Biogeosciences Discuss.,
doi:10.5194/bg-2016-319-RC1, 2017


Biogeosciences Discussions
Open Access
EGU



# *Interactive comment on* "Modelling Holocene peatland dynamics with an individual-based dynamic vegetation model" *by* Nitin Chaudhary et al.

**Anonymous Referee #3**

Received and published: 21 February 2017

Review of Chaudhary et al.

Chaudhary and coworkers adapted the LPJ-GUESS model to simulate peatland and permafrost dynamics at boreal peatland sites. The model can dynamically grown peat producing a peat depth that can be compared to observations. The model additionally has the ability to simulate water transfer between sub-grid patches that are of differing heights. After parameterizing the model at one site they ran it at nine more as well as running the initial site through two RCP scenarios.

The paper is generally well presented with reasonable figures. While the model does appear able to produce some reasonable peat depths at some sites, it fails at others. This along with the rather poor NEE performance makes me wonder about how well the



Printer-friendly version

Discussion paper

model is truly able to provide predictions of changes in the C cycle in future simulations. I think more effort should be place on demonstrating the model performance before attempting future scenarios. I think many resources for model validation were not used that could have been. I recommend revisions before this MS can be published.

General comments:

Looking at figure 8, it is apparent that the modelled peat depth vs. the observed peat depth is not great. This I can understand, the climate of the holocene when these peatlands were forming is not likely to be well captured with climate and conditions as they were able to produce. My main issue is the NEE estimates from the model are also not corresponding well to observations. In this instance the conditions at the sites are well known and reasonable climate should be possible. The problem with the NEE values being off significantly is that it is difficult then to trust when the model predicts the peat depth at sites should grow significantly or shrink since the NEE is how that is controlled in essence.

I also feel that many of the model outputs are not compared to observations when they should be. For e.g., the active layer depth is only compared at one of the 10 sites simulated. Do any of the other sites have information about ALD? Do any have ALD timeseries for comparision? What about the PFT distribution. The PFT distribution is shown in Table 5 but is just a presence or absence. Is there any more quantitative values that can be used to compare the model to obs here? Given the productivity differences between PFTs, it could be instructive for interpretation of model-obs differences. For the WTP, could there be some comparisons not just of some mean annual value but of the timeseries? Is the water table correct at the different times of the year? In general, much of the model performance is sort of dumped into tables, since this is the first paper describing this peatland version of LPJ-GUESS I believe more effort has to be put into demonstrating that the model doesn't get things 'sort of ok' for the wrong reasons.





Printer-friendly version

Discussion paper

Specific comments:

line 10: Change 'current' to 'many' in the start of the second sentence. Other models do indeed have peatlands, e.g.

Wu, Y., Verseghy, D. L. and Melton, J. R.: Integrating peatlands into the coupled Canadian Land Surface Scheme (CLASS) v3.6 and the Canadian Terrestrial Ecosystem Model (CTEM) v2.0, Geoscientific Model Development, 9(8), 2639–2663, 2016.

Alexandrov, G. A., Brovkin, V. A. and Kleinen, T.: The influence of climate on peatland extent in Western Siberia since the Last Glacial Maximum, Sci. Rep., 6, 24784, 2016.

Kleinen, T., Brovkin, V. and Schuldt, R. J.: A dynamic model of wetland extent and peat accumulation: results for the Holocene, Biogeosciences, 9(1), 235–248, 2012.

Stocker, B. D., Spahni, R. and Joos, F.: DYPTOP: a cost-efficient TOPMODEL implementation to simulate sub-grid spatio-temporal dynamics of global wetlands and peatlands, Geoscientific Model Development, 7(6), 3089–3110, 2014.

l. 30: Do you really mean Wania et al here? That was a modelling study... If you are talking about the mask used for the peatland regions that was Tarnocai, not Wania. Cite the true reference please.

l. 38: Could add some of the refs I gave above to this list.

l. 40: See the Stocker ref along with Alexandrov to see if this statement is correct still.

l. 43: 'northern high latitutdes, ... , could' - suggest adding some commas.

l. 70: By soil resources, you mean water right? nutrients are not simulated in this version, correct?

l. 80: So how many soil layers? This description in this paragraph is different than the figure. Please make them more congruent. I am still not sure how many layer were truly simulated.

l. 95 : based on what studies?

l.97: I don't understand the 'fresh litter debris decomposes through surface forcing until the last day of the year'. Surface forcing?

l 117 : Please put the values of all these constants in the text and not just the table. It was confusing until I found the table since the table is not really mentioned until much later.

l 117: How does K relate to K_o or K_i?

Eqns 4 and 5 - would be nice if these were plotted, easier than trying to imagine in the head...

All eqns - be consistent between 1.0 and 1 etc. in the equations.

Eqn 6 - units?

l. 153 - value of the min and max bulk densities? Calculated somewhere?

pg 7 - choose one: cm or mm and please stick to whichever is chosen.

Eqn 8 - Did I miss how F was found?

Eqn 12 : Are you sure this is a change of porosity? This looks more like a fraction of original porosity. Change to me implies something like flux.

L 227: So moss can get water from 50 cm mineral + peat depth until peat => 50 cm? This seems strange and would greatly advantage moss for quite a while. Is there any indication that moss can access water almost 1 m down? I find this difficult to believe.

l. 253: How are the heights done? Is this peat height or actual elevation?

l. 316: Sure it conserves the IAV - but it also then pegs the IAV as the same for the whole simulation instead of perhaps changing through time.

l. 318: No, it is really reanalysis or interpolated climate. There are no 'observed'





Printer-friendly version

Discussion paper

gridded products available.

l. 341: Can you please expand more on why you needed to keep the mineral and peat layers saturated during initialization. This to me would imply that your model was out of equilibrium at the start of your runs and thus the transient behaviour would be influenced by the model initial conditions. This is a bit worrying. Once you released the saturated conditions the model could then over-react to dry conditions as mentioned.

l. 349 : This comment about adjusting to the local WTP really drives my request for comparing timeseries of WTP since it is then apparent that we cannot put too much stock in the mean WTP values matching reasonably.

l. 400: 'lower than 50 kgm-3' - higher meant?

l. 416: Any obs to compare with here?

l. 421: Are there any vegetation reconstructions available for these sites? Pollen cores that can help determine if the model successional sequence is reasonable?

Fig 1: why are the mosses all different colours? Can this diagram be simplified - like only a couple grass instead of that dark mat? Should permafrost maybe be 'frozen soil' or maybe distinguish seasonally frozen soil from perenially frozen? Why is the permafrost bubble circular? Would the model really have a different bottom permafrost depth between its tiles in the same gridcell? I can understand a different top depth but not really a bottom.

Fig 2: Perhaps choose a different acronym than UM since that is also used in the MS to talk about a model.

Fig 6: I find the acronym choice non-sensible. Why does the final S of deciduous shrubs be S and not a D? Not a big deal but it makes it harder to quickly remember what the acronym stands for.

Fig 7: No description of the X and Z in the caption. What do Top, Middle, and Bottom

really correspond to? This gets back to my earlier comment that I don't understand how your soil layers were divided.

Fig 8: As I said in the general comments, this figure does not give much confidence when combined with the NEE results.

Fig A1 - perhaps add total water (liquid and frozen) so we can see if the total content was changing and it wasn't just changing phase.

Table 2: density is needing the o as an subscript. Also please bring these all into the main text, it is annoying to have to search out the table when one is reading the text (and it is often not mentioned that one needs to search for a table...)

Table 5: WTP units? Please put in proportions of the veg so we can tell if the proportions modelled are in any way correct rather than just presence/absence.

---

Interactive comment on Biogeosciences Discuss., doi:10.5194/bg-2016-319, 2016.



Printer-friendly version

Discussion paper