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Biogeosciences Discussions

Interactive comment on "Simulation of anthropogenic CO_2 uptake in the CCSM3.1 ocean circulation-biogeochemical model: comparison with data-based estimates" *by* S. Wang et al.

Anonymous Referee #3

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Review of "Simulation of anthropogenic CO2 uptake in the CCSM3.1 ocean circulation-biogeochemical model: comparison with data based estimates" by S. Wang, J.K. Moore F.W. Primeau, and S. Khatiwala.

This article describes the outcome of an ocean circulation model with a biogeochemical module, and compares the anthropogenic carbon (Cant) in the model with data-based estimates. The model is run with four different sets of input/forcing (variable or climatologic climate, and constant or transient atmospheric CO2 concentration) in order to be able to quantify the effects of changing circulation/climate on Cant estimations. The paper gives a review of results from the data based methods, and compares those

to the output from the various versions of the model runs. The authors make careful comparisons of inventories over regions and for depth profiles for various regions. The model results are then guiding a section discussing the assumptions made by the KPH method, which is the basis for some statements about the validity of the KPH method. I assume that the authors restrict themselves to the KPH method since model/data comparisons for the other two methods have already been conducted elsewhere. The section discussing the (potentially) time-varying change in Delta-pCO2 is particularly interesting and, as far as I am aware, new. It shows that the assumption of a linear relationship between deltaDelta-pCO2 and delta-pCO2, as used in the KPH method, is not very reliable.

The paper is well organized and well written, the results are interesting, relevant and significant for this scientific field (ocean storage of Cant). The paper deserves to be published in Biogeosciences as it is a relevant contribution to the ocean carbon science, but only after attending to some comments that I have on the manuscript.

Minor comments:

The authors frequently (at least on three places: Abstract, pages 10917, line 3 and 10910 line 21) refer to ""weak mixing and ventilation in the North Atlantic and Southern Ocean". I assume that the authors mean "weak mixing and ventilation in the North Atlantic and Southern Ocean in the CCSM model", rather than in the real ocean.

It would be useful to add the definitions C(ant_cnst), C(ant_var) and C(ant_all) to Table 1. That would make the reading of the ms a bit easier.

The authors refer to the "KPH method", the maximum entropy method. It would be interesting to know what KPH actually stands for. I think I have seen this method referred to as the "Green function" method/approach before.

In section 3.1.1. the range of data-based estimates of the global anthropogenic carbon inventory is given. For the TTD method both the corrected and uncorrected data are

given. In the context of comparing the different methods, it would be interesting to know what the uncorrected value is for the Delta-C* method, i.e. without setting negative Cant concentrations to zero. Since the non-corrected TTD value is given, it would be fair to state the non-corrected Delta-C* value as well.

In figure 1, the term C(ant_cnst) is used for all four panels with the particular method stated in parenthesis afterwards. In figure 2b, the title states "C(ant_cnst – KPH)". Although the legend explains the panel, the title is not consequent. Maybe it is the title of Figure 1 that makes it confusing at first. Terms like C(ant_KPH) are used in the text, which is useful.

Figure 2: Why don't go all the way, and add a panel with the differences between TTD and anyone of the other approaches as well?

Figure 3: It is very difficult to evaluate the differences in the various estimates in the upper 1000 meter of the water column from these figures, maybe with the exception of the SO panel. Maybe a new set of panels can be made where the upper 1000 meters are expanded, or the difference in Cant vs. as reference method is shown for the whole water column would be useful.

Interactive comment on Biogeosciences Discuss., 8, 10895, 2011.