

Interactive comment on
“Competitionalterspredicted forest carbon cycle responses to nitrogen availability and elevated CO₂: simulationsusing an explicitly competitive, game-theoreticvegetation demographic mode” by Ensheng Weng et al.

Anonymous Referee #1

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The current paper aims to compare the predictions of biomass allocation within a vegetation demographic model (VDM) with explicit competition versus a model without competition, under elevated CO₂ across a nitrogen availability gradient. To this end, the authors use a derivation of an existing VDM, where the only process that varies is the biomass allocation. The authors then present comparisons between the two model versions at equilibrium for one site. The topic of predicting vegetation allocation pattern for different nutrient limitation states is an important one, and one that existing vegeta-

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tion model often have trouble with. The approach of having one model with two different process representations is also very valuable as it can pinpoint model differences to the exact processes in question.

However, the value of this study is largely obscured by the way the model is presented and discussed, making it very difficult for the reader to link between model assumptions, results and model implications.

Major comments

It is unclear to me if this analysis actually shows a difference between a model with and one without competition or simply a difference between a model with fixed and one with flexible allocation. As the authors themselves point out in the introduction, pool-based vegetation models often incorporate a flexible allocation scheme based on nutrient and water availability. It is currently unclear if a model with such a scheme would perform differently from the competition model included here,

One of the key assumptions of the model is the order of allocation (l 245): first a fixed fraction allocated to the sapwood, then allocation to the leaves and roots, then if there is available C and N left, to sapwood and fruit. And, most importantly, any carbon left in excess because of N limitation is allocated to sapwood. This last step could have some interesting implications for light competition under N limitation, and can maybe explain the different wood allocation patterns observed for the competition models. This model assumption needs to be justified and discussed.

While I understand that this is a theoretical study, and such studies are valuable and note every study needs to show a comparison with data, there is a complete lack of model reality checking. Especially when the two model versions show contrasting allocation patterns, there should be a way to determine what the reality is. There is a wealth of data from FACE experiments, N addition experiments, long-term measurements, soil N gradients etc. I believe it would be very interesting to have a section in the discussion comparing the current model predictions with general observed trends.

As it is, the discussion mostly contains comparisons with previous models from the same model family, which while I think is probably relevant to the authors for model development purposes, is of little interest to the general audience.

Detailed comments

L 52 I'm not sure there are any ESM's that just simulate the nitrogen cycle, this sentence might need rephrasing

L85 the last sentence in this paragraph ("Competitively-optimal...") does not follow directly from the rest of the paragraph, there seems to be a logic jump. What is competitively-optimal? How does such a model result in allocation strategies?

L99 There is a lot of information packed into this equation which is not appropriately explained. Also I am not sure if this equation is relevant to the rest of the paper.

L111 The turnover of vegetation carbon pools is generally not only driven by mortality but also tissue senescence

L 207 Are the C:N ratios of all pools considered fixed?

L238, eq. 7 It would help here if the first term and the second term in the minimum function were explained in words - I think it is start of growing season available NSC and during growing season available NSC?

L245 I'm not sure I understand why step 1 is needed given eq 6c

L254 Does step 4 here imply that the sapwood has variable C:N? Can this increase indefinitely under N limitation?

L279 Is there a justification for the range of soil N availability?

L355 Generally, I would say 'hump-shaped' is a curve that goes up then down, which is not the case here.

L445 Are there no observational studies showing this behaviour? L482 Are there no

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measurements in the literature of fine root C:N ratios?

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