

Interactive comment on “Quantifying the impact of ocean acidification on our future climate” by R. J. Matear and A. Lenton

Anonymous Referee #1

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General remarks:

The aim of the study by Matear and Lenton is to quantify the impact of ocean acidification on future climate. On the basis of an Earth system model they performed a set of sensitivity studies whereby most of the tested assumptions have already been investigated by other research groups. The new aspect of this manuscript is the focus on the OA impact on climate. This is an interesting scientific question which would be relevant to the scope of the Biogeosciences journal. However, the insufficient description of the model set up creates rather confusion than new insights. Appendix A gives some rudimentary information in an unstructured way. Only the fallback to the original paper by Matear and Hirst (2003) could improve the reader's understanding. Sparse information is also given in the discussion of the results; e.g. the authors describe in

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section 4.2.5 the changing dissolved oxygen cycle, which is currently one of the most interesting questions of the climate change impact, without mentioning that their model includes an implicit formulation of unlimited denitrification. Enhanced export production, as assumed in 3 out of 4 sensitivity studies, might therefore have only a limited affect on the oxygen concentration at depth.

The major part of the section “summary and perspectives” is just a listing of other potential OA feedback mechanisms by referring to the work of others. This paragraph could be drastically shortened as there is no additional information related to the presented study.

To summarize, I support this kind of model study and I would like to see it being published. But major revisions have to be done before I could recommend the publication of this manuscript.

Special remarks:

-the impact of OA is in the focus of this ms and inorganic carbon and alkalinity are prognostic tracers of the model: So why seems the dissolution of PIC not to be a function of the aragonite/carbonate saturation state (page 17704, line 4-10, A 11)?

-oxygen cycle: please add more details on denitrification and its changing magnitude in the different sensitivity studies

does the oxygen consumption change during remineralisation in the sensitivity studies with increased C/P ratio?

-the change in alkalinity due to aerobic remineralisation of org. matter is very different than due to denitrification (see Paulmier et al. Biogeosciences, 6, 923–935, 2009). Is this considered?

-for what reason is exp. CRTL included in the ms.? There is no discussion on CRTL. In Fig. 8 and 9 panel a and b could refer to REF 1850

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page 17684, line 23-25 : it is not the pH that changes by 30 % but the H⁺ concentration; what is a 100 % change in pH in 2100 – again here the authors must refer to H⁺

page 17686, line 21 : "... provide a negative feedback to climate change" replace "change" by "warming"

page 17690, line 13 , replace 2006 by 2005

page 17690, line 25 – give value of F(o) for 2100 for completeness

page 17691, line 20 delete a in " have a prescribed depth profiles"

page 17693, line 27 replace "water" by "layer" in "that the suboxic water is too thick"

page 17694, line 5 please add the mean atmospheric pCO₂ in 2100 of REF for better understanding

page 17695, line 7 incomplete sentence ... "level of saturation state that historically corals are not found "

page 17697, line 17 add Fig 10a

page 17699, line, 4-6 "While the differences that occur by including OA impacts on biogeochemistry are small, we emphasize with the RCP8.5 scenario by 2100 there will be significant changes in ocean acidification, that will impact the marine ecosystem." I do not understand this sentence. What do the authors mean by "biogeochemistry" and what by "marine ecosystem"?

page 17699, line 20 infinitive "address" or "to be addressed"

page 17702, line 13 delete "the" in "...summarises the how the BGC processes"

page 17704, line 7-10 please rephrase, this is confusing

page 17703, A6 why has the O:P Redfield ratio changed from 138 (Matear & Hirst,2003) to 136

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page 17704 , line 7-8 and A 10 and A11 : please do not use POC and POC(z) for very different expressions => POC is defined as export flux of POC and POC(z) is a dimensionless function (PIC,PIC(z) resp.)

page 17704 A12 and A13 : why are these equations negative? C(o) is the remineralisation of POC should be added to the inorganic carbon.

Table 1: "positive value reflecting greater climate change", replace "change" by "warming"

Figure 1: could be reduced to only 1a

Figure 4 : Why are the lines in panel b and c not given as changes relative to REF as in panel a and d. Please unify the presented information.

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