

## ***Interactive comment on “The [simple carbon project] model v1.0” by Cameron O’Neill et al.***

### **Anonymous Referee #2**

Received and published: 19 December 2018

This paper is mostly well-written. The model is nicely described and is a genuinely useful framework for investigating physical and biogeochemical controls on the marine carbon cycle. I have no serious concerns with the work and my comments are mostly suggestions for rewording and clarification. A few slightly more important issues are below, followed by line-by-line notes.

1. I did not see a description of the numerical method employed or confirmation of model stability and potential for numerical error. Fig 7 shows some potential error propagation / numerical oscillation? Have the authors investigated this?
2. Figure placement needs significant improvement. For example, Figure 9 appears 5 pages after it is mentioned and is in a different section.
3. A few times it is noted that the model supports a physical overturning mechanism for driving LGM-Holocene changes, it should be made clearer that this idea has been

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proposed before and the current work supports it, rather than introducing the concept.

Line-by-line: Page2: line 15: summary of box models is too vague Line 32: “simple carbon project model model”

Page 3: Line 20: does ‘zonally averaged’ make sense? There are no spatial dimensions here? E.g. later zonally-averaged refers to a 2D model. Figure 1. It is not always clear which arrows exchange with which boxes. E.g. some arrows are entirely within one box, some cross box borders but do not terminate. The diagram should show what is actually happening in the model.

Page 5 Line 14 to end: A little confusion over model dimensionality. Be precise here. Explain how the model has no spatial dimensions but does have a representation of sizes and locations of boxes (if that is indeed correct).

Figure 2. Caption – “implemented”. Also explain the direction of arrows here.

Page 9: Line 1: Biological flux “parameters” or “parameterization” Line 2: “action of biological activity” – reword Line 21: sub-surface or subsurface

Page 11: Line17: ‘lending it some interest’, consider rewording Line 34: should be “non-saturation-dependent” ?, “Earth”

Page 13: line 5: replace “extra ocean” with something more descriptive line 22: non-zero line 25: short-term, long-term

Page 14: Line 3: state meaning of beta parameter Figure 4: This is hard to read, consider better ways to display (e.g. title and unit on x axis)

Page 19: Line 7: “the carbon isotopes” reword Line 12 “the values for the isotopes” too vague Line 17: “response to the shocks” does not give the right impression

Figure 5. Explain data in panel b, why are there two data lines for the atmosphere? Remove “selection of boxes shown to reduce clutter”, ironically this statement is itself clutter.

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Figure 6. Remove “fed into” from caption. Use inputted or similar.

Page 20: Line 17: “carbon cycle destination for human emissions” – not clear what this means Line 19-20: explain this in more detail, a little confusing Line 22: the figures are becoming a long way from the relevant text by this point in the paper.

Figure 7: use of multiple transparencies and colors here makes it very hard to see the ranges, especially in the bottom panel. Also, it appears there is some oscillation developing in the model? Have you investigated this?

Figure 8: This is quite simple, can a comparison be incorporated? Line 22: “release of emissions” should be reworded

Figure 9: I would consider if there is a better way to show this. It takes a very long time to decode this information. Bar or pie charts would be more easily understood.

Page 22: Line 8: first line here needs clarification.

Page 25: Note that table 4 is in the appendix

Page 29 Line 8: net respiration versus net uptake should be made clear

Page 30 Line 10: don’t need ‘however’ here Line 30: “showed deltas in the range of” – be more precise here

Page 31 Line 6: “but critically *are* accompanied” Line 7: *the* carbonate ion proxy? Line 23: superscript <sup>14</sup>C Line 25: it cannot be wholly explained by overturning changes, as these must be combined with temp/salinity etc. changes listed afterwards. Also this work confirms that reduced overturning can drive the changes, rather than proposing this.

Figure 12: as with Figure 9, it’s very difficult to get any meaning from this figure. Perhaps colours could be used to denote increases/decreases at the very least?

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Interactive comment on Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2018-176>,

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