Biogeosciences
Discussions

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Interactive comment on "Modelling the habitat preference of two key *Sphagnum* species in a poor fen as controlled by capitulum water retention" *by* Jinnan Gong et al.

Jinnan Gong et al.

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Major Comments

A. The Abstract and Introduction focus on feedbacks between the plant community structure and the environment. It seems from the outline of the model (Fig 1) and the descriptions of it that the environment serves as more of a forcing variable on the plant physiology and community dynamics. For example, there are no processes that feedback to the "Community environment" module in their model (Fig 1) and I did not see any not listed within the descriptions of the model structure in the text. Clearly there are feedbacks between the capitula environment module and the shoot growth

and competition module, but I don't think the capitula environment is really what people would consider part of the plant's environment. Fixing this will reframe the justification, but I think it can still be well justified.

R: The bold mentions on the feedback to hydrology in Abstract and Introduction are now removed as they were misleading.

B. In my opinion, the paper would be improved by applying the model to make predictions about a particular response to an environmental change. It could be argued that this paper is for model development and validation and the next one will use it in a predictive context. However, is there a small question that could be addressed with the model that would illustrate its value?

R: We agree that applying the model to predict change in community structure as a response to environmental change would be a logical next step and make the story far more interesting. However, as we are already here combining new empirical measurements conducted for model parameterizing and testing and description of the new model (and ending having a lot of text, tables and figures as appendix to keep the story readable) we see that adding more would be just too much.

C. I was surprised that the model did not deal with any of the autogenic processes that lead to hummock formation. The community model is spatially explicit and it would seem that it would allow for rule-based hummock formation simulation when succeeding from a high water table. Instead, the model simulates either high or low water tables. This seems like hummock forming processes would represent a true feedback to the environment. Is this either desirable or possible in this model iteration?

R: We agree that our model will be an excellent starting point to address autogenic processes that lead to hummock formation by including feedback to hydrology. We see PMS, the first model addressing Sphagnum community dynamics, as a steppingstone for the future work in numerical conceptualizing of peatland processes.

D. The living tissue of Sphagnum species clearly differ in their hydraulic conductivity (Km, p8; as shown in the McCarter and Price 2014 paper cited, see also Li, Glime and Liao 1992, J Bryology 17:59); however, this was treated as a constant. Although I do not think there are reports of how this differs between S. magellanicum and S. fallax, I think it would be important to consider variation in this using hummock and hollow values for the two. I suspect that this would only accentuate the differences they observe in their results, and/or, speed up the time until species distributions equilibrate. In any case, given that species cover changes are quite sensitive to Km (Table 3), I think it is worth modeling species-specific differences in this parameter.

R: We agree, but species-specific data on the hydraulic conductance was generally lacking. It would be very intriguing to see the impact of these parameters on modelling results, once the measurement date becomes available.

Minor Comments

E. I was surprised that the Titus and Wagner (1984, Ecology 65:1765) paper was not cited. Some of the simulation modeling is similar and should make for a nice comparison.

R: Now included

F. Need a table of abbreviations.

R: Added

G. It would be very helpful to show how the parameter values used fall within reported ranges in the literature (e.g., Table 1).

R: We did a large search to fulfil this. Although we were able to find some meaningful values for comparison in the literature, we did not find them for most of the parameters and many of the ones related to photosynthesis were not measured in comparable conditions. For these reasons we abandoned the good idea to include ranges in the table but took the few ones found as subnotes in Table2 (previous Table 1).

Specific Comments

1. Line 81-2 Aren't they linked by capitulum water balance? Retention is too specific, I think. R: modified

2. L101-4 I find this sentence confusing. Can you be more clear about the linkages? R: Rewritten to be clearer, as suggested by both reviewers.

3. L142-3 I think it is controlled by water content âËŸAËǦ Tnot the same thing as water retention. R: Rewritten

4. Fig 1. What is the difference between dashed and solid lines? Can the boxes or arrows be changed so it is easier to tell that Module III influences Module IIâËŸA ËǦ Tit took a while to realize it wasn't controlled by precip and evap, where I thought the arrows were coming from. I would suggest making the figure legend more complete.

R: In revised Fig 1, we added instructions to submodule boxes, replaced arrows from water balance to evaporation and capillary flow and added legend for different types of arrows in the figure.

5. L213-18 This is the discussion of reseeding. It would be useful to know how frequently this was necessary. Was it rare with little impact on results or more common?

R: The re-establishment from spore is calculated annually but it was not common in general. Most changes in grid cell occupants come from the invasion from neighboring cells. This process was mostly observed in the first two years of simulation, as the trait combination were randomly chosen, and consequently some combinations performed too poor to support the survival of individuals.

6. L380-82 Is it worth listing what the parameters are meant here in text as is done below?

R: We added list of symbols and abbreviations (New Table 1)

7. Fig 2. The y-axis for the top figure should be "Relative Cover". Also, can you use

C4

solid and dashed lines to distinguish Hummock from Lawn? Would make it easier to read on B&W print. changed as suggested

R: Modified as suggested

8. L415 Why not show both species in both environments? Here only show S. mag in hummocks and S. fal in lawns. R: We have empirical data only from their natural habitats

9. L418-23 Would it be better to report these as elasticities (% change in outcome per % change in parameter). This is easy to do as they were all set to vary by +/- 10%. However, this would allow you to assess whether or not it was a large change or notâËŸA ËĞTwhat would cutoff be? You report that being less than the standard deviation for a 10% change is meaningful (L490), can you defend that?

R: We appreciate this suggestion and modified our statement

10. L469 You state that S. fallax capitula were less resistant to evaporation, but the data in Table B1 seem to indicate otherwise (see ra; this result is opposite to what I would expect although the do not differ significantly).

R: Rewritten to clarify. This was obviously unclearly expressed as it confused both reviewers.

11. L492 Yes, it would be expected for n to have a large effect as it is a scaling factor, so changes in its magnitude get amplified.

R: added to the text

12. L502-06 See Comment D above.

R: see response to D

13. L968 The procedure for doing the photosynthetic measurements would seem to cause quite a lot of drying within the cuvette (RH 60%, impeller at level 5) where they

were measured over 60-120 minutes. Were they rewetted following each light level? Were they allowed to dry? How did mass change during the course of the measurement and did that influence shape of curve? Can you provide a light response curve showing data? If there are not good answers to these questions, it would at least be helpful to include how the parameters measured compare with other ones in the literature.

R: We have added more details on the measurement protocol. The cuvette relative humidity was kept at 80% to slow down the drying process, but not to cause damage to the devise.

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