

## ***Interactive comment on “Effects of N and P fertilization on the greenhouse gas exchange in two nutrient-poor peatlands” by M. Lund et al.***

**M. Lund et al.**

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*We would like to thank the reviewer for careful reading and constructive comments on the manuscript. Our responses to the comments can be found in italics below.*

General Comments: This paper explores the importance of nitrogen and phosphorus on ecosystem carbon cycling (GPP, NEE, respiration) in two peatlands – one in a high N deposition area and one in a low N deposition area. Understanding the controls on carbon cycling in peatlands has important implications for the global carbon cycles, and, while there has been previous work on the role of N and P, this project contributes to this understanding. As hypothesized, in the low N deposition area, N had effects on GPP and respiration while P stimulated GPP in the high N deposition peatland. There were few treatment effects on the vegetation community at either site. There is some

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indication that N fertilization increases N<sub>2</sub>O flux, but the evidence here is a bit weak. The writing in this paper could be tightened. There are a number of awkward phrases throughout and a solid editing would be helpful.

My major hesitation with this paper is that the main story is not clear. The ‘meat’ of the data interpretation is included in Table 1 and Table 2 and in both cases I found it difficult to get the big picture. Table 1 gives no information about what treatments drive the response variables or in which direction (positive or negative). Table 2 lacks statistics – which treatments are different? Could these be combined? Perhaps a multi-paneled figure? Also, did you see significant time \* treatment interactions in your RM-ANOVAs?

*Table 1 and 2 has been merged into a multi-panel table according to reviewer suggestion. Post hoc tests to find which means that differ are not possible in RM-ANOVA when covariates are used in the model. A significant time\*treatment interaction effect is seen for GPP and NEE in Storflaket, indicating that the treatments responded in dissimilar ways to nutrient addition during the measurement period. This has been included in the results section.*

Consider some discussion about the relevance of the nitrogen and phosphorus treatments used here. The HN treatment is roughly 3-times higher than the deposition at a high nitrogen deposition site. I fully understand that treatments are designed to push the system and generate responses, but are they at all realistic for these bogs?

*Such high rates may not be expected in these bogs; however these rates are similar to the high deposition rates that can be found in central Europe. A sentence on this has been included in the end of section 2.2.*

This is a minor point in this particular case, but Reco should include CH<sub>4</sub> flux as well. It is a tiny proportion here, but this is not always the case.

*In this study we define NEE = Reco – GPP, and these terms do only include the ex-*

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change CO<sub>2</sub>. As is stated by the reviewer, the CH<sub>4</sub> flux account for a small fraction of total respiration, generally accounting for less than 1 percent. No action taken.

Do you suspect that CH<sub>4</sub> was oxidized at this site as the fluxes seem quite low?

*A section on potential explanations for low CH<sub>4</sub> flux is included in discussions section.*

Specific Comments: P4804; L11. In the sentence beginning "In addition, a short" specify which site you're referring to.

*Specification included (both sites).*

P4804, L16. The final two sentences of the Abstract are very awkward.

*These have been changed to "In a longer term, increased nutrient availability will cause changes in plant composition, which will further act to regulate the peatland greenhouse gas exchange."*

P4805, L5. This should read methanogenic "microbes" – methanogens are archaea, not bacteria.

*Changed according to reviewer suggestion.*

P4805, L15. I was surprised to see no discussion of the potential toxicity effects of nitrogen on Sphagnum.

*A few lines on this matter have been inserted into introduction section.*

P4807, L2. All greenhouse gases are not measured here. The key ones are, but there are many more.

*Changed according to reviewer suggestion.*

P4808, L2. I am not sure how low N deposition in and of itself indicates N limitation.

*Subordinate clause on N limitation removed.*

P4808, L13. The sentence reading "In 2007, the amount of P . ." is confusing. What

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is meant by "the quotient between fertilization water concentration and soil water concentration was higher for N than P". Are you comparing the ratio of N:P in the control and in the HNHP plots?

*This has been clarified; the amount of P was increased so that the HNP treatment would more closely resemble the N:P ratio of mire water.*

P4810, L2. I might add a bit more detail about your vegetation measurements given that they receive so much weight in the results and discussion. Another sentence describing the vegetation categories used, for example, might be helpful.

*Sentence included according to reviewer suggestion.*

P4810, L12. This seems like an incredibly low  $r^2$  value to call linear. Typically, I expect to see numbers more like  $>0.9$  when looking for linear flux. Values of  $>0.8$  make me nervous, and  $>0.7$  seems like a very generous threshold to use. Perhaps some evaluation of the distributions of  $r^2$  values would be helpful here. How frequently were  $r^2$  values  $>0.9$ , for example?

*This is an important question. Reviewer 1 argued that an  $r^2$  threshold of 0.7 could lead to significant data reduction, while reviewer 2 considered it low. Small fluxes will have low  $r^2$  values; fluxes of N<sub>2</sub>O and CH<sub>4</sub> may also be subjected to nonlinear emission patterns. We have found that using an  $r^2$  threshold of 0.7 results in reliable fluxes, which can be illustrated by the close agreement with gas chromatography as described in the methods section. For CH<sub>4</sub>, 80 and 51 percent of the measurements had  $r^2$  values above 0.7 and 0.9, respectively. For N<sub>2</sub>O, 38 and 10 percent of the measurement had  $r^2$  values above 0.7 and 0.9, respectively. No action taken.*

P4812, L1. Have you previously defined PFT? I didn't see it anywhere.

*Now defined in section 2.4.*

P4814, L5. "Complex and nonlinear responses to nutrient additions for CH<sub>4</sub> exchange" seems to me a bit of an overstatement. In reality you see no treatment effect on CH<sub>4</sub>

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exchange except for a near significant response at one site.

*This line has been changed to "No significant effects of nutrient addition were found for the CH<sub>4</sub> exchange".*

Figure 2. Could asterisks be used to show days where there were significant treatment effects? You might consider making Figures 2 and 3 more easy to interpret in black and white. I realize that color is a publishing option online, but I printed the paper out and had a hard time reading the graphs.

*Changed according to reviewer suggestion.*

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