

***Interactive comment on* “Estimating the storage of anthropogenic carbon in the subtropical Indian Ocean: a comparison of five different approaches” by M. Álvarez et al.**

Anonymous Referee #1

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Review of "Estimating the storage of anthropogenic carbon in the subtropical Indian Ocean: a comparison of five different approaches" by Alvarez et al. for Biogeosciences

This is an interesting manuscript comparing different methods of Cant determination on a high quality transect in the Indian Ocean. It adds significant insights to the importance of single terms in Cant determinations and is acceptable for Biogeosciences. However, the question below must be addressed satisfactorily.

It appears that the main goal of this manuscript is to verify the much used DELTA C* method to determine anthropogenic CO₂ in the oceans. It is not just "a comparison exercise between different data-based techniques for estimating Cant ..." (page 733),

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because all through the manuscript comparisons are done against just that method. Certainly this is legitimate, but then it should also be stronger emphasized as the main goal. The main conclusion is that the DELTA C* method underestimates the Cant inventory. At different places in the manuscript it is stated that the carbon-based methods (like DELTA C*) are not valid in the surface layer. In Fig. 8 the computed inventory with this method is much smaller than that of other methods and certainly smaller than the 7 mol m⁻² taken to be the value for the surface layer and based on OCCAM and the TTD method. However, in Fig. 10 the DELTA C* method is surprisingly the method that fits well within the upper and lower boundaries set by theoretical considerations, while OCCAM and TTD are less good. What does this mean for the general estimation of the inventory? A lower estimate for the surface layer would bring the optimal estimate of the inventory very close to that obtained with the DELTA C* method.

I think the manuscript is rather long and it would enhance the readability if the authors could compress the text to some significant extent. Moreover, the appendices give many details which, as it is now, are redundant (see below comments on page 736). If the authors come to a different conclusion about the level of CT (i.e. do not apply result of the final comparison), my conclusion would be different.

The axes descriptions of many figures are too small (e.g. Figs. 2,5,6,8,9).

p730, line 10 insert after: ... from the: much utilized

p730, line 11 delete: Additionally,

p731, line 2 While being a well-known ...

p731, line 3 delete ,

p731, line 7 delete: still

p731, lines 7-11 The joint ... final.pdf). This text does not fit here. Delete it or try to move it to another place in the manuscript.

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p732, lines 3-5 delete: "in the initial works" and "and later put ... Sabine et al., 2004)".

p732, line 10 This is trivial. Or do you mean: Full equilibration?

p733, line 5 "could" instead of "should"?

p734 Except for the CFCs, no accuracies and precisions are given for the measured parameters. Please add them.

p734, line 12, 16 Niskin bottle instead of water bottle?

p734, line 26 2x a, typo

p735, line 3 control instead of controls?

p735, line 13 analyses

p735, line 16 Niskin bottles

p735, line 28 standard deviation of 2 analyses? This is not meaningful.

p 736, line 15-17 "... the calculated CD139 CT data should be reduced by 4 $\mu\text{mol kg}^{-1}$." From this text, it is not clear whether you actually applied the correction or not. After reading the appendix, it is evident that the correction was applied. But I am very surprised about this. On the previous pages and in the appendices, you explain all that you've done to achieve a high quality and accuracy of the data, and this is very convincing indeed. But still you don't trust you own data! Why do you trust the other data more than your own? Table 5 says that the data you compare your data with originate from 1995. Could this explain some of the discrepancy? Anyway, if you do not put a lot of faith in your own data, you don't have to treat the data reduction in such a very extensive way in this paper, like for example in Tables 2 and 3 and associated text. This is much more than usually done in publications; most of this is usually published in cruise or data reports. You may also consider the new Copernicus journal Earth System Science Data.

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p739, line 10 delete 2nd the (typo)

p740, line 1 delete: (Lo Monaco, personal communication); because Lo Monaco is 2nd author of the paper.

p740, lines 20-22 Please add that the measured CFC concentration was zero for evidence (Table 4).

p742, line 20 delete: in

p742, line 25 principle instead of principal

p743, line 18 delete one single

p744, lines 2-3 Please rewrite this sentence. It is not clear to me.

p744, line 5 What does OCCAM stand for?

p744, line 17 What does NPZD stand for?

p745 section 7.1 It occurs to me that a lot of text is a duplication of the previous sections. The whole section should be restructured, or at least the obvious duplications should be removed.

p745, line 15 core of NADW

p745, line 16 delete: a maximum of

p746, lines 16-18 I don't understand this explanation. Please reformulate it.

p746, line 21 delete clear

p746, line 23, 24 Replace "On" with "For"

p746, line 26 Replace "On" with "In"

p747, lines 7-8 Any explanation for this discrepancy? Does it have influence on the results?

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p747, line 9 I suggest: which is less than the limit of detection ...

p748, line 10 delete: Surprisingly, (this is as if it is hard to believe it)

p749, lines 2-8 First, at line 2 "... carbon-based methods are invalid in the mixed layer ...". However, fig. 8 shows Cant values for those. This is confusing. If the method is not valid, it should not be used. Second, I did not understand what this paragraph wanted to say, e.g. why these perturbations are done. Please explain.

p749, line 12 delete: Curiously,

p749, lines 15-16 I am not sure what you want to say with this. Should the word "may" be deleted?

p750, lines 1-3 All methods are subject to some level of uncertainty, so that is no reason to not choose one of them. I assume that the authors do not mean to say that all methods are unreliable.

750, line 18 "are similar" or "are equal" instead of "coincide"?

p751, line 13 delete clear

p752, line 20 end: transient

p753, line 2 "... in that CFCs WOULD provide ..." ?

p755, lines 11-19 This is partly duplicating what has been discussed earlier in the paper. Please reduce text.

p756, lines 4-6 This is not completely clear. Please reformulate.

p756, lines 7-14 How was the inventory calculated? The average of 3 methods?

p756, line 15 delete: still

p756, line 16 "less than" instead of "within"?

Figure 3 could be improved. Increasing the size of the symbols may help, or less data

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points (taking every 2nd or 3rd).

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