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Biogeosciences Discussions

Interactive comment on "Chronic nitrogen addition causes a reduction in soil carbon dioxide efflux during the high stem-growth period in a tropical montane forest but no response from a tropical lowland forest in decadal scale" *by* B. Koehler et al.

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First, we would like to thank the referee for the thorough review of our manuscript and for her/his constructive, helpful and kind critique. We would also like to thank Kirsten Küsel for acting as editor for the manuscript, and for her access-review. We will now answer to the referees questions and comments, and point out the revisions which we conducted based on the referees suggestions.

1) The main and justified concern of the referee addresses our argument of why the soil CO_2 efflux declined in the montane forest. We agree with the referee that our hypothesized decrease in rhizosphere respiration was not yet strongly supported in the discussion paper. We also agree that, as we can not exclude further possible causes as changes in the soil decomposer community and enzyme production, we should pay more attention to these in the discussion section. Our explanation was based on the fact that the reduction in soil CO_2 efflux occurred simultaneously with an increase in stem diameter growth. To improve that discussion chapter we followed the helpful advice of the referee to provide the reader with a better illustration of the relationship between stem growth and soil respiration. We thus added a graph in our revised manuscript which shows that the ratio of soil CO_2 efflux to stem diameter growth was, since May 2007, considerably smaller in the N-addition than the control plots (Fig. 6, please see supplement). This strong link, which hints at a shift in C partitioning from below- to aboveground, persisted throughout the 2nd and 3rd year N-addition (i.e. until the end of the study). The graph supports our argument that the reduction in soil CO_2 efflux was partly due to a reduction in rhizosphere respiration. The fact that 1.5-yr N addition did not affect fine root biomass, production or turnover in the organic layer and 0-0.2-m mineral soil does not invalidate this implication because a reduction of root and root-associated respiration may also stem from a decline in the total belowground C allocation and rhizosphere C flux (Giardina et al., 2004) or a decrease in root colonization with mycorrhizal fungi (Treseder, 2004; Talbot et al., 2008). Also we do not have information about possible fine root responses that may have occurred after August 2007, or on coarse roots. We revised the respective discussion section (Sect. 4.3) in order to strengthen our argument, and in order to also point out to the reader that –based on the literature- reductions in microbial respiration may also have contributed to our observed decline in soil CO_2 efflux.

2) Linear vs. quadratic gas flux calculations of closed chamber data (page 8639 line 18 ff.): If we would base the whole flux calculations on a linear model (fitted to the initial linear concentration increase) the treatment effects would be qualitatively identical (i.e.

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no N-addition effect on soil CO2 efflux in the lowland forest, reduction of soil CO2 efflux in the montane forest). By using a quadratic regression model when it was statistically justified, however, we improved the absolute accuracy of our flux estimates by minimizing potential underestimations due to chamber-feedbacks.

3) Why were the N-addition plots not included in the regression analyses with soil moisture and temperature? Originally, we only wanted to explore the moisture and temperature regulation of soil respiration in the control forests. The reason why we pooled the data of the control and N-addition lowland forest plots was to increase the robustness of the parameter estimates. This was justified by the fact that, in the lowland forest, temperature, moisture and soil CO2 efflux did not differ between treatments. However, we agree with the referee that the study would gain from an additional analysis of potential changes in the abiotic regulation of soil respiration following N-enrichment for the montane forest, where soil CO2 efflux declined. We added these regression analyses (Figs. 3 and 4, Sects. 3.3 and 4.3).

We are grateful for the suggested edits and included them in the final revised manuscript.

References

Giardina CP, Binkley D, Ryan MG, Fownes JH, Senock RS (2004) Belowground carbon cycling in a humid tropical forest decreases with fertilization. Oecologia, 139, 545-550.

Talbot JM, Allison SD, Treseder KK (2008) Decomposers in disguise: mycorrhizal fungi as regulators of soil C dynamics in ecosystems under global change. Functional Ecology, 22, 955-963.

Treseder KK (2004) A meta-analysis of mycorrhizal responses to nitrogen, phosphorus, and atmospheric CO2 in field studies. New Phytologist, 164, 347-355.

Please also note the Supplement to this comment.

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