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Discussions

Interactive comment on "Modeling the hydrology and physiology of *Sphagnum* moss in a northern temperate bog" *by* Xiaoying Shi et al.

Anonymous Referee #1

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Even though, mosses are ubiquitous part of boreal vegetation, especially so in peatlands, mosses and their contribution to ecosystem functions are overlooked. The study introduces new plant functional type (PFT) with Sphagnum-specific processes that can be in some extent to be used to describe mosses in other boreal and arctic environments, e.g. upland forests and wet tundra. Manuscript consists, sensitivity analysis of updated land model component and validation part that takes place in boreal ombrotrophic, raised-dome bog peatland with warming and CO2 enrichment experiment.

Authors have stated that drier and warmer future climates can lower water table and it has implications on growth of Sphagnum. In the study, capillary rise is a function of peat water content in 10 cm, but it is not clearly stated that if measured or modelled values of peat water content is used in sensitivity analysis and in case study and how

water table fluctuations affect functions (e.g. gross primary production) of Sphagnum mosses? If there is more Larix and taller shrubs growing on the site, does it drain more or less the site? Do you see effect of warmer climate on water table depth in higher temperatures and how this will affect Sphaghnum mosses?

What I am after is that which kind of hydrological feedbacks there are and how it affects ecophysiology of Sphagnum PFT if temperature will increase +9.0 degrees of Celsius. This is something to think about especially if capillary connection of Sphagnum is described through a simple relationship between capitulum water content and peat water content at 10 cm depth. This could be answered simply by studying hydrological balance of Sphagnum PFT and showing how large part capillary rise plays in Sphagnum hydrological balance. Is it even necessary or which kinds of implications it has to photosynthetic capacity or other ecophysiological processes? In my opinion, authors have not clearly showed or discussed underlying assumptions and consequences of made choices and it should be improved.

Sphagnum mosses are sitting on top of high CO2 (and water vapor) sources and experiencing naturally higher concentrations of CO2. How this affects to gross primary production of mosses and which kind of differences there possibly are between mosses that are located to hollows and hummocks? How does this fit to CO2 enrichment study? Is CO2 concentration profile assumed to be uniform throughout the canopy profile? Does this have effects on results of simulations?

In Chapter 5.3 authors raise important issues and future directions. To me problem is that now it seems to be detached from the model description and discussions. Could this be embedded better in discussions to make the manuscript more coherent and structure clearer?

L183: Are measurements of Sphagnum water contents from Sphagnum growing on hollows and hummocks? Were there any differences between these microtopograpichal features on water content in moss? Even though, this is clever way to solve

capillary rise issue of mosses in simple manner but is this method applicable in both microtopographical positions? My main concern is that does this approach mask the effects of hydrology that is quite important for Sphagnum ecophysiology (main source of water in hollows and hummocks). How about self-cooling (enhanced evaporation) of Sphagnum covered surfaces due to capillary rise? Does the static approach fail especially in sunny days and which kinds of implications it has to Sphagnum ecophysiology?

L589-L591 This is not only in case with submerged Sphagnum, but it seems that Sphagnum utilizes CH4 as an indirect source of CO2 (e.g. Larmola et al., 2014: DOI: 10.1073/pnas.1314284111)

L614-618: Can it be that model parameters of hollow and hummock Sphagnum can differ from each other? How this could affect outcome of simulations? I would quess that Sphagnum growing on hummocks are more drought tolerant and resistant than those species growing in hollows. This could be seen i.e. in different slatop -value and, as discussed by authors, in base rate for maintenance respiration.

L684: Is N fixation somehow represented in a model. Should that be mentioned in a model description? In my opinion, this is quite interesting and important part why moss PFTs should be included in models handling boreal and arctic regions.

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