

Interactive comment on “Nordic Seas nutrients data in CARINA” by J. Olafsson and A. Olsen

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Received and published: 8 July 2010

Responses to Reviewer #1

We would like to thank the reviewer for taking time to assess the manuscript and for the comments, which have helped us clarify aspects of the manuscript. In the following we go through the comments one-by-one. The reviewer's comments are in italics and our responses in normal font.

General comment

The main problem with the paper is many of the adjustments suggested come from a subjective application of the crossover analysis results. More rigorous criteria should be applied if the adjustments are to be accepted with confidence, or it should be made more explicit that the crossover analysis is a tool and other tools are also necessary to

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adjust the data (maybe including expert subjectivity).

We appreciate the reviewer's thorough scrutiny and comments to improve this work. In our revision we will explain better the cases where subjective reasoning had to be applied. There are, in general, many instances in works of this kind where decisions have to be made by subjective reasoning. They can be classified as:

- (i) The objective tools provide no results
- (ii) The results of of objective tools are uncertain.

Class (ii) mainly occurs if the analysis is carried out in a region with large spatial variability, for instance in the Nordic Seas to North Atlantic overflow region, or if there are temporal changes, for instance the changes in silicate with time in the deep Greenland Sea.

Given this, a consistency analysis cannot and should no be a fully objective excercise, and the results of a crossover analysis cannot be blindly applied to the data. We took on this task on the basis of our experiences in working in the Nordic Seas, with data collection, chemical analysis and data interpretation. That is what the reviwier terms “expert subjectivity”, which we want to emphasize can never be above doubt.

Specific comments

C1 (Page 59 , line 10)

- What do the authors mean by "the differences in data density in the two regions enforced the use of different QC methods"

In essence that there were no possibilities for crossover comparisons due to scarcity of observations in the Arctic Ocean. We will add a note on this in our revised manuscript.

C2 (Page 59, line 28)

- It is good that 5 cruises were analyzed for both the Atlantic sector and the Nordic

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Seas sector. A little more should be written about how the analysis compare. For one cruise it is mentioned that the Nordic Sea qc resulted in an 'NC' designation due to lack of data, but the Atlantic qc resulted in a valid adjustment. Is this the case for all 5 cruises? If not how do the two analyses of each cruise compare? This is a good way to check if the entire CARINA dataset is internally consistent, or consistency is relative to the basin.

Out of the five overlap cruises, 3 had nutrients. The recommendations for these are consistent for the Atlantic group and the Nordic Seas group. The intention with these cruises was to ensure consistency across the regions. Alas, for all of these, geographical emphasis was either in one of the regions (either Atlantic or AMS regions), with some additional stations in the overflow area (which was included in both the ATL and AMS regions), or only in the overflow area. *A priori* we chose to assign a NC to cruises with data only in the overflow area, as the validity of the crossover analysis here can be questioned given the hydrographic variability in this area. None of the three overlap cruises had enough data in the more quiet areas of the Nordic Seas to provide a well founded basis for an adjustment. Whenever an adjustment could be established based on the analyses of the Atlantic group, their verdict was applied in the Nordic Seas as well, so that each cruise has only one set of adjustments in CARINA.

All in all we realise that is a shortcoming and will clarify this in our revised manuscript.

C3 (Page 63, line 19 and page 64, line 17)

- The authors state in at least two cases that adjustments seem reasonable (Cruise 58AA19940826 Nitrate, Cruise 74JC19960720 Nitrate). This is subjective and does not

inspire confidence in the analysis. Especially the later cruise, where the authors note

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that a 0.8 factor appears large, whereas 0.83 appears reasonable. The authors should state why subjective adjustments are necessary, other than the calculated adjustment didn't look right.

Given the time trends that has occurred in the deep Greenland Sea (see comment C5), we recognised that time trends may influence the crossover and inversion results. To evaluate this potential effect we always evaluated any adjustments to be applied by direct comparison with data from the cruises which were closest in time. We will explain the considerations with respect to these cruises in the revised manuscript.

C4 (Page 76, Fig. 4)

- Speaking subjectively, the corrections to cruise 58AA19940826 appear suspect in figure

4. While the deep values are in line with a later cruise, many middepth values appear to be adjusted too high.

The nitrate data from this cruise has quite large variability at all depths and consequently relatively many observations outside the $\pm 5\%$ limits. We will add remarks on this fact.

C5 (Page 66, line 6)

- The fact that deep silicate values are changing over time calls into question the validity of the crossover analysis in this area for all variables. These changes are not seasonal, but they are significant changes nonetheless. Crossover analysis assumes a consistency in values at deep levels. This should be addressed.

As mentioned in our remark to the general comment, time variations at depth is one of the reasons why adjustments calculated from a crossover and inversion analysis

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should not be blindly applied. This is exactly why we - for each adjustment- also made a special comparison of the cruise in question with subsequent and previous cruises. It was also the reason for not applying any adjustments to the silicate data, only removing obviously poor data.

We will make this clearer in the revised manuscript.

C6 (Page 67, line 8)

- How do the 'NC' cruises fit into the CARINA data set? They are not internally consistent

because they cannot be analyzed to find an adjustment factor. Should they be used for the purposes stated in the introduction?

The "NC" cruises have data from regions of greater hydrographic variability with time than we expect to be in the main Nordic basins, e.g. the Greenland Sea. Therefore we consider that our methods are not appropriate to produce correction factors. Nevertheless, these data may well be of good quality. We will explain this for the benefit of the data "users".

C7 (Page 68, line 20)

- The data access paragraph is confusing. The uncorrected cruises are shown to be available on the given website. But these are not the important files. These uncorrected

data are available through CCHDO and other sites. Please make it clear how to access and use the files with corrected data. Are all primary and secondary qc flags available with the corrected data? Are corrected and uncorrected data available in the corrected data files for comparison? Are the adjustment factors noted in the corrected data files?

We will revise this section and explain that there is a main CARINA

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home page at CDIAC (<http://cdiac.ornl.gov/oceans/CARINA/>), and that there is one address for the uncorrected data, and one address for corrected data (http://cdiac.ornl.gov/ftp/oceans/CARINA/CARINA_Database/CARINA.AMS.V1.2/).

The primary and secondary flags are in the corrected files. It was deemed unpractical to include the adjustment factors in the corrected files, however, these can easily be extracted from machine readable files that can be generated at http://carina.ifm-geomar.de/adjustments/select_cruises. This page is easily accessed from the CARINA homepage at CDIAC.

C8 (Page 62, line 22)

- two small grammar errors: page 8, line 22 "For phosphate following 6 cruises..." add "the" after phosphate.

This is corrected.

C9 Figure legend for Fig 4.

"been drawn at drawn at" remove second "drawn at"

This is corrected.

Interactive comment on Earth Syst. Sci. Data Discuss., 3, 55, 2010.