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Interactive comment on "Scaling from individuals to ecosystems in an Earth System Model using a mathematically tractable model of height-structured competition for light" *by* E. S. Weng et al.

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Review of Weng et al.

The manuscript by Weng et al. describes the implementation of a size-structured approach to model forest dynamics in the LM3 DGVM by using the perfect plasticity assumption (PPA). The authors argue that the approach provides a mathematically tractable solution for modeling vegetation dynamics, i.e., where stochastic simulations and/or non-linear dynamics can be solved deterministically. The model is applied to

a temperate broadleaf forest in northeastern USA to demonstrate how the approach can be used to analyze optimal allocation strategies and their evolution under elevated CO2 concentrations, which lead to competitive exclusion.

The technical accomplishment presented here, where PPA is implemented in LM3, represents a very important scientific advance in the field of dynamic global vegetation modeling. The paper articulates this point very clearly and provides sufficient information to follow most of the work in some detail. The challenge of efficiently representing light competition is very elegantly solved by PPA and the coupling of PPA to LM3 opens up many opportunities for studying forest dynamics.

My main concern is that the authors make the point that this development is for Earth System Modeling (ESM) and that the approach now makes ESM solutions tractable at the global scale. However, the example simulation is made for just one location and for just a handful of the tree species that co-exist at that location. The tractability of the modeling approach thus seems limited for grasslands, savannas, systems experiencing gap dynamics, and this is not fully covered in the paper. Beyond the technical presentation of the paper, which is superb, it would be more convincing to see a global simulation performed.

Please find my more detailed comments below: 1. The compute times for the single grid cell, three species simulation for one year would be appreciated. Obviously a key limitation in DGVM development has been computational constraints – how fast does LM3-PPA run?

2. P17762, line 5: spell out the LM3 acronym

3. P17762, line 15: the idealized conditions are mentioned here and then once in the Discussion. Some more detail on what the idealized conditions refers to would be very helpful.

4. P17765, line 9: need to define SD

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5. P17773, 2.1.5: currently, the model has mortality from the non-structural carbohydrate pool being in deficit, and the authors point out that disturbance (insect, windstorms, etc..) are not included. Please can you define then what sort of mortality 'background mortality' refers to?

6. P17774, line 11: what does 'sufficiently similar' refer to? Please define this in a quantitative way, presumably as implemented in the model.

7. P17812, line 16: Medvigy reference is missing in References section

8. P17788, line 9: If I understand correctly, the macroscopic equations are coming from ED? Throughout the paper, the approximation offered by ED (used by LM3) and the tractable solution to size structured population modeling (PPA) gets confusing. At this point, it would be helpful to distinguish the two.

9. Equation B17: should variabl qc be qa, there seems to be an error here.

Interactive comment on Biogeosciences Discuss., 11, 17757, 2014.