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Interactive comment on "Taking off the training wheels: the properties of a dynamic vegetation model without climate envelopes" *by* R. A. Fisher et al.

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Received and published: 22 June 2015

Fisher et al. attempt to simulate competition between needleleaf evergreen broadleaf cold deciduous trees in Eastern North America on the basis of cost-benefit analysis from a carbon perspective and reduce the dependence of the model on bioclimatic constraints. Their effort is a step in the right direction.

A recent paper by Zhu et al. (2015), in fact, tends to do the opposite. Zhu et al. (2015) include additional bioclimatic constraints in the framework of the ORCHIDEE dynamic global vegetation model (DGVM) to simulate the spatial distribution of plant functional types (PFTs) in the northern hemisphere more realistically. One reviewer response

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to this was - if by including additional bioclimatic constrains we are essentially turning DGVMs into biogeography models.

However, the challenge of taking the "training wheels off" is difficult and a global simulation that can reproduce the observed geographical distribution of PFTs without any bioclimatic constraints will likely be the ultimate test of DGVMs.

I would also like to comment on the following statement in this discussion paper. The authors say ...

> Another class of model is derived from the Lotka–Volterra representation of competitive ecological processes (Cox et al., 1998; Arora and Boer, 2006). In these models, for each pairwise competitive interaction between plant types, a "dominance hierarchy" 20 is pre-ordained that represents the expected outcome of competition between any two plant types with similar growth rates. Thus, the distribution of plants is also not a direct function of their physiological performance or dominance over resources but is also controlled by pre-defined rules based on existing vegetation distributions.

However, this statement is not entirely correct. The Arora and Boer (2006) implementation of the modified version of the Lotka-Volterra equations **does not** include a pre-defined "dominance hierarchy" for all PFTs. The only pre-defined "dominance hierarchy" used in the model is for trees and grasses. Trees are considered superior to grasses because of their ability to shade them and climate permitting trees are able to take over fraction of a grid cell that is covered by grasses. This dominance hierarchy is realistic. Within the tree and grass PFTs, however, the dominance hierarchy in the model is based on the colonization rate of PFTs which in turn depends primarily on their net primary productivity (NPP). The resulting distribution of tree and grass PFTs is thus based on their physiological performance. The model does, however, uses broad bioclimatic constraints to ensure PFTs do not venture outside their bioclimatic

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envelopes. For PFTs that can exist in a grid cell, the competition between them determines what fraction of grid cell they occupy. The Canadian Terrestrial Ecosystem Model (CTEM) used by Arora and Boer (2006) represents seven natural PFTs - 5 tree PFTs and two grass PFTs. Out of these seven PFTs over about 95% of the land area the number of PFTs that can exist in a grid cell varies from 3 to 5.

The "bioclimatic whip" the model uses accounts for lack of physiological processes that are not included in the model. The holy grail for the DGVM community is, of course, to wean off the bioclimatic constraints as the Fisher et al. (2015) manuscript attempts to illustrate.

References

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