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Geoscientific
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Discussions

Interactive comment on "PEATBOG: a biogeochemical model for analyzing coupled carbon and nitrogen dynamics in northern peatlands" *by* Y. Wu and C. Blodau

Anonymous Referee #1

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This long paper represents a very thorough description of a new, comprehensive model of peat bog C and N dynamics. The topic of the fate of peat carbon is of interest to the global change community, and there are few models specifically designed to simulate peat bog behavior. This model is an original approach to the issue, and GMD is an appropriate journal for its publication.

The paper is very well organized and well written, and the model is presented in great detail, including a list of all equations (I'll confess I did not study each equation) and tables of all parameters. My comments are mostly minor edit suggestions for clarity (see MINOR POINTS below), but I have a few questions related to the results/discussion.

Decoupling the O2 and WT boundary is an interesting enhancement beyond many other models. This did not get much attention in the discussion; is that planned for a separate manuscript? I think it would be very useful to discuss this further, as modeling methane emissions remains a challenge after 20+ of work. However, I also think that this paper should not get any longer, so if this is planned for another manuscript, please make that clear.

The simulation of longer-term N saturation impacts was an interesting additional study, where the model showed interesting dynamics in terms of lag (or threshold) in response. Would you expect the impact to be related to cumulative N input (i.e., something like 100 years of low excess N is roughly equivalent to 10 years of high excess, or would the N-loss mechanisms be able to 'handle' low excess inputs indefinitely? If the latter, can the model generate a hypothesis about these values (N-dep rate and time to impact)? (This may be beyond the scope of this model-introduction paper, but seems like it would be an interesting model application.) Is there a reason why vegetation lost 2.5% of its N per year (p. 1628; line 20)? Was this due to changes in PFT N contents, or changes in relative proportions of PFTs? Was there an equivalent loss in biomass?

p. 1629; ∼line 22: some sensitivity section points – e.g., 'The sensitivity of HR to temperature was greater than that of AR, implying preferential C loss from peat rather than from plant respiration with increasing temperature.' – seem like they must arise from parameter values (in this case HR Q10,dec,q = 2.3 or 3.3, which are larger than AR Q10,X,r,j = 2 or 1.7 or 1.8), but the text ('implying') sounds as if the result might not have been expected. I think 'implying' should be changed to 'resulting in'. It is good that the model performance is consistent with parameterization, but the overall behavior (preferential loss) was somewhat built-in. Of course, other factors could have dominated, but there is a 'hard-wired' sensitivity relationship in place.

Was model output more sensitive to kpot_R and Q_10,R than kpot_L and Q_10,L because of parameter values or because the SOM_R pool was much larger than the SOM_L pool, so SOM_R pool behavior had the dominant impact?

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MINOR POINTS

P 1600, line 22: '... about 547 Pg C ...'; this is reported to three figures (i.e., 0.1%); that is not an 'about' value for something as uncertain as global peat C.

p. 1604, line 13: do you mean vertical spatial resolution or horizontal?

p. 1606, line 17: HMP rather than HPM

p. 1609, line 24: is consumption of O2 in methane oxidation insignificant to the O2 budget?

p. 1613, line 28: '... about one order of magnitude ...

p. 1614, line 10: '... C and N are present ...'

p. 1616, line 8: use of both DOM and DOC may be confusing. Do they differ only by a carbon fraction factor? Is that factor constant in the model? If so, could you just use one?

p. 1616, line 23: second equation was deduced ...

p. 1619, line 9; how long are 'short gaps'? what about longer gaps?

p. 1620, line 22: nitrification occurs in anoxic layers?

p. 1630, line 14: change 'lead' to 'led'

p. 1635, lines 19 & 20: change 'leave' to 'leaf'; line 25: change 'build' to 'built'

p. 1638, line 2: delete 'ranged'; line 14: grass-rich; line 26: change 'transportation' to 'transport'.

p. 1639, line 17: suggest changing '..., and in reality reported ...' to something like '..., as observed ...'

p. 1641, lines 13-15: suggest moving 'in the future' to 'other below ground processes in the future'; competition among electron acceptors won't change in the future, just

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Interactive Comment

the model.

Table 4: I don't think that all of the sources cited in footnotes are included in the reference list.

Fig. 9 either caption or figure labels mis-ordered. Caption has CH4 on left, CO2 in middle, while figure has CO2 on left and CH4 in middle.

Fig. 10 – font for text is quite small.

Citations in Supplement Table 6 – these are not all in the main manuscript reference list.

Interactive comment on Geosci. Model Dev. Discuss., 6, 1599, 2013.