

Interactive comment on “Inorganic carbon fluxes on the Mackenzie Shelf of the Beaufort Sea” by Jacoba Mol et al.

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The authors wish to thank referee #3 for their insightful comments and helpful revisions of this manuscript. The authors agree for the most part with all of the revisions that have been suggested. Each of the referee's comments are individually addressed below, with the referee's comment listed first and subsequently responded to.

1) It must be better to list major findings and quantified numbers in the abstract.

See above response to reviewer 2's comment on abstract and conclusion (#6).

2) P4L27, UHL water has a salinity range, it's usually defined with salinities centered at $S=33.1$.

C1

This should be changed to “a salinity range centered at 33.1”.

3) P4L28, Atlantic water is characterized by a temperature maximum while the salinity is not the largest in the salinity depth profile. Please define these water masses either by ranges of salinity, temperature, and or potential density, as well as depth range.

The definitions of these water masses can be altered to read “The upper halocline layer (UHL) originates in the Pacific Ocean and lies below the PML. It covers a depth range of ~ 25 to 150 m, a salinity range of 31.6 to 34.6 and is characterized by a temperature minimum. Below the UHL is the Atlantic layer (ATL), covering the depths below 150 m, with a salinity range of 34.6 to 34.9.

4) P4L30, have you considered the influence of denitrification on the conservation of TA? And how much error it will introduce into your calculation?

This hasn't been quantified for the water mass calculations. One reason for this is that the water mass fractions are only used as an identification tool and so any error from changing values of TA will not have a large impact on the outcome of the results.

5) “p” in pCO_2 is italic.

The author will edit this point throughout the article.

6) P5L15, where are the values of DIC from for these endmembers in Table 1?

P5L20 add “The value of DIC for MW is taken from Shadwick et al. (2011b).” P5L20 “the values of TA, DIC and salinity for SIM are taken from Lansard et al. (2012). Values of $\delta^{18}O$, TA and DIC for the UHL are the average. . .”

Also need to change citation on P7L30, “These values are close to the Mackenzie River properties published in Shadwick et al. (2011b) and Cooper et al. (2008) used for the water mass decomposition. . .”

7) P6L20, could you please list the uncertainties?

C2

See response to reviewer 2's fifth specific comment.

8) P6L30, please mark "Amundsen Gulf" in fig. 1. Not all readers know where it is.

As mentioned in the comments to reviewer 1, this label will be added to Figure 1.

9) P7L28, for fMW and fSIM, "MW" and "SIM" should be subscripted.

Making the MW and SIM subscripted would have to be altered throughout the paper and figures for MW, SIM, ATL and UHL.

10) P7L34, "TA is conservative" is not really true. Given the authors discuss biological production, photosynthesis/respiration will change TA. In addition, denitrification also changes TA and pH.

TA does change with biological activity, but not nearly as greatly as DIC. The sentence in question could be altered to better display that as something like, "TA is near conservative while DIC. . ."

11) P9L14, use period "break; it did".

Can be changed to "beyond the shelf break. It did not intrude. . ."

12) P9L21, how long the wind should sustain to introduce upwelling or upwell subsurface water into the surface water on the Mackenzie shelf?

This is a question that in order to give a real response I believe would require a more in depth look at the physics on the shelf and possibly running a model with directed wind. We can make an estimate of how long by looking at the hydrodynamic velocity through a time when wind was causing upwelling and the size of the shelf.

13) P11L32, Fig.10 is wrong.

Should be changed to Fig. 9.

14) P12L18, where is the flux of TA?

C3

If this comment is in reference to Fig 10, which displays the DIC flux, if the TA flux is added onto this figure, it looks basically identical to the line of the DIC flux. Because of the magnitude of the fluxes, the lines do not differ enough to display them in this way for the UHL layer, which is the area of interest.

15) P13L18, how the bottom water impact the air-sea exchange? Is it more related to wind speed or the air-sea pCO₂ difference?

The bottom water here impacts the air-sea exchange because of the air-sea pCO₂ difference. This sentence could be changed to reflect that more closely: "... may impact the air-sea exchange of CO₂ due to the large air-sea pCO₂ difference including. . ."

16) P14L7, what's the importance of H⁺ flux? How is it related to DIC flux? Linear or exponential?

The H⁺ flux in this case is displaying the change in pH conditions along the shelf. It is positively related to the DIC flux across the shelf. The relationship is linear in this case, but is complicated by TA concentrations in certain areas.

17) P14, p4.4, how low the aragonite saturation will impact the calcifier? And how low the saturation you observed? list the numbers.

P14L25: Can state that the aragonite saturation in this water mass reaches values as low as 0.83. Varying impacts of these levels of aragonite saturation have been found within different communities and with different organisms. Could insert this type of a statement with reference to Ries et al., 2011 paper.

18) Fig.11, list stations 428 and 435.

This can be added to the figure to aid in station location.

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C4