

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.

Anonymous Referee #1

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General comments

Soil respiration is an important component of the global C cycle, and yet environmental controls on soil respiration remain poorly understood. In this study soil respiration was measured frequently during a 3-year period in a tropical lowland and montane forest in Panama, using static chambers. The effect of N addition (150 kg N ha⁻¹ yr⁻¹) was assessed in both forests. The authors conclude that N addition did not affect soil

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respiration in the lowland forest, likely because this forest was not N-limited, and that N addition decreased soil respiration (in 2nd and 3rd year) in the montane forest, likely because of a shift in carbon partitioning from below- to aboveground biomass in the N-addition plots. This study appears to have been carefully executed, the manuscript is well written, and the topic should be of interest to readers of Biogeosciences.

Nevertheless I have one major concern about the explanation of why soil respiration declined with N addition in the montane forest. There is quite a bit of evidence from the literature that N addition alters the microbial decomposer community and extracellular enzyme productivity in the soil (e.g., Treseder, 2004; Waldrop et al., 2004; Waldrop et al., 2006), which in my opinion could have caused the reduction in soil respiration with N addition in the montane forest. Although the possibility of a change in microbial community is briefly discussed (top of page 8648), it is later on, for reasons that are not clear to me, dismissed as a possible explanation. The authors mention that a “possible decline in microbial respiration would not suffice to explain our observed decrease in soil CO₂ efflux” (p. 8648, l. 11-12). But why would a possible decline in mycorrhizal activity with N addition not have sufficed to cause the decline? Were mycorrhizal infection rates measured at this site? What about enzyme productivity? The explanation that the decrease in soil respiration with N addition was due to increased stem growth that occurred at the same time, is not clear to me either. Apparently, addition of N in this forest did not affect fine root biomass, production or turnover. It was suggested that increased stem growth may have lowered specific root respiration rates in the N-addition plots. Do the authors have evidence for this? Or, are there other studies that have shown this? In conclusion, I believe that the results of this study are interesting, but that the explanation of a decline in soil respiration with N addition in the montane forest could be more nuanced.

Other comments

p. 8636, l. 11: N enrichment can also affect the microbial decomposer community and enzyme activities (e.g., Treseder, 2004; Waldrop et al., 2004; Waldrop et al., 2006).

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p. 8639, l. 24: In 30

p. 8640, l. 1: It may be true that if only a linear model was used that this would have underestimated CO₂ fluxes sometimes. However, Venterea et al. (2009) have shown that a linear model will be more likely to detect relative differences in fluxes, although less accurate in absolute terms than nonlinear models. Would there be similar treatment effects if ONLY a linear model was used to calculate CO₂ fluxes?

p. 8642, l. 24-25: Was there a relationship between stem growth and soil respiration?

p. 8643, l. 1-2: Why were the N addition plots in the montane forest not included in the regressions with soil moisture and temperature?

p. 8647, l. 16-19: I do not understand this reasoning. If the decomposition rates declined with N addition (e.g., because of changes in microbial community composition or enzyme production), why could this not fully account for the observed reduction in soil CO₂ efflux?

Figure 4 and 5: Why were the N-addition plots in the montane forest not included in the regressions?

Suggested edits

p. 8636, l. 1: Change 'question on' into 'question of' p. 8636, l. 4: 'conflictive'? Suggest removing this term, or replace with something else.

Literature cited

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

Venterea RT, Spokas KA, Baker JM (2009) Accuracy and precision analysis of chamber-based nitrous oxide gas flux estimates. *Soil Science Society of America Journal*, 73, 1087-1093.

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Waldrop MP, Zak DR (2006) Response of oxidative enzyme activities to nitrogen deposition affects soil concentrations of dissolved organic carbon. *Ecosystems*, 9, 921-933.

Waldrop MP, Zak DR, Sinsabaugh RL (2004) Microbial community response to nitrogen deposition in northern forest ecosystems. *Soil Biology Biochemistry*, 36, 1443-1451.

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