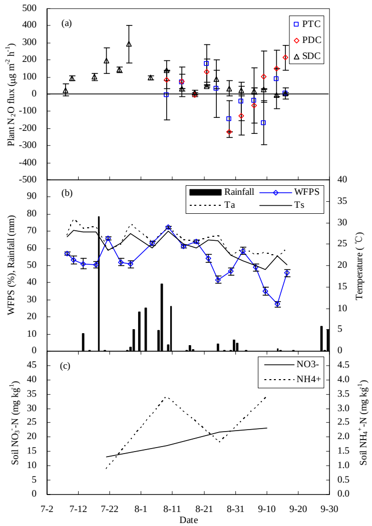

Fig. 5 Seasonal variation of plant and soil N_2O fluxes, air temperature (T_a), soil temperature at depth of 5 cm (T_s), the percentage of soil pore volume filled with water at the depth of 0–5 cm (WFPS), soil NO_3^--N and NH_4^+-N content (0–40 cm) in a soybean field. The meaning of PTC, PDC and SDC is the same as Figure 3.

Fig. 5.

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