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Biogeosciences Discussions

Interactive comment on "Calcium carbonate saturation in the surface water of the Arctic Ocean: undersaturation in freshwater influenced shelves" *by* M. Chierici and A. Fransson

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In this manuscript Chierici and Fransson present a very interesting dataset, which provides a nice overview of the carbon chemistry of along the Arctic Shelf areas from Cape Farewell, through the Northwest Passage and across the Bering Strait. I recommend publication after consideration of the following comments.

1.Most of the data are presented in the form of color coded maps (Figs. 2, 5, 6, & 7). These are at times hard to read, in particular for color-blind people (approximately 10% of the male population). I recommend that all the surface data are plotted in same way as on figure 10, i.e. x-y plots with longitude on the x-axis. The figures could be stacked

on one x-axis. This would also enable faster comparison of variations of the different parameters and would save space.

2.Bering Strait figures (Figs. 3, 8, and 9). Please include bathymetry. Also, resolution (in particular for Figs. 8 and 9) is poor and should be improved before publication.

3.Considering the carbon system calculations. I miss a better evaluation of the errors. There are several sub-issues:

(i) The authors quite Dickson et al. (2008) for error in calculated carbonate concentration (2%). The link to the EPOCA website does not work, please find a persistent reference or evaluate the error yourself (methods for evaluation of carbon system calculation errors can be found for instance in Nondal et al (2009) and references therein.

(ii) The error in the omega values as well as calculated DIC (Fig. 5b) should also be provided.

(iii) I cannot see that Mojica Prieto and Millero (2002) explicitly state that the constants of Roy et al (1993, 1994) are better for cold water than the constants for Merbach et al. (1973). Rather they state that ". . .these results indicate that the measurements of . . ... and Roy et al (1993) are reliable for artificial seawater, but are not appropriate for real seawater". Elsewhere in the oceans, carbon system overdetermination studies have shown that the refitted Merbach constants are the most accurate (e.g. Wanninkhof et al., 1999). Regardless, this issue appears nowhere near solved for the Arctic. I think that the authors should provide an evaluation of the effects of using a different set of constants – in particular does the occurance of calcite and aragonite undersaturation depend on the set of constants used? Moreover – obviously Chierici and Fransson have access to fCO2 data from the same cruise (as published by Fransson et al. 2009) and should carry out an overdetermination of the carbon system- this may allow them to identify the best set of constants for this area.

4.The equations for Bering Strait pH and At carries uncertainty (they have a root mean

square error). This should be provided and should be propagated to the DIC and omega values presented in Figs 8. and 9.

5.For Fig. 10. Please explain better- right at the start- how the At:DIC relationship can be used to diagnose how the listed processes have affected the omega values.

6.The sampling date is not included in Table 1 (as stated at page 4969, line 26)

REFERENCES not appearing the paper.

Merbach, C. et al., Measurement of the apparent dissociation constants of carbonic acid in seawater at atmospheric pressure, Limnology and Oceanography, 18, 897-907.

Nondal, G. et al., Optimal evaluation of the surface ocean CO2 system in the northern North Atlantic using data from voluntary observing ships, Limology and Oceanography: Methods, 7, 109-118, 2009.

Wanninkhof, R. et al., The optimal carbonate dissociation constants for determining surface water pCO2 from alkalinity and total inorganic carbon, Marine Chemistry, 65, 291-301.

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