

Interactive comment on “Effects of experimental nitrogen deposition on peatland carbon pools and fluxes: a modeling analysis” by Y. Wu et al.

Anonymous Referee #1

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Wu and colleagues tackle an important problem within the global carbon cycle. In their model study they analyze the behavior of peatland ecosystems under potential N fertilization with a sophisticated model. Their finding is well presented and concluded. The problem description and wording of the highly diverse and complex peatland processes is comprehensible. I thus suggest the paper for publication after some minor corrections as suggested below.

General:

One of the novelties of the paper I consider the test of the GEPmax dependence on leaf N content. In my view this deserves an additional exposition in the introduction and being mentioned in the abstract.

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It is hard to judge how robust the response of the different PFTs to N fertilization actually is. Granath et al., 2009 suggest that some Sphagnum species behave differently and can actually adapt to higher leaf N content. Would a scenario with mosses having a higher max N tolerance in the N factor on GEPmax than in the original model also be possible? In this case mosses would simply be outcompeted by graminoids/shrubs through growth and light competition. Can you exclude this possibility?

Reading this model study I often found myself looking up the PEATBOG model paper (Wu and Blodau, 2013) in order to find the corresponding equation. I don't think this is a bad thing per se, regarding the complexity of the problem, but repeating the main model equations for a given sensitivity could greatly improve the visibility for the reader. My suggestions are e.g. the model eqs. for (i) the dependence of GEPmax on leaf N content, (ii) the C/N effect on ER and (iii) the competition for N uptake.

Specific:

p. 10274, l. 17: Please add global estimates/modelling studies for future peatland C storage changes under N fertilization and dynamic peatland vegetation change, e.g. results from Spahni et al., 2013.

p. 10277, l. 14: missing “g N” units

p. 10277, l. 28: Please be careful with the wording. If you define GEP (gross ecosystem production) as photosynthesis, I assume you mean gross carbon assimilation during photosynthesis. Later on photosynthesis is shown being dependent on leaf N content. But there are two parts of N allocation as you explain 10 pages later: once to photosynthetically active processes and once to biomass growth. Please be more precise in general and early on, when you use the term “photosynthesis” as this is a major part of the paper.

p. 10277, l. 28: To my understanding and according to Figure 1 this sentence is wrong, it should be $GEP+ER = NEE$ and not $ER+NEE = GEP$.

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p. 10279, l. 5: Do 10000 years reflect the basal age of Mere Bleue Bog? Is the model in a steady state regarding net ecosystem carbon accumulation?

p. 10279, l. 20: typo "leaf area index"

p. 10283, l. 5: I can't follow the last statements. Do sphagnum and vascular plant biomass have different properties that directly affect the rate of respiration in the model? Please clarify.

p. 10287, l. 9: Is the C/N increase because of the shift in vegetation composition?

p. 10288, l. 26: Just to get it right, for the comparisons of the modifications 1,2,3 you do not correct GEP, ER, NEE anymore as you did in Fig. 1?

p. 10290, l. 3: Where can I find supplementary Figures?

p. 10290, l. 8: Use 'Mer Bleue' instead of 'MB' or define it at the first occurrence of the name in the text.

p. 10291, l. 18: How does the model handle competition for N uptake exactly? Assuming a bog ecosystem with limited N availability: is there a priority rule for PFTs accessing nutrients? Would that change in the case for N fertilization and thus increased GEP?

Tables:

- Table 3 caption is missing units: g C m⁻² ?

Figures:

Fig. 1 caption has a typos: "The green dotted lines in ? represent weekly averaged CO₂ flux ...", and "Note that P was K not constrained in the model. " Please correct.

Fig. 4: Figure shows "FPT" instead of "EPT"

Fig. 8: Please write out 'sh' and 'tr' in the line description. I guess 'sh' means shoot not shrub. Also correct 'shurb'.

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References:

Granath, G., Strengbom, J., Breeuwer, A., Heijmans, M. M., Berendse, F., and Rydin, H.: Photosynthetic performance in Sphagnum transplanted along a latitudinal nitrogen deposition gradient, *Oecologia*, 159, 705–715, doi:10.1007/s00442-008-1261-1, 2009.

Wu, Y. and Blodau, C.: PEATBOG: a biogeochemical model for analyzing coupled carbon and nitrogen dynamics in northern peatlands, *Geosci. Model Dev.*, 6, 1173-1207, doi:10.5194/gmd-6-1173-2013, 2013.

Spahni, R., Joos, F., Stocker, B. D., Steinacher, M., and Yu, Z. C.: Transient simulations of the carbon and nitrogen dynamics in northern peatlands: from the Last Glacial Maximum to the 21st century, *Clim. Past*, 9, 1287-1308, doi:10.5194/cp-9-1287-2013, 2013.

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