

## ***Interactive comment on “Upscaling with the dynamic two-layer classification concept (D2C): TreeMig-2L, an efficient implementation of the forest-landscape model TreeMig” by J. E. M. S. Nabel***

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This paper introduces a concept for scaling and accelerating the performance of a dynamic vegetation model which includes the processes of migration (TreeMig). The new concept (TreeMig-2L), as the name suggests, divides the processes represented by the model into two distinct computational ‘layers’. The first layer, where every cell in the 2D spatial matrix is represented, represents the processes of seed dispersal in space (but could in principle be used for any process with a spatial dimension, including fires and avalanches). The second layer represents the processes of vegetation growth and

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succession and contains all of the model physiology. For this layer, the model cells are aggregated according to a set of criteria such that cell with similar environment/climate envelopes and extant vegetation composition are treated as a single model entity.

In some ways, this methodology extends the aggregation methods of existing ecosystem cohort models, whereby similar successional stages and/or tree cohorts are aggregated into single model entities. This approach creates a new type of spatial aggregation that might (?) be considered analogous to these ideas.

The paper presents an illustration of this concept applied to the TreeMig vegetation model. The impacts of numerous alternative assumptions pertaining to the degree of aggregation are tested in terms of the accuracy and the computational performance of the algorithm. The paper as written is a particularly thorough illustration of the idea, and should provide an excellent resource to others wishing to use this code or implement similar ideas.

The paper is very well written (particularly given the complex nature of the subject material) but in places could benefit from minor changes to make the text a bit easier to follow.

### Specific Comments

P5536 L25: I think a comment on the nature of DVM's according to Snell 2014 would be useful here.

P5537 L27: Could do with references to models that use cohorts. I am not sure that it is very useful to refer so heavily to another paper here.

P5541 L17: I think it is perhaps better to be explicit that you are referring to avalanches.

P5542 L17: ‘Supporting period’ is not a very intuitive descriptive term here. Could the the need for the definition of the period be described more clearly?

P5542 L 20: What happens if the bioclimate bins change between supporting periods?

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Is there an accommodation for a changing climate?

P5542 L25-30: Maybe too much detail? Defer to editorial advice on how much description of the actual code is desirable.

P5543 L2 : Is this sentence “The communication between the layers is asymmetric.” needed? I found it rather inhibited my understanding of this paragraph.

P5543 L6: Are the light conditions those of the under-storey, above the canopy, or in gaps?

P5543 L13: Averaged densities of what?

P5544 L4: The concept of ‘tracked’ and ‘untracked’ species I find confusing. Can it be elaborated on slightly?

P5545 L6: ‘influenced’, not ‘influence’.

P5545 L 26: Maybe add some brief context here, like ‘the scenarios pertain to different regions of Switzerland’.

P5546: Again, perhaps some context might be of use here, in terms of ‘scenario A1, in the flatter areas of Northern Switzerland’ vs scenario B, a N-S transect across the whole of the Swiss Alps’.

P5546 L16: I am not sure what happens to the other species. Are there other species? How many? Do their dynamics not affect the distributions of the ‘tracked’ species?

P5546 L25: This idea of ‘stochastic extrapolation’ could do with some more explanation. What is the timespan of the simulation compared to the availability of the driving data? Why does the extrapolation need to be stochastic?

P5547 L1: I am confused about the need to use/define these three sampling periods? Are they ‘supporting periods’? Why not use the whole time series?

P5547 L7: Suggest adding “Simulations with scenario A2, a much smaller land area,

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required one-tenth. . .”

P5547 L10: Are there not four versions, including the control 1L-ORG?

L5549 L15: To what extent is the 2L approximation dependent upon how the model is driven? In the nomenclature I am most used to, metrics of bioclimate are not used as drivers, e.g. annual/daily/hourly meteorology is the main driving data set. Longer ‘bioclimate’ averages are more often used to define the ranges of vegetation, not their driving data. Is there some confusion over the use of the term ‘bioclimate’ here that requires further clarification?

P5549: L10-30: This discussion is interesting, but slightly breaks the flow of the text. Might it be relegated to the supplementary information?

P5551 L9: Suggest replacing ‘selected set’ with ‘resolution’.

P5551 L 25-30: Could you add a sentence here about why adding more tracked species reduces the error?

P5555 L2-5: Not sure I understand this sentence (Most importantly. . .) . Is there a word missing?

P5555 L14: Updated reference for LPJ-GUESS:

Smith, B., Warlind, D., Arneeth, A., Hickler, T., Leadley, P., Siltberg, J., & Zaehle, S. (2014). Implications of incorporating N cycling and N limitations on primary production in an individual-based dynamic vegetation model. *Biogeosciences*, 11, 2027-2054.

ED references should probably include:

Medvigy, D., & Moorcroft, P. R. (2012). Predicting ecosystem dynamics at regional scales: an evaluation of a terrestrial biosphere model for the forests of northeastern North America. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 367(1586), 222-235.

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and/or

Moorcroft, P. R., Hurtt, G. C., & Pacala, S. W. (2001). A method for scaling vegetation dynamics: the ecosystem demography model (ED). *Ecological monographs*, 71(4), 557-586.

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