

Interactive comment on “Intense $p\text{CO}_2$ and $[\text{O}_2]$ Oscillations in a Mussel-Seagrass Habitat: Implications for Calcification” by Vincent Saderne et al.

Anonymous Referee #2

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Summary: This study reports $p\text{CO}_2$, O_2 , salinity, and temperature sensor time-series in August and September 2013 in Kiel Bay. Sensors were deployed in seagrass mussel habitat. Using discrete samples of TA, DIC, phosphate, and silicate, the authors calculate calcite and aragonite saturation states. The authors placed a lot of emphasis on contributions of organic TA to these calculations, despite the fact that they concluded that the contribution was low. In the Discussion, the authors briefly relate the conditions to regional physiological tolerance of *Mytilus edulis*.

General comments

Overall, I think that the time-series data is of publishable quality, pending additional

C1

reporting of accuracy and uncertainty associated with the carbonate system calculations (by incorporating the uncertainty of the measurements - this can be done in the R Seacarb package, see comments below). These kind of data are necessary, however, the time-series too short to fully describe what organisms experience in this habitat. My main concerns relate to how the data are used to generate a manuscript:

(1) There is no question or hypothesis that is being tested for the given (and incorrect) statistical approach. Comparison of two months is an odd approach for high-frequency time-series of two months. Why are August and September being compared so distinctively? Is there some important biological process that occurs during these months? It's time-series data, and the data are not independent (required for the Mann-Whitney U test). The authors do not spend much time on the one interesting event in this time-series: TA and declined in early August, altering the TA-salinity relationship.

(2) The emphasis on TAorg appears very small, yet such big emphasis is placed on trying to identify TAorg contributions. The authors do not adhere to one method in terms of assessing TAorg in their study (see details below). This is confusing and, as currently presented, makes it seem like the authors cannot decide how to integrate TAorg in their study.

As presented, this dataset makes for a weak standalone paper. It seems that this dataset should be paired with a biological study on the mussels (as indicated by the title). I assume, given the motivation for measurements at this site, that this is underway. A sensor-biology pairing will be a much more powerful than a stand-alone chemistry and biology paper.

Specific comments on TAorganic

If TAorg contribution is low in this region (as they authors conclude, L300-304), the authors should just state that. If there is no citation, an appendix could be added explaining why. TAorg was not the focus of this study, it's deemed not important, yet it takes up a large portion of the manuscript (but ignored in the Discussion). The authors

C2

present various estimates for TAorg and do not adhere to one approach for use of TAorg in their dataset. Instead, they just present all options. If I somehow misunderstood the intent, I urge the authors to greatly clarify their intention and relevance of doing so.

L187: I don't understand the relevance of the modeling approach in the context of the small spatial context of this study. The data from this study already show the increasing offset with increasing sensor pCO₂.

In Fig. 2, I don't understand why one dataset from GEOMAR pier contains no TAorg dependency and the other one does (grey circles vs dark grey diamonds). Are the TA fraction results from Hiebenthal et al? If the TAorg contribution at GEOMAR varies, that is further justification to not blindly apply the TAorg contribution from GEOMAR to the current study site.

L205-213: I don't understand why the authors are not confident in their own bottle sample data and instead choose to use data from a different site from a different year to estimate the contribution of TAorg to TA during their study. Surely a spatio-temporal mismatch error at the study site in 2013 would be smaller than the error introduced by using data from GEOMAR in 2015.

L209: How was the 0.48% error calculated (it is also different from what is reported in Fig. 2 legend. Is this the same calculation)? Is the sensor data from Fig. 2 grey circles all from 2013? This section, as well as the Fig. 2 legend is confusing.

3.1: Why is the salinity derived TA time-series being reported on after all the focus on TAorg contributions?

3.3: Why are timeseries calculated using TAinorg but then analyzed with TAorg of 8 and 30 in Table 1? Why and when is TAorg 19 used in Fig 7 and where does that number come from?

4. Discussion: no mention of TAorg.

Specific comments:

C3

Title: "Implications for calcification" is misleading, as no biological data is included.

L26: perhaps report the full range of diel pH cycles (min and max) rather than the SD, which is quite large.

L37-38: report CO₂ concentration in the same units.

L64: include upwelling

L102: explain why this site was chosen

L113: is this a SeapHOX? Is there a reason why the pH data is not included?

L127: specify which sensor this paragraph relates to

L139: Error in pCO₂ is 2.5% (although the authors should clarify what they mean by standard deviation - are they calling the error a standard deviation?). Given the emphasis on saturation states, this error and those of the bottle samples should be extrapolated and saturation states should be reported with an error (graphically).

L147-149: explain why these sampling times were chosen. Was this every third day or only once? Which corresponding samples are averaged? Since this is a dynamic environment, averaging measurements taken one hour apart may not be appropriate. Please justify and report agreement of these samples.

L150: samples were preserved after salinity measurements? That implies CO₂ off-gassing. I assume that the preservation was done immediately. Please clarify.

L152-154: need to report accuracy, in addition to the precision. Describe how accuracy was determined.

L155-158: need to report accuracy, in addition to the precision. Describe how accuracy was determined.

L176: specify that this sentence is based on data from Kiel Fjord (reads as if it is the Baltic)

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L308: Discuss why the CO₂ baseline is different between the current study and Saderne et al. 2013.

L352: Frieder uses semidiurnal cycles, not diel

L361: I don't think this study demonstrates this point

L365: Again, TAorg was deemed not important, so why is its contribution emphasized here?

L369: Why is this site exemplary? The site choice was not justified anywhere in the text.

Fig. 1A: add scale bar

Fig. 3C: add atmospheric CO₂ time-series to this plot (given Sect. 3.2)

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