

Interactive comment on “Seasonal calcium carbonate undersaturation in shelf waters of the Western Arctic Ocean; how biological processes exacerbate the impact of ocean acidification” by N. R. Bates et al.

Anonymous Referee #1

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General comments: This study by Bates et al. address a very topical issue, ocean acidification, and focuses on the region first impacted, the cold Arctic Ocean. It is largely well written and summarizes recent publications by some of the authors and add data from three new cruises to the picture. The new data does not add any substantial knowledge relative to earlier publications. However, some new approaches in illustrating the changes of the carbon system parameters, and its impact on the solubility of calcium carbonate, are included.

Unfortunately these new approaches have some fundamental errors. The first ones

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are obvious when looking at figure 7. Dissolution/precipitation of calcium carbonate will change TA with twice the DIC change, not equally as it looks like in the arrow of the figure. This has a direct effect on the impact on omega. Next the arrow in sea ice melt increases DIC, and decreases TA, not consistent with the text of the manuscript (line 15, page 14269). Finally it is not possible to represent omega in a TA-DIC plot in a situation when salinity change, as this also will cause a change in calcium ion concentration. As it now is drawn it assumes a constant calcium ion concentration, which obviously is not the case in a region where salinity changes by up to ~20%. The change in calcium ion concentration is something that is lacking in the discussion of the whole manuscript.

In figure 8 it should be stressed that the change due to anthropogenic emissions of CO₂ is from preindustrial to the present situation, while the others are only for a seasonal change. In the text it is argued that the magnitude of some of the physical-biochemical processes also might have changed as a result of anthropogenic effects (sea ice cover, surface water temperature, etc.). These facts needs to be spelled out in the figure legend in order for the reader not to misinterpret the message. Finally the line representing the effect of summer heating is drawn in the wrong direction. It should be an increase in omega not a decrease, see the text (last line page 14268) where it is correct. Unfortunately the error is still in the equation (line 21, page 14269).

Technical aspects: There also are a number of editorial errors, like missing references in the list, missing labeling of figures (2 & 5), no reference to figure 1 in the text, no identification of the term "Siberian Sea Current (page 14263). Throughout the text there are also expressions like "relatively" and "higher" without stating compared to what, as well as "appears" without any reference what the basis is. A scientific paper needs to be more stringent. One of the more amusing mistakes is that there is a reference to the late 2000s on page 1427. That far does not even modelers go!