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Interactive comment on "Carbon sequestration in managed temperate coniferous forests under climate change" *by* C. C. Dymond et al.

Anonymous Referee #1

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Title: Carbon Sequestration in Managed Temperate Coniferous Forests under Climate Change Author(s): C.C. Dymond et al. MS No.: bg-2015-586 Date: February 2, 2016

This paper presented by Dymond and others represents a solid step forward in our efforts to simulate the effects of climate on landscape carbon dynamics in a manner that explicitly considers both disturbance and plant demographics. I applaud the authors for taking on such an ambitious suite of factors (as is ultimately necessary to make realistic predictions) while also resisting temptation to over-interpret every last one of their results (which could have easily led to an indigestible paper). The objectives are clear, text is well written, and the paper overall is an easy read. My only major concerns regards the cryptic nature of some of the methods. I deeply appreciate that a comprehensive description of every modeling detail is unrealistic and works such as

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these must rely on citing earlier-published methods, however there remain a few things that require some clarification before a reader can really understand the results.

Regarding the climate inputs that underpin the growth responses:

I remain a little confused as to the spatial and temporal nature of the climate data and wonder how these alleged weather stations play in, but most importantly it is unclear exactly what underlies variability among the 144 different scenarios. Do they include alternate Fossil emission scenarios? Do they include alternate GCM models? Are they temporally stochastic expressions of a single change scenario (that would be cool)? And how did you end up with 144 of them. I don't see one answer being any better than another, but this is the source of variation that ultimately defines the "high" and "low" productivity scenarios, so I need to know what it is.

Regarding construction of climate-specific growth parameters:

A great deal of the study results depend on the relationships established between LANDIS growth parameters (i.e. max NPP, max biomass, and the growth factor r) and mapable climate metrics. The methods state that this was done using TACA-GAP, ZELIG, and BRIND. I and other readers unfamiliar with these tools don't need to know exactly how they work, but we do need to know the identity and source of the input variables. Are they based on some sort of empirical site index (i.e. max height and or biomass at some specified location)? Are there other growth limiting or facilitating process built in to the model. What is the source of the climate variables? Table 3 has a lot of information in it, but in no way tells me how growth became described as a function of climate (in TACA-GAP) and eventually time-space (in LANDIS).

Regarding the simulation of climate change:

Did LANDIS dynamically update growth parameters to accommodate incremental climate change between 2010 and 2050, as graphically suggested in Figure 5, or did it simply run from 2010 to 2050 with fixed growth parameters representing the following 4

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scenarios: 1) average growth among 144 alternate climates between 1961 and 1990. 2) average growth among 144 alternate climates between 2040 and 2069. 3) average growth plus one SD among 144 alternate climates between 2040 and 2069. 4) average growth minus one SD among 144 alternate climates between 2040 and 2069. If growth parameters were indeed fixed throughout the 40 year simulations, it should be made clear in Figure 5.

How exactly are the landscape-wide “high” and “low” productivity scenarios arrived upon?:

In the Methods it seems like the “average”, “high”, and “low” growth scenarios (from among 144 alternate future climates) were species-specific. I see how these scenarios can scale across the landscape for a single species (e.g. Figure 9), but it is unclear to me how this works collectively across species (e.g. Figure 6). If this was explained somewhere, I must have missed it.

Regarding the t-tests for significance:

I know there is pressure employ some sort of quantitative statistics to evaluate “treatment” effects in simulation models such as these, but rarely is it appropriate or necessary. The way I read it, the t-test in this paper compares two populations: 1) a population of 20 LANDIS runs sharing common set of “high” growth parameters, but differing randomly in the number, size, and intensity of disturbance imposed, and 2) a population of 20 LANDIS runs sharing common set of “low” growth parameters, also differing randomly in the number, size, and intensity of disturbance imposed. This was a great approach to comparing the relative influence of deterministic climate-driven growth in the context of probabilistic disturbance, but all you need to evaluate the results is the variation between and among groups. The strength of the P-value is irrelevant. After all, in the real world, if someone was testing for a significant climate effect they would factor out disturbance. However, if you were to do that here, one would reveal what is built into the model (i.e. a climate effect on growth). In other words, you can’t really

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make discoveries about your own model, you can only evaluate sensitivity, which does not require P-statistics. If the authors choose to retain their t-test (which despite my diatribe, I suspect they will), they should explain in Figure 7, Figure 5, and Table 6 exactly what the sources of between and within group variance are.

Closing comment:

In closing, let me again say that this is a well-designed study and well written paper which should serve as a good anchor publication to which future modeling papers can be tied, including but not limited to those more deeply exploring the effects of climate and disturbance on the heterotrophic components of NEP, and Net Sector Productivity. I hope the questions I raised above help the authors clarify their methods.

As requested by Copernicus:

Does the paper address relevant scientific questions within the scope of BG? YES Does the paper present novel concepts, ideas, tools, or data? YES Are substantial conclusions reached? YES Are the scientific methods and assumptions valid and clearly outlined? SORT OF Are the results sufficient to support the interpretations and conclusions? YES Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? LARGELY Do the authors give proper credit to related work and clearly indicate their own new/original contribution? YES Does the title clearly reflect the contents of the paper? YES Does the abstract provide a concise and complete summary? YES Is the overall presentation well structured and clear? YES Is the language fluent and precise? YES Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? YES Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? SOME Are the number and quality of references appropriate? YES Is the amount and quality of supplementary material appropriate? YES

Interactive comment on Biogeosciences Discuss., 12, 20283, 2015.