

General comments

Representation of plant interactions remains a challenging question for vegetation distribution modelling. The purpose of this paper to improve the representation of plant competitive interactions in the Canadian Terrestrial Ecosystem Model is therefore totally relevant.

In this new model version (v. 2.0), the authors use a modified version of the Lotka-Volterra predator-prey equations to represent competition between PFTs. The authors show that modifications improve model results compared to results obtained with unmodified L-V equations as well as with prescribed PFT fractional coverages. The new parameterization of L-V equations allows the coexistence of more species than with unmodified L-V, reducing notably the dominance of tree PFTs on grass PFTs.

This paper is first a global validation of the model after different re-parameterizations required by the new plant dynamics and other improvements made since the CTEM version 1.0. It does not present actually any new modelling concept or tool. The competition scheme using modified L-V equations was already presented in a previous CTEM paper (Arora and Boer, 2006, *Earth Interact.* 10, 1-30) and it is not the first model which uses L-V equations to represent competition. Moreover, the number of simulated PFTs remains very low (7 PFTs) and the spatial resolution quite coarse (3.75°) compared notably to the Community Land Model (CLM) (integrated in the Community Earth System Model) which can simulate 16 PFTs in finer scale simulations (Oleson et al., 2013, *Technical Description of version 4.5 of the CLM*).

Descriptions of changes performed for this study are very detailed and adaptions made since CTEM version 1.0 in related works are integrated in Appendix and well documented. Nevertheless, the paper is quite long and some parts, e.g. the description and discussion of results, could certainly be reduced. Some very long sentences and misplaced punctuation make sometimes the reading difficult.

Specific comments

Though model descriptions are very complete, the modifications of the L-V equations through the empirical parameter b (p. 4859 and 4864) are yet rather poorly justified. How has the value of b been determined? It is surely explained in Arora and Boer (2006, *Earth Interact.* 10, 1-30) but authors should develop again here. Maybe could they show some tests of the sensitivity of the results to this parameter b ?

Same comment for the re-parameterization required after the modification of the competition scheme (p. 4879). It is difficult to find which parameters have been changed and the consecutive impacts on carbon and water fluxes. Authors should clearly indicate the modified parameters and the tables where the new values are presented. How did you get the new values? By optimization using observation-based datasets?

Even if some statistics are presented about how the different simulations compared to observation-based estimated (principally Figure 5), the frequent use of expressions like "compare reasonably with" are not very indicative of the agreement level with

observations. P. 4870 line 8, authors describe as "fairly reasonable" a correlation of 0.38. P. 4867 line 11, authors should directly present some global statistics.

Concerning the structure, the results section is very long. Authors should reduce it. There are some repetitions between section 4.2 (Geographical distributions) and section 4.3 (Individual PFTs). In section 4, the comparisons between the three simulations (CTCOMP, LVCOMP and PRES) are sometimes irrelevant (e.g. p. 4880 lines 27-28-p. 4881 lines 1-4). You should only focus on comparisons CTCOMP-observation-based estimates. Similarly, Figure 7 should display a column with observation-based estimates (even if estimates are not available globally).

Summary and conclusions section should only focus on main outcomes of the study. The approaches currently used in other models and their limitations have been already listed in the introduction section (p. 4855). So, this paragraph can strongly be summarized (p. 4884 lines 1-14). The discussion about bioclimatic limits within models (p. 4884 line 15-p. 4885 line 12) should appear earlier and surely not in conclusion (section 2.1.4 ?).

Technical corrections

p. 4853 line 13: please use singular for "respond" and "influence"
p. 4853 line 22: remove comma
p. 4854 line 28: use plural for "adds"
p. 4858 line 22: maybe change "During competition"
p. 4859 line 4: replace "with" by ";"
p. 4863 line 12: what is a e-folding sense?
p. 4872 line 23: remove comma between "grass" and "cover"
p. 4875 line 16: change "at" by "with"
p. 4876 line 13: use plural for "precludes"
p. 4876 lines 14-20: I suggest to move the paragraph "While...." in line 7, just after the sentence starting with "The bioclimatic indices..."
p. 4877 line 25: use plural for "grass"
p. 4877 line 27: use plural for "response"
p. 4878 line 25: I do not understand "...which may be important is parts of..."
p. 4879 line 9 and line 18: use plural for "coverage"
p. 4880 line 16: remove "s" to "simulations"
p. 4881 line 8-12: maybe sentence could be simplified ("CTCOMP and LVCOMP simulations" twice in the same sentence)
p. 4881 line 10: use plural for "simulation"
p. 4881 line 27: Please explain why annual fire emissions are highest in the CTCOMP simulation
p. 4882 line 3: Which contemporary observation-based estimates did you use?
p. 4882 line 5: use plural for "coverage"
p. 4882: Why comparing only with PRES simulations and not with observational estimates?
p. 4883 lines 17-20: I do not understand this sentence...

Summary and conclusions

- p. 4884 line 18: remove “s” to “PFTs”
- p. 4885 line 11: use plural for “distribution”
- p. 4885 line 14: what do you mean by “fairly relaxed”?
- p. 4885 line 19: add a comma after PFTs
- p. 4885 line 24-25: remove commas in “, and modified,”

Appendix

- p. 4887 line 23: please use plural for “process”
- p. 4890 equations A9-A10: what are (2.1) and (1.2)?
- p. 4891 line 10: add commas for “as a result”
- p. 4891 lines 17-18: add a dash for “leaf level”
- p. 4892 line 10: I do not understand “nitrogen/time” ...
- p. 4893 line 13: remove commas after “(g_c)” and “(g_b)”
- p. 4893 line 15: remove dot
- p. 4894 line 5: use plural for “respiration”
- p. 4894 line 20: use plural for “sensitivity”
- p. 4895 line 7: remove “by”
- p. 4896 line 13: add “on” before “a PFT-dependent”
- p. 4897 line 13: use singular for “temperatures”
- p. 4897 line 18: what is a “log math” ? not very clear...
- p. 4897 line 21: please correct “mircobial”
- p. 4898 equations A35-A36: Is it “100.0” not “1.0”?
- p. 4898 line 11: use plural for “comes”
- p. 4898 line 14: change “fashion” by “manner”
- p. 4898 line 14: use singular for “respirations”
- p. 4899 line 7: use singular for “biomasses”
- p. 4900 line 18: add “up” to “add up to one”
- p. 4901 line 3: use plural for “biomass”
- p. 4901 line 27: add “the” to “all the NPP”
- p. 4902 line 15: change “is not” to “are not”
- p. 4902 line 25: please add “that” before “a give amount” to clarify the sentence
- p. 4905 line 6: use plural for “maintenance and growth respiration”
- p. 4905 line 7: add a comma before “it is possible”
- p. 4908 line 1: specify “fire disturbance”
- p. 4908 line 11: Why a representative area of 500 km²? Maybe explain...
- p. 4910 line 15: add “as” before “a surrogate”
- p. 4915 line 4: use plural for “contributes”
- p. 4917 line 8: Please split sentence “Crops increase...” in two phrases. Start a new sentence from “However”
- p. 4917 line 10: why not use the sum of degree-days for harvest?
- p. 4917 line 15: use plural for “leads”
- p. 4918 line 22: change “,” to “:”
- p. 4918 line 26: use plural for “depends”

References

- p. 4865 line 4: Ramankutty and Foley (1999) does not appear in the bibliography
- p. 4921 line 17: correct “CMPI5”