Interactive comment on "Phosphorus addition mitigates N_2O and CH_4 emissions in N-saturated subtropical forest, SW China" by Longfei Yu et al.

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Referee #2

General comments The authors reported en experiment of P addition (79 kg P ha-1 yr-1, applied as NaH2PO4 powder) to an N saturated, Masson pine-dominated forest at TieShanPing (TSP), Chongqing, SW China for a period of 18 months. In the experiment, they measured soil fluxes of N2O and CH4, soil chemistry and plant growth. They found that P addition significantly decreased soil N2O emissions and turned the soil from CH4 emissions into a net sink. The experiment is appropriate. Data interpretation was logical and supported their conclusion. The study is for a type of ecosystem (subtropical, high ambient N deposition, N-saturated forest soil) for which such information is lacking. Their findings are interesting, can help us understand the interaction effect of N and P on greenhouse gas emission and also have implication for the forest management (such as P fertilization). In addition, the manuscript is also well organized and well written. I have only some minor concerns which I would like to discuss with the authors or maybe helpful for improving the manuscript, please see details below.

R 2.0: We thank referee #2 for the positive feedback. The comments are addressed point by point below.

Specific comments

1) P7, Line117. "annual N deposition at TSP measured in throughfall varies between 40-65 kg ha-1". What is the N deposition in precipitation there? Because N deposition in throughfall may be affected by difference in species, structure etc. of the forest, N deposition in precipitation is better data for comparing different forests.

R 2.1: The bulk deposition at TSP is in a range of 20 to 30 kg N ha^{-1} yr^{-1} (Chen and Mulder, 2007). We will add this to our site description.

2) P9, L165. Please give the locations (in the center of the plot?) where you measured the gas emission in the plots.

R 2.2: Chambers for flux measurements were deployed next to the lysimeters, which were randomly distributed near the center in each of the 20m * 20 m plots, at least 3 meters away from the border.

3) P9, L165-167. "to investigate the immediate effect of P addition on ..... (7, 10 and 12 May) after the P application." Did you show these results in the result or discussion section? If not, please delete it.

R 2.3: Yes, the data were shown in Fig. S6 and the result section (line 228). Other studies have reported stimulation of N_2O emission by P addition, presumably due to microbial response in soil (Mori et al., 2013; Wang et al., 2014). Hence, we included the short-term data for comparison.

4) P11, Line 195 Statistical analyses. In the Experimental Design, the author showed that three blocks were established and two plots in each block in the study forest. In each block, plots were assigned randomly to a

reference (Ref) and a P treatment. Did you try One-way Repeated-Measures ANOVA to exam the treatment effect for the emission of CH4 and N2O, due to measuring the gas repeatedly.

R 2.4: We have used repeated measures ANOVA to compare the fluxes of CH_4 and N_2O as well as DIN concentrations among all our plots (Ref-1, Ref-2, Ref-3, P-1, P-2 and P-3). These six plots were compared as independent groups instead of three Ref plots as a group and three plots as the other. If we use N_2O fluxes as an example, our results showed that in blocks 2 and 3, ref-2 and ref-3 were significantly larger than P-2 and P-3, respectively. Indeed, we believe and appreciate the suggestion from referee #1, that Linear Mixed Effects Models are better for interpreting treatment effects in our study. In the revision, we will reanalyze our dataset and anchor our discussion within the outcome of a Mixed Effect Model. For comparing parameters for tree-growth and soil properties (single observations only), one-way ANOVA is used (as in the original manuscript).

5) P19, L362-363. "Overall, our study demonstrates that chronically high N deposition has transformed TSP soils to a regional hotspot for N2O and CH4 emission." It is not clear for me. Could you explain it?

R 2.5: For details, please refer to R 1.3 and R1.8.

6) P25, L565-568, "Zhang et al., 2014. Responses of nitrous oxide emissions to nitrogen and phosphorus

....." has been published in Biogeosciences, please replace Biogeosciences Discuss.

R 2.6: Thanks. We will change it in the new version of manuscript.

7) P27, L585, Table 1. How did you get n=6? Did you mixed samples in each plot?

R 2.7: Before P application, we sampled the soil (for background properties) three times within each plot. Since there was no treatment yet, we combined two plots in the same block for presentation of the data.

8) P28, L591, Table 2. The yearly variation for some data is big. For example, PAL in the ref plots was 5.4 in Aug. 2013, but was 13.4 in Aug. 2015. Do you have any explanation for it?

R 2.8: Every half year, we sampled soil in triplicates from each plot randomly. Significant spatial heterogeneity is common in surface soils in 20*20 m^2 plots, as the litterfall may directly affect surface soil composition.

Reference 2

Chen, X. and Mulder, J.: Indicators for nitrogen status and leaching in subtropical forest ecosystems, South China, Biogeochemistry, 82(2), 165–180, doi:10.1007/s10533-006-9061-3, 2007.

Mori, T., Ohta, S., Ishizuka, S., Konda, R., Wicaksono, A., Heriyanto, J. and Hardjono, A.: Effects of phosphorus addition with and without ammonium, nitrate, or glucose on N2O and NO emissions from soil sampled under Acacia mangium plantation and incubated at 100 % of the water-filled pore space, Biol. Fertil. Soils, 49(1), 13–21, doi:10.1007/s00374-012-0690-5, 2013.

Wang, F., Li, J., Wang, X., Zhang, W., Zou, B., Neher, D. a and Li, Z.: Nitrogen and phosphorus addition impact soil N2O emission in a secondary tropical forest of South China., Sci. Rep., 4, 5615, doi:10.1038/srep05615, 2014.