

Interactive comment on “Measurements of the stable carbon isotope composition of dissolved inorganic carbon in the Northeastern Atlantic and Nordic Seas during summer 2012” by M. P. Humphreys et al.

M. P. Humphreys et al.

m.p.humphreys@soton.ac.uk

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We are grateful to the reviewer for their detailed comments, which have allowed us to make many improvements to the manuscript. Our responses to specific points can be found below. We hope that we have addressed the issues that were raised in sufficient detail.

“1. "precision" is used throughout to quantify the spread of repeated measurements. I think that "short term reproducibility" would be a more accurate descriptor.”

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- We have now clarified in the text that our quoted precision is equivalent to short-term reproducibility (i.e. repeatability), and have made it more explicit that it applies to samples measured consecutively within the same batch of analysis. We have adjusted the text of the Abstract to instead describe explicitly what we have calculated, and we have changed 'precision' to 'repeatability' or 'uncertainty' where appropriate throughout the manuscript.

- We had carefully defined what we mean by the word 'precision' in the text and how it has been calculated, so that equivalent statistics from different studies can be reliably identified, irrespective of the terminology used. The metric that we have calculated – the mean of the absolute differences between duplicate pairs, divided by $2/\sqrt{\pi}$ – is mathematically equivalent to the standard deviation of the results that would be obtained if a single sample was measured many times.

"2. I tried two different times and was unable to get to the data files at BODC. I'm not questioning that the data are there, just saying that I couldn't get the listed DOIs in the abstract to work. Since some of the data are already stored at CDIAC. The authors might consider additionally storing the cruise files there since so much of the global c13 collection already resides at CDIAC."

- We re-tested the BODC DOIs and were able to access the data. On the BODC page that the DOIs link to, there is a 'Download' button directly below the large dataset title and above the metadata table. This Download button leads to a .zip file containing the datasets. At your recommendation, we have made contact with CDIAC and begun the submission process.

"3. Unless I missed it, no mention is made of the 3 other cruises in the region that include c13 data (e.g. 58JH19920712, 58AA20010527, 64TR19900417)"

- We have added nearby historical cruises to Figure 1 and performed a basic cross-over analysis using their data – see response to your point 4.

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“4. Comparison of these new data to the older data isn’t required but would be interesting.”

- We have now performed a simple cross-over analysis with $\delta^{13}\text{CDIC}$ data from the Schmittner et al. (2013) compilation to test the consistency; the method is described in Section 4.4 and the results in Section 5.4.1 of the revised manuscript. These revealed negligible offsets at depths greater than 1500 m for our data compared with nearby stations from the OACES93 and 58GS20030922 cruises. Metadata for 58AA20010527 appear to be erroneous in the compilation and we were unable to find any $\delta^{13}\text{CDIC}$ data from this cruise from another source. 64TR19900417 was identified as having ‘obviously bad data’ by Schmittner et al. (2013) and as such is excluded from their dataset and therefore our analysis.

“5. These data are especially important because they help to fill a gap left by the international WOCE/CLIVAR/GO-SHIP sampling program. This is worth mention.”

- We have now mentioned this in Section 1.

“6. I had quite a bit of difficulty tracking down the cruise reports. Direct links (URL) to the documents would be useful.”

- We have added URLs to the cruise reports in Section 2.1.

“7. Tens of thousands of c^{13} measurements have been made as part of the programs mentioned in #5. How do the methods used here differ? Specifically at issue would be the different vials since they seemed to matter.”

- Although having different container types did increase the mean of the absolute differences between duplicate pairs, this was not consistent in direction (e.g. vials did not typically return higher values than bottles); we did not find a systematic offset between the bottles and the vials (Section 3.5.3). We have performed a basic cross-over analysis to evaluate the accuracy of our measurements relative to the historical dataset – see response to your point 4.

“8. "overgassing" is a new term for me. Does it mean what it sounds like? (i.e. flushing the headspace).”

- Your interpretation of ‘overgassing’ is correct. This is explicitly described in Section 3 (Section 3.2 of the revised manuscript).

“9. How can a sample bottle have 1ml of headspace AND be "completely full of seawater"?”

- Headspace depended on the container; ‘bottles and ‘vials’ refer to different container types, and we have made this more explicit. Bottles had 1 ml of headspace, vials had no headspace, as described in Section 2.2.

“10. Some results are described as "erroneous". Wouldn't "anomalous" be a better word?”

- We agree and have changed the wording to ‘anomalous’ throughout.

“11. Under 4.1.4 constants "x, y and z" are mentioned, but there is no z”

- This was a typo in the equation; we have added the z term.

“12. "SD" is used without definition. It's almost certainly standard deviation, but some use standard error, so it should be explicitly defined.”

- We have now defined SD as standard deviation at its first appearance (Section 4.2).

“13. I could not find the data at CDIAC. Provide URL”

- The auxiliary data for D379 can be directly accessed via the DOI on the Hartman et al. (2014) citation. We have added a URL to the text as well. The auxiliary data for JR271 are in the process of being submitted to CDIAC, along with our $\delta^{13}\text{CDIC}$ measurements.

“14. In 5.1, any idea(s) what caused the fliers?”

- Most of these fliers were from very low peak areas that were caused by temporary

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blockages in the instrument tubes. We have added a note of this in the section.

“15. Section 5.2. I had difficulty following this procedure. Try a re-write or equation or schematic - something to clarify.”

- We initially test the calibration by applying it to the data it was generated from. If you use a linear calibration this gives very bad results. We have used a non-linear calibration instead, which fixes this problem. We have re-worded this section and added histograms of the linearly-calibrated standards to Figure 5.

“16. In section 5.3 I'm not sure the comparisons are the "best". The comparison to Olsen is good. NOSAMS, is a factory - they do very good work, but a small operation should be able to equal or surpass their quality. More importantly, no mention/comparison is made to P. Quay's results/reproducibility. So far as I know, his data are generally considered to be the highest precision available.”

- We have added a comparison to P. Quay's reproducibility results to Section 5.3.

“17. In 5.3 the differences in results due to container type are described as "small". While technically true, the difference is also a factor of 2. I doubt that the stated result (.168) is valid for 3 sig.digits, but a factor of 2 probably is significant?”

- We recognise that our use of the word 'small' in this context as subjective and so have removed it.

“18. In Fig 3 the "MAB", "NA" and "CA" are used without definition”

- Despite the capital letters, MAB, NA and CA are the actual names of the standards and not abbreviations/acronyms. We have added a reference to Table 2 to these figures to aid comprehension here.

“19. The colored dots are OK in Fig 6, but useless (to my eye) in Figure 7. Why not make a normal section plot??”

- We have replaced the figure with an interpolated filled contour plot. We have also

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similarly updated Figure 6, to improve clarity especially in the northernmost part where there are many data points close together.

“20. One last pass of grammatical/sentence structure editing is needed.”

- We have looked through and have hopefully fixed any outstanding issues.

References

Hartman, S., Griffiths, A. and Achterberg, E.: Discrete Carbon Dioxide Data Obtained During the R/V Discovery EEL_2012_D379 Cruise Along Extended Ellett Line, Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, TN, USA, doi:10.3334/CDIAC/OTG.CLIVAR_EEL_2012_D379, 2014.

Schmittner, A., Gruber, N., Mix, A. C., Key, R. M., Tagliabue, A. and Westberry, T. K.: Biology and air–sea gas exchange controls on the distribution of carbon isotope ratios ($\delta^{13}\text{C}$) in the ocean, *Biogeosciences*, 10(9), 5793–5816, doi:10.5194/bg-10-5793-2013, 2013.

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