

Interactive comment on “Nordic Seas dissolved oxygen data in CARINA” by E. Falck and A. Olsen

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Reply to comments from anonymous reviewer 2.

We would like to thank the reviewer for the helpful comments. We have carefully considered each, and have made several changes to the original manuscript in response. In the following we go through the comments one-by-one. The reviewer comments are in italics and our response in normal font

It should be made clear why a separate paper is needed for Nordic Sea oxygen. The vague statement that there are different data distributions and basins are more or less separate in the Arctic is not enough. Conditions within the Nordic Seas themselves can be different as the ridge cruises attest. It is not so much the measured values that are important in crossover analysis, but the differences between measurements of values of ocean parameters at depths where they are deemed to be more or less constant.

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In an effort like CARINA, which requires commitment and many working hours from many scientists, it is very important that everybody who made significant contributions are recognised. The QC work was carried out by specialists in their field, Nordic Seas oxygen, Arctic Ocean data, Nordic Seas nutrients, Nordic Seas carbon data etc. In order to give each appropriate credit, it was decided early on that the best way to do it was to ensure that each got hers/his first authorship by preparing a series of articles instead of just one, hence the separate articles for the Arctic Ocean and Nordic Seas and the parameter specific articles for the Nordic Seas. However, we would also like to explicitly state that we worked as a group and that the results for one parameter were always interpreted in light of the results for the others.

Temperature and salinity changes in the Nordic Seas could and should be a valuable tool in assessing the differences between cruises in the oxygen data. The authors do use the salinity data to confirm their views on the oxygen data for one cruise. Why are the temp, sal, and o2 not analyzed and presented together for the Nordic Seas?

Please see reply to previous comment.

It is not acceptable to state as the authors do that it is almost certain that some CTD oxygen data were reported as Winkler titrated oxygen values. The difference between the two can be large, especially if the CTD oxygen sensor is not carefully calibrated. There are not that many cruises in the Nordic Seas CARINA data set. Many of them are by one or the other of the authors of this paper. Many of the rest are by Francisco Rey. In the text the authors note that they have communicated with F. Rey so information is being exchanged. Effort should be made to ensure that all the oxygen data are of known method.

We have now further investigated which methods were used for oxygen analyses at the different cruises and have added a column in Table 1 that provides information on whether the data are from Winkler analysis, or from CTD mounted sensors.

It is not clear from the method or recommendations why the given cruises were singled

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out to be considered further. It appears that some other cruises have a larger or similar adjustment. Why single out the given cruises? It would also be helpful if Figure 2 had some marking for the cruises that are mentioned for further consideration (maybe darken the grid lines for these cruises).

We have added text in section 3.2 that should clarify that the cruises were singled out considering the trend of decreasing oxygen. We have also marked these cruises in the new Fig. 3 (earlier Fig.2).

Accepting the authors cruise analysis, the data can be made consistent within the Nordic Seas. The authors mention that 5 of the given cruises extend into the Atlantic Ocean. Does crossover analysis with Atlantic Ocean cruises confirm the results given for the Nordic Seas? If they do not, can the full CARINA oxygen dataset be called internally consistent?

The plan was to make it consistent in all regions but this was not possible for oxygen because none of the cruises that occurred both in the Atlantic and in the Nordic Seas had enough data that allowed for a full consistency analysis in each region. However, the recommendations for these are the same in both regions. Some comments on this have been added at the end of section 4 of our revised manuscript

Please discuss the magnitude of the correction with regards to the error of measurement for the Winkler method. Is the correction larger than the error of measurement, and if not, why apply the corrections? It would be helpful to have the corrected and uncorrected data in different colors on figure 3.

The applied corrections were equal to or larger than the error of the Winkler method, this is now stated at the end of section 3.3.4 of our revised manuscript. We found that including also non-corrected data in Fig. 3 made the figure harder to read. The readers of this paper should be able to themselves assess the effect of the correction as both the non-corrected and corrected data are available at the CARINA home page, and any correction factors are listed in this paper.

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From the text, page 544, lines 20-21, the authors appear to attribute cruise 128 to Norway/UoB, but Table 1 assigns this cruise to Norway/IMR. If the cruise is from Norway/IMR does it still have equipment problems? Please elaborate on the equipment problems. Old equipment does not necessarily give bad results. For which cruises was the bad equipment employed? When was it replaced? Assuming the same equipment was used on earlier cruises, what can be said about the quality of the earlier cruise data?

Cruise 128 is Norway/UoB and it is now corrected in Table 1, thank you for this information. We have rewritten the part about the equipment problems, that part was not well written. We did speculate a lot what could be the reasons why these UoB cruises were different. What we meant with equipment problem was more a problem on how the standards were prepared (different scales used), not the actual equipment to do the titrations. We must confess that are still not certain if this is the reason. In the rewritten part we have therefore decided not to mention equipment problems but rather that they were adjusted to make them consistent with the other cruises from that period.

There should be some indication in the merged CARINA data files of which cruises have been corrected and by how much. Is there such indication?

There is no such indication in the file, and –although it would be useful- it is not possible to add such without a major change of code and file format, which would affect the whole CARINA database. However, a table that lists all adjustments implemented is available through the CARINA home page at CDIAC. It is also possible to export a csv formatted file with the adjustments from this page. This is now explicitly mentioned in section 5 of the revised manuscript.

The crossover results in figure 2 show 2 periods in the data, the pre-1995 data which has no clear pattern and the 1995-2003 data which show a consistent crossover correction above 1.0 with 4 anomalously < 1.0 correction cruises. The consistency of the data 1995 - 2003 allow for crossover corrections. The inconsistency of the data pre-

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1995 do not allow for correction, since there is no a priori set of correct cruises. Can the Nordic Seas CARINA data be called internally consistent if some are corrected and others quality cannot be judged? Can the crossover analysis even be valid if the baseline (depths > 1900 meters) is changing?

The apparent non-consistency of the pre-1995 data is caused by cruises no 130, 116, and 135. Two of these are from the Greenland - Scotland ridge region (and have been labelled NC) and for one (116) there is a perfectly plausible reason for the offset, namely the northern coverage, which gives greater influence of, Arctic deep waters. If these are neglected, the pre-1995 data appears as consistent as the 1995-2003 data. In the section on the consistency of the Nordic Seas data we clearly state that: "With the exception of the three ridge cruises" and given the trend (i.e. that the baseline is changing) that the data appear consistent to within ± 1

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