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Geoscientific Model Development Discussions

Interactive comment on "On constraining the strength of the terrestrial CO_2 fertilization effect in an Earth system model" *by* V. K. Arora and J. F. Scinocca

Anonymous Referee #1

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Comments on "On constraining the strength of the terrestrial CO2 fertilization effect in an Earth system model" submitted by V.K.Arora and J.F.Scinocca to Geoscientific Model Development

General comments

In this manuscript, the authors attempted to constrain a parameter of the Canadian Earth System Model version 4.2 in terms of atmospheric CO2 fertilization effect, which is one of the most uncertain process in the future climate–carbon cycle feedback. By conducting a series of simulations using different parameter values (gamma-d = 0.25, 0.4, 0.55), they chose the most plausible parameter value that allows most realistic simulations of atmospheric CO2 growth and its seasonal amplitude. Apparently, this is

an up-to-date and meaningful work to improve the reliability of Earth System Models. The new experiment, "relaxed-CO2", is especially interesting for me. The manuscript was clearly written and I found no logical fault. Nevertheless, I have a few moderate caveats on this study. First, the CO2 fertilization parameter (gamma-d) represents photosynthetic down-regulation (not the fertilization effect itself) in an empirical manner. So, the selected parameter value (i.e., 0.4) seems to be specific to the CanESM4.2. Second, this study compared only three parameter values, and so the selected one (0.4) may not be exactly the best one. Third, recently, Schimel et al. (2015) published a very relevant paper on constraining the CO2 fertilization effect, but this was not referred in the manuscript. In conclusion, the manuscript is well prepared and may be accepted for publication after moderate revision. Specific comments are given below.

Specific comments

Page 4 Line 21–26: Several studies used FACE data for benchmarking of terrestrial vegetation models (Piao et al., 2013; Zaehle et al., 2014).

Page 12 Line 24: How the default parameter of CanESM2 (gamma-d = 0.25) was determined?

Page 19 Line 25: Remove the space between "under" and "predict".

References

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