Interactive comment on "Simulating the effects of temperature and precipitation change on vegetation composition in Arctic tundra ecosystems" *by* H. van der Kolk et al.

Anonymous Referee #2

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This is an interesting and relevant studied, which in my opinion deserves to be published in Biogeosciences. The paper presents in a clear and interesting way potential changes of Arctic tundra under warming/precipitation change/permafrost thaw. Especially, addressing 3 factors in combination, i.e. warming, precipitation and permafrost thaw is a relevant contribution to our understanding of tundra change.

The paper is well written and the results are clearly presented. As this study represents a modelling approach, I would find it helpful if some modelling related issues could be clarified. In particular, many parameters in the NUCOM-tundra model were defined based on e.g. vegetation composition found in the field, so I was sometimes uncertain what I learned in the paper about mechanisms responsible for changes in the tundra.

Also related to this issue: of course simplifications/assumptions need to be made for a model, especially if access to measured data is limited. However, I asked myself a few times if the simplification were justified.

A few examples. Abstract. L.24. The simulations suggest that shrubs are better light competitors... etc. If I understand the model right, shrubs are good competitors because they were defined as good competitors in the first place. Not that this would be incorrect. But several times I get the impression that findings are not necessarily a result of the model but a result of how the model was set up, which assumptions were made and which data were used to feed the model. Again, this is certainly an issue that can be said for all models. But I think the text needs some rephrasing to be clear about what is indeed a model outcome (e.g. increase of graminoids under wetter conditions) and what is not. To me the text seems to go too far, which mechanisms can actually explained by this model and which cannot. See related comments below.

Questionable assumption? p4 l21. Graminoids and dwarf shrubs are assumed to be equally tall. The authors may have their reasons to do so, but this is not entirely clear to me. Betula nana can grow easily 2.5 m tall (e.g. in parts of Alaska) and arctic graminoids don't. An incorrect assumption here could have a large influence on the results.

Explaining mechanisms? P. 9 l16ff. The authors state that the NUCOM model was developed to assess which mechanisms are responsible for tundra change. I found this statement somewhat questionable because many very important mechanisms remain unknown when assumptions are made for models. The biomass example above is one such example. The issue that rooting depth in a warmer climate is not known is another example, but discussed later in the discussion. It might be helpful if the authors adapt their wording a bit. E.g. that they refer mechanisms to effects of warming vs. precipitation, which is the novel contribution of this paper.

So I suggest that the authors go through the entire manuscript another time and re-

think carefully how to not over-sell their results. Apart from that, to state this again, I like the paper and find it helpful and novel.

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