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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.

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Thank you for your helpful comments and positive feedback on the manuscript. Your comments have helped improve the clarity of the manuscript.

We respond to the individual comments below (original comments numbered with the response below). The revised manuscript is included as a supplement to this comment.

1. P1645L1-8: It would likely help if the authors would introduce already here the "European levels" as stated later and in the table, to facilitate a better connection across

experimental setup and results.

We modified the paragraph to introduce the “European levels”. The paragraph now reads:

“The higher N deposition simulation used N deposition values found in Western Europe and allowed us to explore why N deposition gradients in North America (Thomas et al. 2010) yielded steeper C responses than in Western Europe (de Vries et al. 2009). The high N deposition simulation used a N deposition trajectory from 1850 to 2004 with 1995–2004 mean deposition levels at the five sites of 2.2 g N m−2 yr−1 (Table 1: EU deposition gradient) rather than the actual N deposition rates (1995- 2004) at these sites that ranged from 0.68–1.18 g N m−2 yr−1 (Table 1: US deposition gradient).”

2. P1647L10: “at a single site” instead of “at single site”

Changed in text

3. P1647L18: “baseline production”, I assume NPP?

Changed baseline production to NPP in the text

4. P1647L11-20. How did you arrive at the parameter values such that you have the same baseline production, by manually “zooming” in into the parameter value?

We added that we manually adjusted the parameter value

5. P1648 L19+. Although a lot of the table data is repeated here (this is something Editors often don’t like to see) the numbers actually help the reader here.

Thank you for the support for using the tables.

6. P1650 L5: The first sentence of this section is hard to under- stand. Perhaps rephrasing “The mean retention of N deposition within ecosystem was larger in clm4mod than clm4cn, mirroring the dCACI/dNdeposition response” or similar.

Changed in text to: “The mean retention of N deposition within ecosystem was larger

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in clm4mod than clm4cn, mirroring the dCACI/dNdeposition response"

7. P1651L2: Sentence starting with "dCACI/dNdeposition increased.." is difficult to understand.

To improve clarity we modified the sentence to read as follows:

"dCACI/dNdeposition increased by 8 kgC (kgN)-1 in the simulation that isolated the influence of reduced denitrification on the response to N deposition (Model 5; Table 3; Fig. 4). This simulation had the same pre-industrial primary productivity as the simulation with Michaelis- Menten plant N uptake (Model 6) but without the Michaelis-Menten uptake mechanism (same model structure as Model 4 but with a lower denitrification parameter)."

8. P1652L17-19: It is important to note that the competition of plants against N losses shifts as you shift the loss parameters around to maintain equal productivity across the model modification.

We added the following text to address the reviewer's comment

"The increased N retention was also associated with a lower parameter value for the proportion of excess N lost as N gas in the model with Michaelis-Menten uptake. The lower parameter was necessary to yield the same steady-state N gas loss at pre-industrial conditions in the Michaelis-Menten uptake simulation because this approach to N uptake requires larger stocks of soil inorganic N to retain the same N uptake rate as a model without Michaelis-Menten uptake. The lower N gas loss parameter likely allowed more N deposition to be retained in the ecosystem in the transient simulations."

9. P1653L15: delete either "are" or "had" after "turnover- dependent N losses"

Changed in text

10. P1653L20: As noted by the authors N losses scale to internal N throughput, which in turn scale to internal pool. Setting turnover losses sufficient high thus leads to N

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limitation (Menge, 2010). Concentration dependent losses on the other hand (as noted by the authors, too), occur substantially only under N saturation (when NH4,NO3 are elevated). Although "N saturation" can occur periodically within clm4cn (or any other N model) through a very tight coupling between C:N.

This is a clear way of describing the difference between turnover-dependent and concentration-dependent loss process. We modified the text based on the reviewer's comment. The discussion of the turnover and concentration-dependent losses now reads as follows:

"Turnover dependent pathways refer to N losses that are proportional to the turnover of an internal nitrogen pool (i.e. litter N, soil organic N, or vegetation N). Concentration-dependent pathways refer to N losses that are proportional to the concentration of soil inorganic N and typically only occur under periods of N saturation."

11. P1656L18+: There is a sudden appearance of a simulation of N-unlimited productivity. Perhaps it would be helpful to also introduce this set of simulations in the method section.

We added the following text:

"To test whether the N fertilization treatments completely relieved N limitation, we simulated the six N fertilization experiments again, this time adding a very large dose of enough additional N to the fertilized treatment to meet any remaining N demand by plants and microbial immobilization ('Non-nitrogen limited' treatment)."

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/10/C1146/2013/bgd-10-C1146-2013-supplement.pdf

Interactive comment on Biogeosciences Discuss., 10, 1635, 2013.

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