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Biogeosciences Discussions

Interactive comment on "Changes in column inventories of carbon and oxygen in the Atlantic Ocean" *by* T. Tanhua and R. F. Keeling

Anonymous Referee #1

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General comments:

This paper presents a simple method with few assumptions to compute the changes in the inventories of total inorganic carbon (CT) and dissolved oxygen (O2) in the Atlantic Ocean using the combined CARINA/GLODAP data set from surface to the 2000 meter depth horizon. These data sets are the most complete, quality controlled, interior ocean CT data set for the Atlantic Ocean. The rate of increase of CT is computed considering 1204 station pairs when two stations are at maximum distance of 200 km and 6 year at minimum time lapse. Deep waters are not included in the evaluation of the changes of the inventories, assuming very low contribution to these changes. In addition, an abiotic component of the CT inventory change (abio-CT) is also included, considering a fixed Redfield ratio. This abio-CT is comparable to the back calculation anthropogenic

CT computations.

This paper is a significant contribution because it gives us a different view of the rate of change of the CT in the Atlantic Ocean in combination with the changes in the ventilation rates, which are linked with the water mass formation. Calculations and results are consistent with previous studies which the authors frequently and adequately refer to. I recommend the publication of this article after addressing some small concerns described below:

My biggest concern is related with the low ratio C/-O2 of 0.67 given in the equation (1). The inverse ratio (Rc) -O2/C is 1.49, which is over the upper range of these ratios given in the literature. The typical value form Anderson and Sarmiento (1994) is of Rc=1.45, but it was computed with other data from the North Atlantic. For the Atlantic Ocean, Kortzinger et al. (2001) gave a rather low Rc of 1.34 +-0.06 in comparison with Anderson and Sarmiento (1994) and which is in agreement with the 'a=1.275' coefficient optimized by Touratier et al. (2007) in the TrOCA method. This coefficient also includes the effect of the mineralization of the organic matter in the alkalinity budget. Even the authors claim for a negligible time variation of the alkalinity, changes in the ventilation modify the contribution of the organic matter mineralization in the alkalinity budget. Altogether, it drives to a more consistent ratio of C/-O2 of about 0.785 which is about 20% higher than that propose by the authors. This ratio has an important role to extract the abio-CT component in the observed changes in the inventories of CT. Additionally, the authors should evaluate how the uncertainty in this ratio affects their results.

Detailed comments: Page 8045 line 19. Change "precipitation" by "formation". The CaCO3 formation in the sea is biologically mediated. It is not a spontaneous chemical formation. Page 8048 line 5 "..density." add: "at in situ T,P". Page 8048 line 13 Change "..information." by " ..contribution." Fig 7 to 9 are mistakenly referenced to Fig 5. Change to Fig 6. The Figures 3, 4, 8 and 9 are redundant considering the information given in table 1 and figures 5 and 10.

Anderson, L.A., Sarmiento, J.L. (1994) Redfield ratios of remineralization determined by nutrient data analysis. Global Biogeochemical Cycles 8, 65-80. Körtzinger, A., Hedges, J.I., Quay, P.D. (2001) Redfield ratios revisited: removing the biasing effect of anthropogenic CO2. Limnology & Oceanography 46, 964-970. Touratier, F., Azouzi, L. & Goyet, C. CFC-11, Δ14C and 3H tracers as a means to assess anthropogenic CO2 concentrations in the ocean. Tellus B 59, 318–325 (2007). doi:10.1111/j.1600-0889.2006.00247.x

Interactive comment on Biogeosciences Discuss., 9, 8039, 2012.