

The manuscript by Longfei Yu and others presents a replicated forest fertilization experiment in an acidified and N-saturated Masson pine-dominated forest at TieShanPing, SW China. The experiment tests the role of mineral P fertilization in regulating nitrous oxide and methane emissions (uptake). Researchers measured soil water NO_3^- concentrations, N_2O emissions, CH_4 emissions (uptake), forest productivity, litter fall, litter chemistry, and soil characteristics prior to and after a one-time fertilization with 79 kg P ha^{-1} (NaH_2PO_4).

The Author's found that P fertilization results in declines in soil NO_3^- and suppressed emissions of N_2O , and CH_4 (not immediately, but over the long term). With P addition TSP soils switched from a CH_4 source to a sink. Elevated biomass production was not observed over the 18-month experimental period. However, understory biomass was not assessed. Based on these results, Authors hypothesized that P additions resulted in increase NO_3^- uptake by plants and microbes leaving less for denitrification. Also, P addition was thought to lessen the NH_4^+ inhibition of methane oxidation.

Overall comments:

This manuscript is well written and presents a topic that is of interest generally to the readers of *Biogeosciences*. I have a couple of concerns that should be addressed prior to publication. First, I feel that these results and their interpretation would be easier to follow if there were a set of explicitly stated hypotheses. There is one hypothesis stated in the Abstract (that concerns the results), but not in the main body of the manuscript.

Regarding the description of the experimental design and sampling, the description in the methods doesn't seem to reflect the data that is presented for N_2O and CH_4 (L167-179). From the methods, I gather that N_2O and CH_4 were measured a total of four times, but clearly more data points are presented. Please clarify in the text how frequently measurements were made over the entire experiment. Other clarifying points are made below in the line-by-line comments.

With the Results, at times the text is confusing because the treatment effects of P additions and the seasonal/temporal patterns are explained simultaneously. I would recommend some minor reorganizing of this information. Perhaps start with the overall seasonal patterns and then state the treatment effects or the opposite.

Line-by-line comments:

L16: Change GHG to green house gas

L18: If this is a single fertilizer event is it necessary to have the unit yr^{-1} ?

L20: Rephrase this sentence to read "We observed a significant decline in soil water NO_3^- concentrations (5 and 20 cm depths) and in soil N_2O emissions following P addition."

L21: It is unclear if this number is the amount of reduction or if it represents the total emission. Please clarify

L23-24: The “As for N₂O” is a confusing way to begin this sentence. Can you revise to something like “P addition significantly decreased CH₄ emissions, turning TSP soils from a net source to a net sink.” I’m sure the Authors will have a more eloquent way of conveying that message.

L26-27: It’s my preference to put this caveat in the discussion or that it’s rephrased. The current wording suggests that you measured understory and that there was an increase in understory biomass.

L48-49: ‘frequently shifting aerobic conditions’ is awkward please revise. Perhaps this is better put in terms of aerobic and anaerobic?

P4 L56: Consider changing ‘mineral’ to ‘inorganic’

L100: The hypothesis is stated in the abstract but not the main text. Please include in text prior to the objectives.

L105: It’s unclear why the study site name is in quotations.

L116: TSP hilltop is not intuitive. Please explain in text

L121-122: Can you state over what time period the decline in growth has occurred here?

L128: Rather than an *, please use ×

L141: Can you report the Na⁺ concentrations of the Reference plots?

L157: Change (2 mm) to (2mm × 2mm)

L165: I think part of the instrument name is missing. Should this be ‘inductively coupled plasma atomic emission spectroscopy’? For all makes/models of equipment here and throughout, please add the location information.

L171: Change to “...into 12 mL pre-evacuated glass vials... (Chromacol, UK).”

L172: I would recommend splitting this into another sentence: “Vials were over pressurized to avoid contamination during sample transport.”

L173: Is ‘Mixing ratio’ what you mean or should this be ‘Fluxes of ...’ or ‘Concentrations of...’

L190: Please specify if the same trees were measured at each time point, this is critical to the interpretation of these data.

L194: Rather than ‘sum of precipitation’ can this be termed ‘daily total precipitation’? Please provide the time period over which precipitation and temperature were measured.

L198: I gather from the methods that gas samples were collected from August 2013 forward, but only during the month of May (2, 7, 10, and 12). This doesn’t reflect all of the data points that are shown in Figures 2 and 5. I would insist that the Authors add clarity to the methods or only show data that were collected in this study.

L206: It is unclear if fluxes of ‘litterfall’ nutrients were scaled to the biomass production. Or was litter biomass a component of the overall biomass calculation?

L210-213: For tree growth, how were the 3 different time points treated? Please be specific.

L226: The phrase ‘sum of charge of dissolved base cations is unclear’, at any rate, it would be more appropriate to say that charge was significantly different between fertilized and unfertilized. I am curious if the ‘charge’ decreases in the P treatment because of the increase of Na⁺. Can you please address?

L232-234: Please report the block effect here.

L236-238: Rephrase to read: The P addition resulted in a 50% (average 3 kg N ha⁻¹ yr⁻¹) reduction of cumulative N₂O emissions (Fig. 3). Please add +/- Stderror if it is available

L238: Change was to were.

L240: Was there a significant block effect that could be reported here?

L245: Should this unit be CH₄-C here and throughout? Also can you add +/- Stderror here?

L250: What does 138 t ha⁻¹ represent? Is it an average across both years and both treatments? I'm not sure how informative that is. Based on your supplemental data, it looks as if biomass was actually lower in the P addition treatment compared to the Reference treatment.

L252: The 500g needle weight does not need to be reported here.

L253: This sentence needs to be clarified to indicate the mechanism responsible for differences in needle chemical composition. "Linked" is vague.

L253: 'hardly' is a vague word, please replace.

L273: Change mineral to inorganic

L273: This paragraph is long and difficult to follow. I believe that the Authors could find a way to make it more streamlined and easier to follow.

L275-279: This sentence is complex and confusing. Please revise, as it seems to contradict your former statement.

L283-292: I think it would be better to put your study into context of others that used similar additions. Perhaps the reference to moderate P additions is a bit of a distraction. I would recommend revising to focus on more similar studies.

L306: Likewise, the point of this paragraph is not entirely clear. As well, it is unclear if the referenced studies are also covering the short-term (~10day) span of time that is referenced in this manuscript.

L324: Change production to 'CH₄ production' just to be clear this isn't primary production

L353: Change apparently to 'may have'

L355: I liked the nice flow and organization of this paragraph!

L375-376: Is there a citation from your previous work that you can add here? As is, these data don't provide obvious evidence for this.

L377: Can this statement be qualified by stating 'to overall reduce'

L379: GHG is used here and in the abstract, but is not explicitly defined. Please do so.

L388: References are not alphabetized consistently.

Tables and Figures:

L603: Please change 'Background' to 'Ambient'

Table 1. Was 5.0 mg kg⁻¹ the detection limit of the instrument for P_{H₂O}? If so, please just indicate this in the footer of the table rather than dedicating an entire column to the < 5.0 information.

Table 2. Here and throughout, please be consistent that the P treatment is '+P'. Also it is unclear what the letters indicate in terms of significance. Should they not indicate significant differences among the Ref and +P treatment? Or is this across all

time points? If so, the analysis should more appropriately be a repeated measures analysis.

Figure 4 and Figure 6: The letters indicating significance are somewhat unnecessary here. The point could be made in either the figure legend or with an asterisk centered above the two boxes. In both figures, I would recommend adding the statistical test that you used.

Figure S6: Litter is spelled incorrectly in the axis title