

Interactive comment on “Sensitivity of Future Ocean Acidification to Carbon Climate Feedbacks” by Richard J. Matear and Andrew Lenton

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We thank the reviewer for the constructive comments. The following are our point by point response to these comments.

Major issues:

1. There is not sufficient discussion of the difference between the dynamics and responses of the carbon sinks between the EP and CP simulations. Nor how the sink responses in your particular model compares to those in other models.

Response: We agree this is an important point to address, we now devote a new section in the paper comparing our model simulations to previously published results on carbon climate feedbacks with the different emissions scenarios. We have also

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compared our results to previous CP simulations. (Please see response to Reviewer 1)

2. There is not sufficient discussion of the changes in ocean and land uptake in the EP simulations compared to CP simulations. Especially I would like to see more discussion about the overall effect these changes have on the atmospheric CO₂. Again, comparison with other models would be helpful.

R: We agree that it is important to show how the carbon-climate feedbacks influence land and ocean carbon uptake. We have added figures showing land and ocean uptake changes and compare our simulations to previously published results, please see Reponse to Reviewer 1.

3. Line 108-109: This sentence implies to me that the results are highly dependent on the land and ocean biogeochemistry in the model, and the dynamics of these sinks. The results will therefore be very model-dependent and some more discussion about how representative your particular model is, is necessary.

R: In fact, this is true for the entire Earth System and indeed the point of the paper, by prescribing atmospheric concentrations of CO₂ the magnitude of sink and sources are irrelevant i.e. the response of the ocean chemistry is to atmosphere and not the changing sinks. However, to provide confidence for the reader we have added a new section in the discussion comparing our simulations to previously published simulations. Our simulated carbon-climate feedback falls within the range of previous results but some models show a much greater feedback which would give a greater impact on OA than presented here.

Line 143: You use 1995 as a reference year here. Why 1995 and GLODAPv1 when there is much more recent data for 2002 and GLODAPv2?

R: We have changed the dataset to GLODAPv2 referenced to Lauvset et al (2016), ESDD

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Lines 153-155: The statement here implies that the increase in atmospheric CO₂ concentration in the EP simulations are due to reduced land uptake. How does that fit with Figure 4? A better explanation is necessary here.

R: We have added a figure of the land uptake, and modified the text to make this point clearer. With reduced uptake by the land the atmospheric CO₂ levels increase which increases uptake by the ocean but it is less than the land response.

Line 184: Here it is stated that the EP scenarios are more negative than the CP simulations. But on Figure 6 all numbers are positive. Rephrase.

R; fixed and rewrote

Line 160 and Figure 4: Firstly, what is the reference year here? Secondly, Is the caption for the figure correct? The label on the y-axis says PgC which suggests that this is a cumulative difference, but the caption states that this is the annual difference (in PgC yr⁻¹). The numbers are very large given the small difference in atmospheric CO₂ and temperature between the EP and CP simulations.

R: The caption was incorrect - the figure shows cumulative uptake. In addressing the previous points, we have added figures of land and ocean uptake to clearly show how the land and ocean respond in the EP simulation.

Minor points:

The reference to Lenton et al (2015) is wrong. This is the Biogeosciences Discussions version but there is a peer-reviewed version from 2016.

R: fixed

In the Figure 1 caption it should read “carbonate ion”.

R: Fixed

In the Figure 3 caption the year defined as present-day needs to be defined and stated.

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R:Yes - now 2002 based on GLODAPv2

Please proof-read the entire manuscript carefully.

R: The manuscript has been rewritten and minor errors addressed

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