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Comment

Interactive comment on “Inorganic carbon time series at Ocean Weather Station M in the Norwegian Sea” by I. Skjelvan et al.

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Received and published: 12 September 2007

Referee Comment MS-NR: bgd-2007-0112 Version: 1 Received: 15 August 2007, 13:08 CET Title: Inorganic carbon time series at Ocean Weather Station M in the Norwegian Sea Author(s): I. Skjelvan, E. Falck, F. Rey, and S. Kringstad

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General comments: This manuscript studies the inorganic carbon increase in the Ocean Weather Station M (OWSM) in the Norwegian Sea, assessing one interesting scientific question, how and how much anthropogenic carbon (CANT) enters the ocean and the temporal variability in this uptake and accumulation. I consider these

topics within the scope of Biogeosciences. As an oceanographer I consider temporal series very difficult to maintain regarding funding and scientific effort. They need to be monitored over long periods of time to detect any change related to global change and predict any future changes and feedbacks within the Earth System. Series are maintained painstakingly by scientists who get some reward quite late. This manuscript presents some new and interesting inorganic carbon data in the OWSM, reaching remarkable and original conclusions about the temporal accumulation of CANT in the water column of the Norwegian Sea. These conclusions are in agreement with the recent idea that the North Atlantic is getting saturated in CANT, with a temporal increase in the water higher than in the atmosphere. The method used (eMLR) is not new but the calculations are clearly explained and reproducible. The manuscript is well structured and easy and clear to follow.

Specific comments:

Abstract: when giving the numbers for the annual rates write $\mu\text{mol kg}^{-1} \text{ yr}^{-1}$, in two cases the yr^{-1} is missing and it could be misleading. Add between brackets the annual atmospheric CO_2 increase, $2.1 \pm 0.2 \text{ uatm yr}^{-1}$ as in section 3.

Introduction:

- the first reference to Friss et al. (2005) could be given as e.g., there several publications dealing with CANT in the North Atlantic subpolar area for example also Alvarez et al (GBC 2003). Instead of intermediate waters, modal, intermediate and deep waters could be more appropriate.

- "due to a lack of oceanic reference data from the ...; (e.g. Wallace, 1995..etc.)". These are inorganic carbon data based methods, those referred as back-calculation techniques. To be fair the first to define these methods were Brewer, P., Direct observation of the oceanic CO_2 increase, *Geophys. Res. Lett.*, 5, 997-1000, 1978 & Chen, C.-T. A., and F. Millero, Gradual increase of oceanic CO_2 , *Nature*, 277, 205- 206, 1979.

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- where the water mass structure is commented: "Warm and saline Atlantic water from the Norwegian" paragraph. It might be illustrated by a T-S figure as Fig 6. This one can be moved backwards. I think fig 6 fits better here in the introduction, where the water mass structure can be described with the T-S and T-SiO₂ relationships.

Data:

- regarding the precision of the Ct measurements: Norwegian sea deep water is used as reference but later on the manuscript comments the temporal evolution of NSDW Ct values. Although small, 0.57 $\mu\text{mol kg}^{-1} \text{yr}^{-1}$, this increase introduces confusion in the previous statement. So please make clear how the precision is determined based on duplicate analysis but not on the NSDW interannual evolution.

- at the end of this section the relative accuracy of the TTO-NAS measurements is commented. It could be helpful to give a short overview of the Tanhua & Wallace (2005) analysis and how it applies to TTO-NAS leg 5. Seasonal and interannual variability:

- Fig 3 is a bit useless for the description in the second paragraph of this section. I would suggest merging fig 2 and 3, the new figure will have the same appearance as fig 2 for temperature, but including four plots, temperature, Ct, NO₃ and SiO₂. Instead of Ct I would suggest normalized Ct to 35 psu. The temporal variation of the mixed layer depth could be also introduced in the temperature plot.

- Table 1, normalized Ct to 35 psu values could be also shown to check that the main drawdown is due to biological activity.

- 5th paragraph in this section "In the transition zone between Atlantic water and arctic intermediate..." fig 3a is used as a reference but here is quite difficult to see anything.

- 6th parag., regarding fig 5 "the figure shows two things.. " those things could be clearly seen in a figure for Ct as fig 2 for temperature, as previously suggested.

- when annual rates are given please introduce the yr^{-1}

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Determining changes in CANT :

- first parag., here you refer to back-calculation methods, please specify because there are several other indirect methods to estimate CANT.

- why not using the TA data and comment them? Usually TA is directly related with SiO₂ in the North Atlantic. Is SiO₂ a better predictive parameter than TA?

Discussion:

- please give the error numbers for each estimation 2.6 uatm yr⁻¹, this will help the reader to check whether the differences are significant and conclusive.

- "— for a long time and are therefore close to saturated.." substitute saturated with saturation.

Sincerely

Marta Álvarez

Interactive comment on Biogeosciences Discuss., 4, 2929, 2007.

BGD

4, S1350–S1353, 2007

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