Geoscientific
Model Development
Discussions

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

**Anonymous Referee #3**

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Lehsten et al. present a nice and timely study focusing on the implementation of migration into dynamic global vegetation models. They show a way to connect established assumptions of seed dispersal based on former studies with two approaches of enhanced seed dispersal based on Fast Fourier transformation and seed matrix shifting. Together with allowing seed dispersal through specified spatially equidistant corridors they show a nice way of how to reduce computation time while losing some accuracy even though there is no real validation presented. The approach has the potential to be applied in the different DGVMs existing today and is an important contribution to their development. My comments mainly concern 1) the reproducibility of their method and 2) the realism of being able to conduct continental scale simulations.

General comments:

Computation time: My biggest concern here is that the authors simulated only one species migrating. Therefore, they were able to simulate only one growing patch per 1 km2 grid cell. When increasing the species number it is definitively important to also increase the number of growing patches (and probably decrease their size to enable local competition or in other words to avoid an unrealistic growing patch overarching competition which is one of the major selling points of a gap model like in LPJ GUESS typically using 100-1000 m2 growing patches) in return increasing the computation time. The computation time for a continental scale simulation with many different species still has to be determined and could be topic of a follow up study. Germination rate: It is unclear how sensitive the presented results are in connection to the germination rate used. Obviously the germination rate must influence the speed of migration. The rate of germination directly influences the competitiveness of each species and therefore its dispersal. Age of maturity: Even though I am totally ok with not taking into account an age of maturity to keep the findings of this study as simple as possible, it is again very obvious that this variable strongly influences the speed of migration. Therefore, this topic needs an extra space in the discussion or some results in the supplement showing e.g. the influence of assuming a minimum age of maturity.

Specific comments:

Line 132-134: How does the seedbank determine establishment probability and how is environmentally-suitable determined? I would like at least a brief explanation of this crucial aspect.

Line 136 – 150:

a) So what I see in figure 3 and 4 is that for the 50km corridor approach you have 6 corridors per 0.5° grid cell (or do neighboring cells share corridors)? And these corridors need 200 simulation cells each of them 1km$^2$ in size? Assuming that a 0.5° grid cell is 50x50km I wonder where the positions of your corridors actually are. At the boarders of each grid cell and also diagonal through the middle? It would be helpful to

see this in Fig. 3 and 4.

b) You are able to use only 1 patch per cell, because you are only simulating 1 species migrating. It is important to explain in the discussion that you definitely need more (and probably smaller) patches if you consider more species. It actually scales with species number. Therefore, computation time would be much higher as well. This is contradicting potential continental simulations.

Line 155-157: Even though you cite Lischke et al. I would like to see a brief explanation of the "maximum fecundity" method.

Line 157: Have you performed tests for age of maturity? I guess setting an age of maturity would lower the speed of migration. I am totally ok with not taking this into account, but it would be good to pick up this issue in the discussion e.g. under 4.4.3.

Line 163-164: Please provide explanation and reference for mast fruiting effects.

Line 188 – 189: So do you use the values for Fagus sylvatica?

Line 191 – 193: Where can I find values of "loss of germinability"? If these are specific values from Lischke et al. I would suggest to list them in a table as well as similar parameter values. This would really help to reproduce the study.

Line 194-198: I have my problems understanding this whole part. 1. "A year is defined for each species and grid cell before which seed bank constraints are ignored". I do not understand this sentence. 2. I also do not understand the second sentence. I believe you talk about the initial conditions and refugia. It is probably a very crucial part for migration simulations so please provide a few more sentences of explanation.

Line 207: Explain "age cohort". It has not appeared before and is important to understand the approach.

Line 199-208:

a) Please provide equations and an according explanation instead of an example in

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line 208.

b) Moreover, I am quite sure that the germination rate strongly influences results. It is probably important for the speed of migration and definitively for competition and therefore equilibrium biomass. What do you mean with "initial testing"? I don't expect a comprehensive full explanation in the text, but I would like to understand why you have chosen certain parameter values.

Line 302 – 303: As suggested above. Please provide the numbers of your parametrization.

Line 442 -443: Is it possible to give a comparison here? What is the computation time for the same setup with standard LPJ-GUESS? I see your comparisons in table 1, but they all refer to simulations which use a master.

Line 488 – 490: Have you estimated the CPU hours for this setup? Would be an interesting information.

Technical comments:

Line 22-24: Indicate that this sentence is about plants in the real world

Line 62-64: For me this is one of the major selling points and I would put it in the abstract as well. You decide.

Line 202: 2 times the word "depending"

Line 203 -205: Confusing sentence. "The probability that a species establishes is proportional to the seed number in the seed bank multiplied by . . .". Wrong formulation.

Line 206: The word "year" is missing.

Line 242: I would not expect that every reader knows what a Moore neighborhood is?

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