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Interactive comment on “Changes in ocean circulation and carbon storage are decoupled from air-sea CO₂ fluxes” by I. Marinov and A. Gnanadesikan

Anonymous Referee #1

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The paper by Marinov and Gnanadesikan is an interesting and well-performed model study of the impact of the large-scale ocean circulation on ocean carbon storage which is quite well-known already and on air-sea carbon fluxes which is more novel. Since my comments are essentially about style and presentation, I recommend publication of the manuscript after minor revisions.

Comments

-Section 3, Results & Discussion could be better structured. In many cases, it was not immediately clear to me how each small paragraph in this section is logically connected to the previous one. Also, there appears to be quite some repetition, for example,

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I would delete the entire paragraph "Because biological and abiotic CO₂ ... change in the abiotic flux." (p. 7992/7993), because everything has essentially already been said earlier. Furthermore, the descriptions are in some cases too qualitative and even vague. For example, on page 7993: "Vertical diffusion increases the poleward heat transport by 0.8 PW.." How much does the diffusion need to increase in order to achieve this 0.8 PW heat transport increase? And what is the function of this paragraph until "... in the Southern Ocean." anyway? What do you want to argue here? Couldn't you just delete it?

-In Figure 1D, it is not clear to me what is the exact difference between the curves with and without the stars. You say that in one model, the C:P ratio is 117, but what is it in the other model? And is that the only difference?

-There are quite a lot of small style, grammar and spelling mistakes. For example, a number of times, there is 'the the' in the text instead of simply 'the'; 'inefficient' (bottom page 7991), 'patern' (page 7992) etc.; replace 'sum between' with 'sum of' (various places in the text), replace 'constraint' with 'constrains' bottom page 7994). I recommend the authors to go through the text carefully a few times to eliminate such minor errors.

-Some textual changes:

p. 7987, l.11: and are likely a main driver for glacial-interglacial → and may play a role in glacial-interglacial

p. 7990, top: We will show below that mechanism A explains most of the observed carbon pump differences among models (Observation I above), while mechanism B dominates the air-sea flux among models (Observation II above). → We will invoke mechanism A to explain the observed carbon pump differences among models (Observation I above), whereas we will argue that mechanism B dominates the air-sea flux differences among models (Observation II above).

p. 7994, l.16: natural carbon. → natural carbon after full equilibration of the ocean-atmosphere carbon system.

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