Biogeosciences Discuss.,
https://doi.org/10.5194/bg-2018-267-RC4, 2018

Biogeosciences Discussions
Open Access
EGU

Interactive comment on "Dispersal distances and migration rates at the arctic treeline in Siberia – a genetic and simulation based study" *by* Stefan Kruse et al.

Anonymous Referee #4

Received and published: 22 November 2018

This study utilizes genotyping and parentage analysis of individual trees to improve larch seed dispersal simulation within an individual-based, spatially-explicit forest model. The study is carried out at a single 100 m x 100 m site in the Taymyr Peninsula in northern Siberia. LAVESI, the forest model used, is specifically designed for individual larch growth, mortality, and regeneration, and the updated model is used to simulate northward migration of the larch treeline and forestline under two different climate scenarios. The updated model performed well when compared to observation data, though it slightly overestimated the number of recruits close to the parent tree as well as an overestimation of very long dispersal. The south-north migration simulation under static climate resulted in a migration rate of 0.6 m/year and 1.6 m/year for the

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forest- and treelines, respectively. Under a climate scenario of decreasing temperature and slightly increasing temperature from south to north, the south-north migration rate was slower. They also found an accelerating rate of dispersal over the simulation time under the static climate scenario.

The study is important for field ecologists as well as the ecological modeling community. Currently, northward tree migration across the circumpolar boreal region is of crucial importance due to its potential impact and feedback to climate. However, most forest models do not adequately represent dispersal mechanisms. This study showcases an innovative way to determine in situ effective seed dispersal and incorporate such data into a forest model for calibration and application.

While the study is effective and well-structured, and shows how well the LAVESI model can perform at a local-scale, the model was tuned quite heavily to the small study area (only 100 m2), and the model output was compared only to data that was used in the tuning process. Before this model can be utilized at a larger scale I believe it will require more generalized parameter values. In particular, because the model produced fairly slow migration rates compared to other studies, I feel it may be overfitted to this study site and data, though only additional comparisons and simulations with the model will be able to determine if this is the case. It would be nice to see a sentence or two acknowledging this in the Conclusions. It would be nice in future studies to see this model compared to independent data at a separate site as well. I would also be interested to see how the migration would play out under a climate change scenario, though this is likely planned for future work.

Overall, I think this paper is well-written and the manuscript should be accepted with only a few minor revisions. This study is a great starting point for future work with this model and the equations developed within it. It should be of interest to other ecologists working on similar problems across the boreal region.

Below are some minor comments and edit suggestions for consideration by the au-

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thors:

Line 92: Change “Subsequent” to “Subsequently,” Line 120: Change “larch species” to “larch individuals” Line 129: You say here and in the Supplementary Material that active layer depth influences tree mortality (which I am guessing is based on growth rate). However, it seems based on the information in the Supplementary Material that active layer depth directly influences tree growth, which in turn would also influence mortality (and potentially seed dispersal?). Lines 135-140: I’m not sure why some of these parameter descriptions are in quotes and some aren’t. In general this sentence is difficult to get through. You may want to consider just publishing a table instead of listing them in the text. Line 139: I’m not sure what “different modes to compute the competition” are Line 151-152: Could you expand on the 20mx20m vs. the surrounding 100mx100m section? I’m not sure I follow where the spatial differences are coming from. Line 224: Add “for this model” after “Mean dispersal” Line 229: change “have the smallest” to “has the smallest”

Supplement S2: Line 74: Change “correspondingly” to “corresponding” and delete “roughly” Line 76: Change “of Matlack” to “from Matlack” Lines 76-79: I’m confused by what 0.86 m/s is referring to. I this Vd? Or w? Additionally this sentence is somewhat awkward and I would recommend breaking it up into two sentences and clarifying. Line 84: how did you obtain the sdist and the scaling parameter? I see that you tuned them variously but did you have initial starting values based on literature or data? Line 88: Where did you obtain the data for the study showing no significant influence of temperature? Was it at the same study site? I am concerned about this growth function modification as it further “tunes” the model to a specific area, and may need to be re-tuned if the model is moved elsewhere Lines 93-98: See my above comment on permafrost-tree growth influence. It seems ALT impacts tree growth directly and mortality indirectly, though I may be wrong. Line 97: What is the parameter fe? Table S4: I would suggest also adding variable symbols next to the parameter descriptions, especially if they are mentioned in this text or other published works. Line 105: Why

do you need to shift the dispersal peak by 2-3 m? Is this based on comparisons with the observation data? I would mention this here. Line 120: What is the reference simulation? Additionally please expand on what you mean by “general performance.” Line 123: I’m not sure what you mean by “In parts” Line 127: What is the ecological basis for changing the density competition to improve the on-site recruitment ratio? Line 128: Delete “were” in between results and strongly

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