

Interactive comment on “Nordic Seas and Arctic Ocean CFC data in CARINA” by E. Jeansson et al.

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We would first like to thank Birgit Klein for carefully reading the manuscript and providing valuable comments. This resulted in improvements on the manuscript, which especially clarified the description of the method and the reasoning behind some of the adjustments. Below we will go through the comments, one by one. The comments are in italics and the response comments in normal font.

General comments: *My only major concern is that all information about the methodology used to perform the quality control is only available in the referenced literature. It would be nice if a few sentences could be added at the end of paragraph 4 which would explain the weighted least square inversion and its benefits and limitations.*

This is a good idea and we have now added this information in Section 4.

It is valuable to have a paragraph for each cruise explaining the findings for the respective CFC species. However it is difficult to understand the reasoning behind the subjective decisions taken on the individual correction factors. I am sure that a lot of discussion and interpretation went into the adjustments of the correction factors, but it might be good to add some information on the overall strategy and the subjective fine-tuning of the coefficients.

Indeed, the strategy is mentioned in Section 4, but not as clearly as supposed to, and this will be clarified in Section 4. As mentioned in this section the overall strategy is to compare the results from the inversions with the surface saturations. If an offset is seen for both these indicators, pointing in the same direction, and magnitude, an adjustment is applied. For the surface saturation several criteria are used, for example CFC-11 and CFC-12 concentrations generally show a relationship close to 2 for most of the water depths. Thus, as an example of our strategy: Since for most of the cruises the surface saturation of these two CFCs are consistent with each other, so if the inversion gives an offset for one of the two species, and the saturation support this offset, then an adjustment of that magnitude is applied. It is not always clear whether one of the CFCs is too low, or the other one too high, but when the mean depth profiles of the CFCs are compared with the mean values for all CARINA AMS cruises, both in the deep water and the surface layers, that question can be answered. However, some level of subjectivity is hard to avoid. A more difficult task is to find a clear motivation for any adjustment of CFC-113 and CCl_4 . We did, nevertheless, recommend some adjustment also of these CFCs, using the same general strategy as for CFC-11 and CFC-12. Hence we recommended an adjustment if the inversion and the surface saturation gave an offset in the same directions and magnitude, as long as the overall quality of the data were acceptable.

Specific comments: *Abstract: the abstract mentions the Southern Ocean as part of the Carina data base, which is not part of this paper. It might be confusing to readers to*

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make this reference in the abstract.

This is a good point. However, we have tried to have consistency among the rather long series of CARINA papers in this Special Issue, and since the Southern Ocean is included in the data set we would like to keep this. Nevertheless, we reorganized the Abstract since it included redundant information.

The sentence 'The Arctic Mediterranean Sea is comprised of the Arctic....' appears out of context and would be better connected in the next paragraph.

Agree; this will be changed.

Introduction: What is meant by 'the second part of the carina data base'?

As stated the CARINA database consist of two parts: (i) one with all the original, non-adjusted cruise data, including the data quality flag for each measurement; and (ii) one part where all cruise files have been merged into three datasets, recommended adjustments (as derived from secondary quality control) have been applied and missing oxygen and nutrients data have been interpolated if possible. It also contains calculated carbon parameters when applicable, e.g., if total dissolved inorganic carbon (TCO₂) and alkalinity (TA) were measured, pH was calculated from these.

The sentence 'Calculated and interpolated values have the quality flag 0.' appears out of context and can be deleted.

Agreed on.

5.6 Any ideas why only the surface levels of CFC-12 appear too high? What could go wrong analytically or could contaminate samples only in a certain layer?

We agree that this could seem, and might be, a bit strange. Problems in the surface layers can often be caused by co-eluted peaks, since the larger concentrations in the more well-ventilated layers may lead to insufficient separation, which makes the integrations more difficult. It is also possible that since the near surface waters are typically

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more biologically active, small peaks caused by trace amounts of compounds released by organisms in the upper waters might co-elute with the CFC peaks. We cannot say, however, if either of these were the actual problems for this cruise. It was only part of the data that had this issue, which might imply that some contamination (possibly from a small leak) caused the problems during part of the cruise. Such a contamination could then cause larger problems in the surface layers.

5.8 I have difficulties with the decision not to perform any adjustments for the CFC-11, CCl₄ data of this cruise while for other cruises the data have been flagged questionable when high corrections were suggested by the inversion. I understand that is near impossible to check the order of the adjustment without independent information, but it still seems to be a rather subjective decision.

The reason for not recommending any adjustment is the non-consistency in the identified offsets. Since an adjustment is applied for all data points for that parameter from that cruise, this can create an even bigger problem, and less consistency after the adjustment is applied. Thus one of the overall strategies for adjustments is to only recommend one if the different quality tools point in the same directions, and are of consistent magnitude. In this particular case, for CFC-11 first, the offset from the inversion and the surface saturation showed very different magnitudes. Hence, if we would apply an adjustment according to the inversion (20% downward) this would lead to a surface saturation of 80%, which is not consistent with any of the cruises the years close after 1991. The decision for CCl₄ is, however, more difficult, and is not made easier when comparing with the cruise one year later, when the surface saturation was the lowest of all Nordic Seas cruises

8. Arctic ocean Would there be any model simulation to help to determine the saturation levels for CFC-113 in the Arctic?

This could certainly be interesting. This is however beyond the scope of this article. In fact, we hope that the CARINA data base will stimulate such analysis, and that is why

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we are trying hard to document everything carefully, i.e. it would be easy for any user to apply other adjustments to the data, should the need arise.

9. cruise 06AQ199607, I have a similar comment as for 5.8. It is a bit troublesome to have some datasets corrected and leave others as they are, if the magnitude of the correction is too difficult to determine. This should somehow be reflected in the data set, maybe a new flag as to be invented.

The Arctic data certainly served a much bigger problem than the Nordic Seas due to the lack of cruises covering the same areas, since this did not allow any crossovers. Therefore it is possible that, for instance, the mentioned potential adjustment of 06AQ199607 should have been applied. However, since one of the main basis for the adjustments of CFC-11 or CFC-12 are the consistency between these two CFCs, and the surface saturation of the 1996 data were the same for the two, we recommended not to apply any adjustment. For the only Arctic cruise that was adjusted there was a disagreement in the surface saturation that mainly supported the adjustment. It is worth pointing out that the CARINA team always tried to err on the safe side, i.e. in case of doubt we would opt for not applying an adjustment. This way we hope that all applied adjustments are well justified.

Interactive comment on Earth Syst. Sci. Data Discuss., 2, 493, 2009.

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