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Earth System Dynamics
Discussions

Interactive comment on "Earth system model simulations show different carbon cycle feedback strengths under glacial and interglacial conditions" *by* Markus Adloff et al.

Anonymous Referee #2

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Authors compare carbon cycle feedbacks from a pre-industrial and LGM simulation using the framework described by Friedlingstein et al. (2006) and Arora et al. (2013). Overall although the result may be somewhat obvious I still see this as a useful study as long as the underlying mechanisms are thoroughly investigated. However, the manner in which the manuscript is currently written shows that the authors haven't gained a sufficient understanding of the science as well as terminologies used in the existing literature. As such then it is clearly not of publication quality in its current form.

Main comments

My biggest concern is with the equations. On page 5 I_tot is not defined (unless I

missed it) but if I try to interpret I_tot it seems like the change in atmospheric CO2 burden. I_ext on the other hand is total cumulative emissions. If true, then the ratio between the two (equation 7) is not the feedback but rather the airborne fraction. This is not the way Friedlingstein et al. (2006) or Arora et al. (2013) described the feedback and the gain. Their feedback and the gain are calculated by comparing either simulated CO2 (in emissions-driven simulation) or diagnosed emissions (in concentration-driven simulations) from fully-coupled and biogeochemically-coupled simulations.

I am also troubled by the fact that in Figure 7 the rate of carbon uptake by land shows an abrupt slow down around CO2 concentration of 650 ppm. Figure 3c of Arora et al. (2009) shows how photosynthesis changes per unit increase in CO2 based on the standard biochemical equations for photosynthesis. Although this rate decreases, because of the saturating effect, I do not see any abrupt changes up until CO2 of 747 ppm in their figure. This abrupt behaviour in authors' model, it seems, doesn't come from the photosynthesis equations but rather something else that is implemented in the model.

Other comments

The lack of understanding of the current literature, or perhaps it's just the first language issue, is seen in several phrases used by the authors which do not appear to make any sense. These include "fertilization and radiation effect to the different vegetation distribution", "sensitivities to the fertilization and radiation effect", "when structural limits are hit", "the point of effectivity change", "physiological limits are hit more frequently", "photosynthesis exploitation of the insolation", and "tropical living conditions deteriorate".

"factorial simulations" are referred to as "factor simulations"

I have marked several other comments on the manuscript itself and am attaching a scanned version of the annotated manuscript.

References:

Arora, V. K., et al., 2013: Carbon-concentration and carbon-climate feedbacks in CMIP5 earth system models. Journal of Climate, 26 (15).

Arora, V. K. et al. The Effect of Terrestrial Photosynthesis Down Regulation on the Twentieth-Century Carbon Budget Simulated with the CCCma Earth System Model. J. Clim. 22, 6066–6088 (2009).

Friedlingstein, P., et al., 2006: Climate-carbon cycle feedback analysis: Results from the C4MIP model intercomparison. Journal of Climate, 19, 3337–3353.

Please also note the supplement to this comment:
https://www.earth-syst-dynam-discuss.net/esd-2017-67/esd-2017-67-RC2-supplement.pdf

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