Reply to Anonymous Referee #2:

We wish to thank the reviewer for his/her comments on this manuscript. Please note that we now denote the "KPH method" as the "Green function" or "GF" method. This is to maintain consistency with other recent publications where this terminology is used. Reviewer comments are in italic.

Page 10897 line 8 and 21: The reference to the work from Pérez et al. 2010 is cited as 2010b but it is the first time in the manuscript this author is cited. Also, the reference Pérez et al. 2010a never appears in the text but is listed in the References section. Please revise the References section and fix the above mistake.

We have corrected the reference.

Page 10899 lines10-11: How are ages calculated? Biases can be expected when CFCs are used to infer water mass ages, particularly in young waters (under 25 years approximately) (Hall et al. 2002 ; Matear et al. 2003). Is the KPH method susceptible of this bias too?

Hall, T. M., Haine, T. W. N., and Waugh, D. W.: Inferring the concentration of anthropogenic carbon in the ocean from tracers, Global Biogeochem. Cy., 16(4), 1131, doi:10.1029/2001GB001835, 2002.

Matear, R. J., Wong, C. S., and Xie, L.: Can CFCs be used to determine anthropogenic CO2, Global Biogeochem. Cy., 17(1), 1013, doi:10.1029/2001GB001415, 2003.

In the KPH/GF approach, multiple conservative (T, S, PO4*) and transient tracers (CFC11, CFC12, C14) are used to constrain the Green function that generically describes the transport of any passive conservative tracer from the mixed layer into the ocean interior. The Green function describes both advective and diffusive transport. CFC tracer ages are never computed or used (as for instance in the ΔC^* method). These, as the reviewer notes, only make sense in a purely advective flow. The KPH/GF method does not make such an assumption and, in so far as the observations allow, fully accounts for mixing in the ocean.

Page 10899 lines 27-30: Although this somewhat discussed later in the manuscript, it would help readers to follow the reasoning for your choices if you described briefly how constant climate, circulation and biological pump affect Cant estimates. This would be even better if you could add a brief sentence pinpointing where or how the different Cant methodologies here considered incorporate those assumptions.

We have modified the manuscript to describe briefly how the sea-surface temperature, circulation and biological pump affect ocean carbon uptake. The added text is attached below:

"These changes can affect the air-sea CO_2 flux and the carbon pumps, and therefore impact carbon storage in the ocean. For example, warmer sea-surface temperature causes increases in the partial pressure of CO_2 in the surface ocean and reduce ocean carbon uptake. Temperature changes also have significant impact on the growth rate of phytoplankton, which are key players in transporting carbon to the deep ocean. Changing oxygen concentrations, and circulation can affect nutrient cycling and distributions, which influence the efficiency of the biological pump. Moreover, some previous research has found that enriched CO_2 could affect ocean biological productivity (Palacios and Zimmerman, 2007;Riebesell et al., 2007). It is also likely that ocean circulation will change in the future as the climate continues to change. With a reduced meridional overturning circulation and convective mixing, the transport of CO_2 into the ocean interior may slow down and oceanic carbon uptake decreases. Currently, all the data-based estimates of anthropogenic carbon uptake assume constant climate and ocean circulation. Also, the biological pump is assumed to be constant and known (the ΔC^* method) (Gruber et al., 1996) or unimportant in the sequestration of anthropogenic carbon (the TTD and GF methods) (Waugh et al., 2006;Khatiwala et al., 2009). These assumptions may introduce significant errors in studies of future anthropogenic carbon uptake."

Page 10900 line 13: I don't know why you cite here the work from Álvarez et al. 2009, since you are considering global ocean studies and the work from Álvarez deals only with the Indian Ocean (although they do compare data-based methods and numerical models).

We agree with the reviewer. The reference is removed.

Section 2.3, second paragraph: Nothing is said about the CFC12-ages biases (see previous comment).

Please see our response above.

Section 2.4: It would make more sense to put this section after 2.1, before the data-based methods are introduced, but this is a somewhat subjective suggestion, so the authors can decide on this.

We agree with the reviewer and have modified the manuscript.

Page 10905 lines 14-16: At least some of the most important effects of CO2 induced climate change on Cant uptake should be listed, if not briefly described, like variations in surface alkalinity over time, etc.

We added several sentences to describe some impacts of climate change and increasing CO_2 on Cant uptake. The modified text is attached below:

"Oceanic carbon uptake can be affected by climate, ocean circulation, and chemical properties of seawater. Changing temperatures can influence both the uptake capacity for C_{ant} and the potential strength of the solubility pump (as reviewed by Friis, 2006). Changes in sea-surface temperature can also influence the distribution of phytoplankton and the efficiency of the biological pump. Elevated CO_2 level is altering the seawater carbon chemistry and causing ocean acidification, which also influence sea-surface pCO_2 and ocean carbon uptake."

Page 10908 line 28 (and other occurrences): Although mmol m-3 are international units, papers dealing with Cant often report concentrations in µmol kg-1.

We converted the unit of Cant from mmol m^{-3} to µmol kg^{-1}, by assuming a density of seawater as 1025 kg m^{-3}.

Fig. 4: It is a little confusing having the secondary axis in green when the line that uses it is plotted in blue. I suggest making these two black (or at least have the same colour).

We accept the suggestion and have made both in black color.