

## ***Interactive comment on “Inorganic Carbon Cycling and Biogeochemical Processes in an Arctic Inland Sea (Hudson Bay)” by William J. Burt et al.***

**L. W. Cooper (Referee)**

cooper@umces.edu

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This is a short descriptive paper describing the results of sampling in 2010 for total alkalinity and inorganic carbon, including the isotopic composition of DIC in Hudson Bay, with the use of oxygen isotopes as tool to evaluate runoff and melted sea ice contributions. It follows related studies by Azetsu-Scott et al. 2014 and Granskog et al. 2011, among others in the same region, so it is of value both as a point in a time-series for possible changes in the inorganic carbon system and to fill in the geographical gap for arctic data coverage within Hudson Bay. Because of the limited one time nature of the sampling, it is not clear whether changes can be readily determined, but the scope of the paper seems appropriate for the descriptive nature of the data set presented. I recommend a few improvements and pose some questions below for the authors to consider.

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Figure 1. The map could be improved. It is plotted in a Mercator projection, which is not a polar projection, so distances are distorted, and it is not clear where the latitude and longitude markers are. The shaded areas denoting sea ice are also rather awkwardly illustrated and hard to see, such as the northern straits connecting to Hudson Bay. I think this could be easily re-done in a standard GIS program in a more appropriate polar map projection with better labeling. The map figure in the Granskog et al. 2011 paper that is referenced in the text, while still plotted in Mercator projection, is a much more attractive example of how to display the geographical information that is important to the data presentation.

Figure 2, and 6c. Why isn't the  $\delta^{13}\text{C}$ -DIC data coverage more complete? Again, as with Figure 1, the quality of these figures is only fair, and it could be improved by exporting out of Ocean Data View into a more robust graphics program, with appropriate labeling undertaken such as of the Nelson River (simply outlined in blue now). Also one of the software license requirements of Ocean Data View is to cite the software developers. "ODV may be used free of charge for non-commercial, non-military research and teaching purposes. If used in scientific papers, reports or posters, ODV must be referenced as follows: Schlitzer, R., Ocean Data View, odv.awi.de, 2015." Please add to the references or acknowledgements.

Figure 5 caption. The discrepancy with rosette bottle salinities can be caused by inadequate flushing time before bottles are closed at depth. Is the flushing time used by the CTD operator known?

Table 1. The one-time sampling of these rivers is a limitation for this type of study that depends upon integrated and flux weighted data. The table could be expanded and include references to any other available data for these rivers.

Page 4, line 25. Friedman and O'Neill (not Friedman et al. 1977) is really not a very appropriate reference for this method of determining oxygen isotopes. It describes the isotopic fractionation factors associated with equilibration of water with carbon dioxide,

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but it is not really a description of the method. Epstein and Mayeda, 1953 in *Geochemica et Cosmochimica Acta* is the original reference for the oxygen isotope equilibration methodology, but the methods used today that involve flushing of sample vials with small quantities of carbon dioxide in otherwise pure helium are not available as details in these two publications of Epstein and Mayeda and Friedman and O'Neill, which were written well before the technology for continuous flow mass spectrometry was developed. Again, the Granskog et al 2011 paper provides a more accurate description of the methods used. I would start with that.

Page 5, second paragraph. It might be worthwhile to reference Smith et al. 2015 (<http://dx.doi.org/10.1080/07011784.2014.9855120>) either here and/or in the discussion, as they have added a significant amount of isotopic data for the Nelson River basin.

Page 5, line 17. I understand that a freshwater end-member isotopic value of -14‰ for Hudson Bay as a whole is used, but the more southern rivers such as the Nelson are clearly more enriched in heavy isotopes and this creates an inaccurate result for the sea ice melt contribution (Figure 2e). I am not sure this can be resolved easily but maybe in the future (with more extensive sampling) it would make more sense to divide Hudson Bay into areas influenced by northern rivers versus James Bay and the Nelson River and try to resolve more than one mixing process with runoff and melted sea ice.

Page 6, line 15-20. I am not sure why nutrient data, such as nitrate-phosphate ratios, and silicate are not also used to verify the presence of Pacific origin water; this would seem to be much more certain than TA, where multiple freshwater sources are present, although the salinity of 33.1 shown on Figure 3a seems convincing enough for the upper Arctic halocline that is characteristic of Pacific-origin water.

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