

## ***Interactive comment on “Nordic Seas total alkalinity data in CARINA” by A. Olsen***

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I would first of all like to thank the reviewer for taking time to carefully read the manuscript and for providing comments. This furnishes me with an excellent opportunity to improve the manuscript.

In the following I will go through the reviewer comments one – by –one. The comments are given in italics and my response in regular font. Each comment has been numbered by myself.

General comments/questions:

1. *Please add definition of total alkalinity or at least cite Dickson (1981).*

I will add the definition of total alkalinity to the paper, at what is now line 5, page 313.

2. *ALK is derived from titration data by various methods. Can I find the details of the*  
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### *applied methods in the metadata*

Yes, whenever this information was available it has been included in the metadata of each cruise, which can be accessed through the “CARINA cruise summary table and data” link at CDIAC. The metadata are also included in the header of the EXCHANGE file.

3. *First reference to Fig.4 before first reference to Fig.2 and Fig.3.*

Fig. 4 will be renamed to Fig. 2, and old Fig. 2 and Fig. 3, will become Fig. 3 and 4 in revision

### *Specific comments:*

4. *p.312, lines 18/19: ‘No adjustments have been applied to any of these values with the exception that all pH measurements were converted to the seawater pH scale at 25oC.’ Could you please explain how this was done (which other carbonate system parameter and which constants were used?).*

The correct thing to do here is to add a reference to the paper that deals with these issues, Velo et al. (2009), and this will be included in revision.

5. *p.314, line 19 “: : : Norway, the Barents Sea Opening, and Spitsbergen to the east” Here you may refer to Fig.1.*

Will add these names in Fig 1 and refer to that.

6. *p.314, lines 13/14 “raw data” are uncorrected TA values or titration data?*

By raw data I mean uncorrected TA values, this will be specified in revision.

7. *p.315, lines 7/8: ‘They must be interpreted with two effects in mind (1) natural spatial variability and (2) precision of measurements.’ This important information should be added to the legend of Fig. 2.*

Yes, the cruise offset and standard deviation shown in Fig. 2 is a result of natural

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spatial and temporal variations, and measurement bias. I will add this information to the caption.

8. *p.315, line 19 (typo): replace 'that' by 'than' after 'deeper'*

Will do

9. *p.316, lines 10-13: "The approach compares the good (i.e. WOCE flag=2) deep data (>1900m for the Nordic Seas (Olsen et al., 2009)), from two cruises that have stations in vicinity and determines the offset between the data within the crossover of the two cruises, and its standard deviation." Rewrite sentence. How do you define 'close-by stations'?*

10. *p.316, line 14: "The set of offsets are then inverted : : : " ???*

11. *p.316, line 19 The term "cnaX scripts" might need some short explanation.*

12. *p.316, line 25: "weighted least squares" How to set weights?*

These 4 comments address issues in the same section, which I will completely revise and specify. The following text will be used:

**3.2.1 Crossover and inversion** The consistency of the Nordic Seas ALK data was evaluated through a crossover and inversion analysis (Gouretski and Jancke, 2001; Johnson et al., 2001). This analysis was carried out using a very early version of the cnaX scripts (Tanhua et al., 2009b) with a high degree of user supervision. First all station pairs, from the two cruises to be analysed, within 300 km from each other were defined as crossover points. Thus two cruises may have several crossover points. Then, the crossovers of the cruise pair were partitioned into circular clusters using a k-means routine (Seber, 1984) and the cluster with the largest amount of stations in the most homogenous region was selected for further analysis. If the k-means routine failed to produce a satisfactory cluster, then the center and radius of the cluster was manually defined. As most campaigns in the Nordic Seas have been focusing on repeat occupations of the Greenland Sea, the clusters normally covered this region and had a radius

of between 150 and 250 km. After the clustering, each station in the cluster was interpolated onto 50 m depth intervals using a piecewise cubic hermite interpolation, and the average profile of each of the two cruises was determined along with its standard deviation. Using these, the weighted mean offset between the two cruises and its uncertainty (the weighted mean offset standard deviation) was computed following Johnson et al. (2001), using deep data (>1900 dbar for the Nordic Seas (Olsen et al., 2009)). These were used as input for the inversion analysis, which determined the corrections required to maximise the consistency among the cruises. The inversion followed the Weighted Least Squares (WLSQ) model of Johnson et al. (2001), where the offsets are weighted by their uncertainty. In this model crossover offsets with large uncertainty are less influential than crossover offsets with smaller uncertainty. The results of this semiautomated approach was virtually indistinguishable from the results derived using a more recent version of the cnaX scripts where the clustering was fully automated, and where up to 6 clusters with a maximum radius of 175 km was allowed for each cruise pair, described by Olsen et al (2009). The maps of the crossovers and clusters as well as the crossover offsets determined during this analysis are available at the CARINA website ([http://cdiac.ornl.gov/oceans/CARINA/Carina\\_inv.html](http://cdiac.ornl.gov/oceans/CARINA/Carina_inv.html)). Here I only present the corrections suggested by the WLSQ inversion of the crossover offsets in Fig. 2. No results were obtained for the 3 cruises 06MT19920701 (10), 58AA19940826 (118) and 58AA19961121 (120), but otherwise are there significant inconsistencies in the data. The ALK data from 18HU19820228 (36) appear  $12 \mu\text{mol kg}^{-1}$  too high, i.e. they should be adjusted down to increase consistency. . . . .” enter into line 27, page 316 of the Discussion paper

13. *p.321, line 4: citation of Tanhua et al., 2009: 2009a or 2009b or both?*

Should be 2009b, will be corrected.

14. *p.321 lines 14-15: exchange file ??? available on the web?*

The exchange files are available through the “CARINA cruise summary table and data”

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Interactive comment on Earth Syst. Sci. Data Discuss., 2, 309, 2009.

**ESSDD**

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