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Interactive comment on "Simulating migration in dynamic vegetation models efficiently with LPJ-GM" *by* Veiko Lehsten et al.

Anonymous Referee #1

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Overall Comments:

The paper describes two approaches, for simulating seed dispersal in global-scale dynamic vegetation models. Vegetation migration in response to climate change (both past and future) is a major area of research, and the ability to simulate dispersal in DGVMs would be a major advance. There is certainly scientific merit in this manuscript, however there are numerous issues that need to be addressed. In general, since this is a paper about model development, more details about the model and justifications for their choices, need to be included.

Major Comments

Seed production (Section 2.3.1) For the entire section – "each grid cell", does this refer

to the large grid cell or the smaller grid cells within?

L157 – "no specific age of maturity is taken into account". Maturation age has been shown to be one of the most important factors for determining tree migration rates (e.g., Nathan et al. 2011; Snell 2014). This is especially relevant for trees, as most tree species delayed maturation. Please include a justification for why this was not included.

Nathan R, Horvitz N, He YP, Kuparinen A, Schurr FM, Katul GG. 2011. Spread of North American wind-dispersed trees in future environments. Ecology Letters, 14: 211-219.

Snell RS. 2014. Simulating long distance seed dispersal in a dynamic vegetation model. Global Ecology and Biogeography, 23: 89-98.

L159 – please clarify what is meant by "seed bank", and perhaps use another term. In ecology, seed bank has a very specific meaning (i.e., the dormant seeds in the soil that can germinate in subsequent years). How long do seeds stay in this "seed bank"? Does each grid cell have their own seed bank? So seeds enter after dispersal has already occurred? Or is this a central seedbank that all grid cells have access to?

L160-160 – please provide a justification for why you chose the LAI approach for seed production, and not the carbon allocation approach already implemented in LPJ-GUESS. In addition, please include some more information for how LAI is used to determine the number of seeds? What value was chosen for maximum fecundity? Is this species specific?

Seed bank dynamics (Section 2.3.3)

L191-193 – this explanation is not sufficient. What is the difference between yearly loss of germinability and the amount of germinated seeds? Is there a single seed bank for each large grid cell, or each smaller grid cell inside? L194-198 – this is confusing.

Germination (Section 2.3.4)

L202 – 208 – why did you want to add more limitations to establishment? What is the biological justification for this? What does "we fixed this parameter to 0.01 after initial testing" mean? What properties did you evaluate? What does this parameter do? And how does your new limitation interact with the already implemented light limitation (i.e., does this filter happen before or after)?

Corridors (Section 2.5)

This entire section is also very confusing - looking at the figures helped, but the text needs to be clarified. Are these corridors the large grid cells, or the smaller grid cells inside? Or both? L260 – 263 – How is the 1 km scale chosen, appropriate for a species with an average long distance dispersal of 200 m? Only a very, very small proportion of seeds would be able to travel 1 km or more. The next section (L285), mentions "parallel and diagonal corridors". What does this mean? This should be described in this section, with some additional details provided.

Results, Explicit seed dispersal (Section 3.1)

It is not clear what results this section is talking about, nor how it relates to the rest of the manuscript. Referring to "pre-studies" is not helpful (i.e., these results are not part of the current manuscript? So why are they included?).

There are also no values in here at all. How much faster did the FFTM or SMSM perform compared to the explicit dispersal?

Also, this is the first mention of a Matlab script (perhaps should be mentioned in the methods?). Since (I assume) the Matlab script doesn't include the additional processes from LPJ-GUESS, how comparable are these results to what you would get in LPJ-GUESS?

Minor Comments

L34 – not "at least", which implies 1 km or greater. But should be "at maximum" implying that 1 km is the greatest size that can be used.

L 37 – what is "it"?

L39 – what "both methods" are you referring to here? The comparison of the Fast Fourier transformation vs the iteratively shifting seed matrix, or the comparison of between the simulations with all grid cells, versus the corridors?

L39 – what does "reliable" mean?

L59 – awkward wording.

L59-79 – both of these paragraphs are missing appropriate references. They have none, but include several statements which need to be referenced.

L95 – although this is explained in more detail in the discussion, it would be helpful to have this information in the introduction. (i.e., what did previous approaches do, and why were they limiting).

L108 – 110 – a few more details about LPJ-GUESS? This one sentence is vague and particularly unhelpful for understanding what this model does.

L127-128 – if all vegetation is killed, and now seed dispersal is active, you MUST have some vegetation or you won't have any seeds?? Where does the first generation come from?

L142-150 – please clarify this how this occurred. So instead of one grid cell with multiple patches, you simulated one grid cells with multiple grid cells? But these smaller grid cells, had spatial locations and could interact with each other (unlike patches)? This was my interpretation, but this needs to be clearer. A conceptual figure would help.

L188-189 – need more details about how these parameters were "roughly estimated" if this approach is to be applied in other models or for different species.

L286-289 – this sentence is confusing.

Figure 5 is not clear – what is causing the white areas? Neither the results nor the methods addresses what the simulation set up was that could cause this pattern. The explanation "no seeds were able to reach them" is not true, as seeds obviously reached all the way around the white circles in the center (i.e., beech arrived in year 2500, but then never migrated in?).

Numerous small grammatical errors throughout (this is not a complete list, just a few examples). L25

L51-52, "to have a sufficient amount of seeds"

L72 – unnecessary "of"

L86 – unnecessary "the"

L202 – "depending stochastically depending"

L305 – "Using at a distance of"

L347 – "..we are the first that manage to implement. . ."

L369

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