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Biogeosciences Discussions

Interactive comment on "Insights into mechanisms governing forest carbon response to nitrogen deposition: a model-data comparison using observed responses to nitrogen addition" *by* R. Q. Thomas et al.

B. Felzer (Referee)

bsf208@lehigh.edu

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The paper by Thomas et al. explores the role of improvements to the nitrogen cycle in CLM-CN to the effects of nitrogen deposition and fertilization on carbon dynamics. In particular, they focus on aboveground Net Primary Productivity (ANPP) and aboveground net carbon increment. They do a nice job setting up model experiments related to several gradational N deposition and fertilization sites and exploring model sensitivity to a range of changes. The paper should be published with the following minor revisions.

1. Since this review is nonanonymous, they really ought to refer in several locations to the work we have done with the TEM model that address these same issues: p. 4, lines 90-92 regarding using the Cleveland et al. approach: Felzer 2012; Hayes et al. 2011; Tian et al. 2011; Kicklighter et al., 2013; p. 4 line 95 with regards to N uptake (Felzer 2013). The Sokolov 2008 reference regarding the effect of N-limitation on carbon models should also be referenced.

2. In the description of the internal N cycle, does clmcn account for N resorption from the leaf nitrogen back into the labile nitrogen pool during senescence? If not, please say so and just consider what effect this omission might have.

3. Section 2.2.3: In the appendix, it directly states that symbiotic N fixation is added to the plant labile N pool and nonsymbiotic N fixation is added to the NH4+ pool. Please state this here since it differs from clmcn.

4. p. 11, line 249: How does stand age play a role in these simulations? i.e. please describe how both versions of clmcn account for land use, as I think it is stated elsewhere that you are only dealing with mature forests. If so, at some point in the discussion the authors ought to discuss how assuming realistic stand ages would alter their results. I would think the Michigan sites are mature, while Harvard Forest has not quite reached maturity yet.

5. Provide another table to summarize the experiments outlined on p. 12.

6. P,12, line 266: Add the bit about the European depositional gradient here when referring to the 2.2 value, because it kind of comes out of nowhere until later in the text (p. 17, lines 384-386).

7. P. 14, line 314 should be 1 and 3 and line 315 should be 1 and 2, I believe.

8. Figure 3 should be relabeled as Figure 1.

9. P. 16, line 355: On a site-by-site basis is misleading – how about, “at some sites”.

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10. P. 17, line 380-382: What is the benefit of including the belowground vegetation and soil response without some data to compare it against? It seems a bit diversionary, because that fact that it increases the values does not actually improve the comparison against the observed aboveground values. Perhaps there are some estimates of above-to-below ground carbon that this can be compared against.

11. P. 18, lines 399-400: Isn't most of the retention in the soils, and not in the aboveground component? That would seem to make this statement not quite right.

12. P. 18, lines 402-404: Please explain this logic. So, it retained as much nitrogen in the final 4 years as in the entire 34 years, yet the retention decreased over time? Is it possible to show a time series plot to better illustrate this point?

13. Discussion as whole was fairly interesting read, especially bit about turnover vs. concentration dependent pathways for N loss, comparisons to isotope data regarding N retention, and synergistic role of CO2 fertilization with nitrogen limitation. These latter relationships will be further affected by moisture limitation in more arid environments (as I discussed in Felzer et al., 2011), so it would be nice to have a caveat here.

14. One final implication I would like to see the authors discuss is the role of DIN leaching, as more nitrogen is retained by the plant and soil, or with differences in N deposition and fertilization. This is an important negative ecosystem consequence that is apparently being modeling, and is a counter to the positive message of increased plant growth with more nitrogen in a higher CO2 environment.

15. Figure 4: Maybe want to change "Change from previous modified model" to "clm-mod – clm4cn".

Additional References

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