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

A. Olsen (Referee)

are.olsen@gfi.uib.no

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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 quote Dickson et al. (2008) for error in calculated carbonate concen-
tration (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 cal-
culation 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 occurrence 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.


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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