

Interactive comment on “Continued increase in atmospheric CO₂ seasonal amplitude in the 21st century projected by the CMIP5 Earth System Models” by F. Zhao and N. Zeng

Anonymous Referee #2

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This paper examines emission-driven simulations of terrestrial and atmospheric CMIP5 models to assess future trends in seasonal amplitude of atmospheric CO₂. The topic is interesting and timely but the paper's contribution to understanding terrestrial biosphere processes and modeled responses to environmental change is marginal, mainly because the description of results does not penetrate deeply into the findings and largely treats the models in aggregate.

Aggregate patterns may be dominated by only a few models, particularly since the seasonality varies considerably between models (up to a factor of 3), and aggregate patterns may be different from individual model responses. It would be useful therefore to describe in more detail the results for individual models, also looking at the factorial

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experiments for those models where it is available.

The statements on P792 about the inability to draw meaningful conclusions from 4 models and the inability to separate carbon and climate effects from factorial experiments are false. Even though the factorial experiments use different emissions than RCP8.5, they are still useful for examining mechanisms in the models. Several impactful papers have made these comparisons with 4 or fewer models.

The authors should look more specifically at Northern Hemisphere fluxes and near-surface CO₂, where the trends in seasonal amplitude have been observed. If the global increase in CO₂ amplitude is 70% to 2100, what does that mean for temperate and boreal fluxes and for Barrow CO₂?

It should be explained why the HadGEM model is omitted, particularly since it has been shown to have strong carbon-climate feedbacks, and its simulations showed the largest change in CO₂ amplitude in Graven et al 2013. Including this model would likely reduce the correlation in Figure 6 since it has a relatively small sink but relatively large change in seasonal NBP amplitude.

It is interesting that the simulations appear to predict decreased seasonality in Northern tropics and subtropics, similar to the result in Graven et al 2013, but the description of this figure is not clear and it seems that it may not account for regional or interhemispheric differences in NBP phasing.

The comparison with previous work is lacking in general and particularly in the Discussion where only three references are cited. A disproportionate part of the Introduction is given to early work rather than the current state of knowledge. The writing needs to be improved overall. The text is also imprecise in several places, for example referring to the amplitude but not specifying the amplitude of what, or referring to the amplitude but meaning the amplitude change.

A major revision is needed to improve the presentation and to develop the scientific

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insights that can be gained from this analysis.

P781 L5 Amplitude figures are outdated

P782 L5 Need reference for decreasing trend at Barrow

P782 L8 Graven 2013 gives 15% and 35%

P782 L17 It is unclear what amplitude this paragraph is referring to, CO₂ or NEP? Randerson et al 1997 and Gurney and Eckels 2011, at least, should be cited and described for NOAA data and CO₂ inversion trends.

P783 L1 Add “, in comparison to Mauna Loa CO₂ observations,” after “for four TBMs”

P783 L8 Replace “might underestimate the amplitude” with “underestimate the CO₂ amplitude change in the mid-troposphere at latitudes north of 45°N”

P783 L22-25 There are grammatical errors in all of these questions

P790 L15 Need reference

P792 L1 Either this work should be included in the analysis or the paragraph deleted

P792 L14 Delete paragraph.

Figure 2 – There are two lines of the same color

Figure 3 - Not clear. Why are there more than two red and black lines in each panel? Why are the time periods, particularly the future period (2006-2099), so long?

Figure 5 - Right panel is not explained. Does this account for different phasing of the NBP cycle in different regions?

Interactive comment on Earth Syst. Dynam. Discuss., 5, 779, 2014.