

Interactive comment on “Glider-Based Observations of CO₂ in the Labrador Sea” by Nicolai von Oppeln-Bronikowski et al.

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This is the Author's response to Reviewer 1 Comments

General Comments:

1) I am not convinced that the CO₂-CV sensor is ideal for validating data against (and is not necessarily the model referred to in the reference to Jiang et al., 2014).

- We will correct the reference and state that it is not the PRO-CV rather the technology that is referenced.

2) Ideally the tank comparisons would also involve validation with state-of-the-art equilibrator systems. Attention should also be paid to errors in CO₂ estimates arising from C1

indirect CO₂ estimates (using CO₂sys).

- We will try to consider this in future experiment designs involving this sensor. DIC and TA were estimated in the lab and pCO₂ was calculated from CO₂Calc (Robbins et al., 2010). TA and DIC are estimated from coulometry (Johnson et al., 1993) and potentiometric titration (Mintrop et al., 2000). In the calculation they used the CO₂ equilibrium constants from (Mehrbach et al. 1973 refit. by Dickson and Millero 1987), total boron constant (Lee et al., 2010), and KHSO₄ constants (Dickson 1990). I regret the error in the original text which was oversight. The samples were analyzed in the lab. of Fisheries and Oceans Canada and at the moment they are not setup to measure the uncertainty of the pCO₂ estimate in CO₂calc from DIC and TA. Reported uncertainty in the procedure for DIC and TA were 3 and 4 μmol/kg respectively. Unfortunately CO₂calc is not available to me. From repeating the calculations with the same settings mentioned above and using CO₂sys, using the uncertainty in TA and DIC, we arrive at an uncertainty of 4.48 μatm for the lab-based pCO₂ estimates mentioned in the text.

3) The paper could also be improved with increased use of tables and attention to detail on the figures (eg: colour legend when required).

- Where appropriate and as pointed out by you in below specific comments, these changes have been implemented. Thank you so much. We modified or slightly adjusted Figures 1- 10 with respect to specific comments. We will add a summary table of data mentioned in the text or in the figures near Figure 3 and Figure 4 based on additional feedback from Reviewer 2.

Editorial and Other Specific Comments

L53. May not be necessary to spell out CTD but it is an acronym?

- Noted. In this case given the journal and audience it probably is safe to leave as an acronym.

L124. Is CO₂ accuracy really 2-75µatm? It seems a large range (and may depend on the concentration?)

- Accuracy range is the results so far available in the literature as described in Atamanchuk et al 2014, 2015. The large range, points (in our opinion) to a large range in foil performance under ambient conditions also the range in manufactured foils. Some work better than others... Temperature and concentration gradients definitely have an impact. Large gradients (see our results) seem to produce more reliably strong signals in the sensor than small gradients. Absolute accuracy is pretty low and foil chemistry was not designed for that. It is not sensitive to absolute concentrations but the change of pH which then induces a fluorescent response of the foil chemistry.

L130. Would benefit from putting the dominant current flow onto the map perhaps?

- Will try to add arrows. If it is too busy we may omit them as they are not as important to the main story of the paper.

L141. Profile of temperature to capture this?

- We will add the average T-S structure from Trinity Bay into the paper

L158. You present T, S, O₂ offsets – what about the other variables? A table would help Fig3. Put T and S on the axis (titles and units)

- Summary tables for CO₂ conditioning offsets and improvement to Figure 3 will be implemented in the next revision.

C3

L239. Could tabulate some of the response time findings Fig5. Caption could be clearer on what VITALS is so the figure can stand alone

- Figure 4 and 5 will be modified including also the feedback from Reviewer 2 and a Table will be used to summarize results from Figure 4.

L272. Compared 'to' O₂.. Fig6 and Fig7. You switch to DO₂ without explanation or reference elsewhere in the text and use just O₂ in the caption. Also colour bars/legend required

- Will change DO₂ to just O₂ to avoid confusion. Will double check if legend placement/colorbar can be improved in the next revision.

All editorial comments/changes below will be addressed in the next revision of the paper.

L3. Remove repeat of 'capable'

L43. Use carbon sink (not carbon sinks)

L44. Plural gliders to remove

L56. 'Periods'

L59. Insert 'a' (from a..)

L87. Fall of 2016

L91. VITALS is an acronym? Fig1 caption requires more detail

L102. Clarify that 4797 is the CO₂ optode

L106. Selected stop depths

L108. Validate rather than calibrate

C4

L114. Would be good to know precision too?

L136. Use cold instead of frigid

L195. Remove duplicate of 'the'

L270. To a depth of large change in O₂ and CO₂?

L318. Change 'another' to 'from each other'

L327 add year to the Chatfield reference(1998)

L337. Its OK to switch to T and O₂ but be consistent (in full again on L334)

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