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Climate of the Past Discussions

Interactive comment on "Glacial – interglacial atmospheric CO_2 change: a simple "hypsometric effect" on deep-ocean carbon sequestration?[1]" *by* L. C. Skinner

Anonymous Referee #2

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I'm glad that Luke Skinner is thinking about these things, but I am not satisfied by the current version of the paper which omits too much information for me to evaluate its findings. I think that major revisions are required along with another round of reviews.

(1) My major problem with manuscript is that it does not provide enough information to reproduce the model without heroic effort and uncertainty. We aren't given any of the box mass balance equations that are used, so we just have to assume that they were correctly done. They probably were, but I would like to see the equations for at least one surface box and one deep box in order to know if they were. Similarly, although

[1]Invited contribution by L. Skinner, one of the EGU Outstanding Young Scientist Award winners 2006

we are given the complete set of input parameters for the “modern” scenario, we are not given the complete set of output parameters, and we are given neither of these for the “hypsometric” version. These are essential for evaluating the model and must be included in a revised version.

(2) I would have liked to see C14 included in the model because that would allow us to evaluate the appropriateness of the overturning and mixing parameters, as well as gas exchange in the southern ocean.

(3) Although the author admits that the “thought experiment” has some flaws, taken as it is, it would increase the total phosphorus content of the ocean so it is hardly a surprise that atmospheric CO2 would be lowered.

(4) It is not correct to say that “the bulk of the deep oceanĚis ‘ventilated’ from the Southern Ocean”. Roughly equal amounts of NADW and AABW are formed (maybe even more NADW than AABW; Orsi imply about 10 Sverdrups total for AABW but there is more than 13 Sverdrups of NADW (DICKSON RR, BROWN J, THE PRODUCTION OF NORTH-ATLANTIC DEEP-WATER - SOURCES, RATES, AND PATHWAYS, JOURNAL OF GEOPHYSICAL RESEARCH-OCEANS 99 (C6): 12319-12341 JUN 15 1994). Although there is more NADW in the Atlantic than elsewhere, the Atlantic is only ˜25% of the volume of the ocean. And this seems contradicted in the paper itself with the statement on p. 722 that “?15 Sv of deep-water being exported southward from the North Atlantic and ?6 Sv being exported northward into the Atlantic from the Southern Ocean (giving a total of ?21 Sv of overturning in the ocean)” The same comments apply to the statement later in the paper “currently the volumetrically largest body of deep-water formed”.

(5) Although it is fair to construct simple models, a model that neglects light and iron limitation of Antarctic productivity is bound to miss something.

(6) The use of the word “skill” in describing the ability of the model to simulate modern data is misleading because the model was set up and tuned so that it would be able to

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reproduce the features of the modern ocean.

(7) Although this is peripheral to the main point of the paper, it is annoying to see the history of the discovery of the glacial Atlantic chemical distributions rewritten to praise the heroic carbon isotope data and slight the merely “supporting” Cd data. In fact, Cd data feature in the discovery of both of the main features of the glacial Atlantic circulation - high deep Atlantic nutrients (Science 218:784-787, 1982) and the reduction of nutrients in the upper Atlantic (Nature 330:35-40, 1987) that pre-date any of the carbon isotope references given here.

(8) Finally, I would like the author to be explicit on how this concept is different from the Toggweiler models (one referenced here, another just published in Paleoceanography) which have some similarity to the concept proposed here.

Interactive comment on Clim. Past Discuss., 2, 711, 2006.