

Comment on “A large CO₂ sink enhanced by eutrophication in a tropical coastal embayment (Guanabara Bay, Rio de Janeiro, Brazil)” by L. C. Cotovicz Jr. et al.

General comments:

The present paper under review for biogeosciences describes the surface water pCO₂ and ancillary parameters in a semi-enclosed estuarine embayment. The paper gives interesting results (adding more studies of the carbon cycle in coastal area) and I recognize the sampling strategy effort done by the authors. It was also been really quick from the last sampling period to the submission so I congratulate the first author for this effort. There are not mistakes in the bibliography list and spelling, attesting to the close attention the authors paid to writing.

However, I have three major concerns about the current version of the manuscript:

1. Statistical analysis need to be better explained and improved:
 - a. There is no section on the M&M on how the stats have been carried on, which program...
 - b. P-values alone (e.g.: 4685, 1) do not provide any information (need to know which test...)
 - c. “pCO₂ correlated with DO” (4683, 26) need to know which correlation: Beware that standard regression is inappropriate as both variables are subject to errors. In such cases, one should use type 2 or geometric regression.
 - d. “Trends that mirrored” (4672, 9) need a stats background.
 - e. Authors used a PCA in section 4.2 that has not been introduced before. Moreover, PCA is a reduction technique, it does not show any correlation (maybe need to use a Multiple Linear Regression to show that.)...
2. The paper talks a lot about residence times and net ecosystem production. I think the authors have everything they need to calculate both of these parameters and will increase the robustness of this really good paper.
3. Some question I had when I read the abstract and have not been answer are:
 - a. Have the tide/tidal currents an effect in exchanging with open water?
 - b. What is the influence of mangrove? This is really interesting point of the view of Koné et al. works.
 - c. Is there any other biological activity in the bay (seagrass, cultures, macrophytes...)
 - d. What happens when the summer stratification break?

I use (page number, line number) or (section number) as in the friendly printed version of BDG to locate the comments

Specific comments:

Abstract:

Here and elsewhere in the ms: Why the use of pCO₂ units? Community normally use μatm .

(4672, 21-25): important message in a too long and confusing phrase. It's not clear how the embayment is: classic, in contrast of what?? Here and elsewhere, emitter is a synonym of source? Please stick to sink/source to not confuse readers. It is scientific writing, not literature, do not be afraid of repetition (also in 4696, 15).

Introduction:

(4673, 25): no necessary comma before reference

(4673, 28): you don't use GPP again so avoid excess of abbreviation.

(4674, 2): you haven't defined what LOICZ stand for. In one of its manual, there's a nice example on how to calculate residence times.

Materials and methods:

(4676, 11): "moderate stratified in wintertime", do not look like that in your winter profiles, completely mixed.

Locate Ilha do Governador, Santos Dumont, Geleao in Fig. 1. Also add where the sea is, it took me a while to understand the situation (for non-knowers of the area)

(4677, 24-): if I read this paragraph first, it will be easier to understand the whole study area section. Right now it is difficult to know where the wide entrance, which is the inner regions...

(4678, 10): caution here and everywhere else where you talk about areas. For example in (4684, 10) 75% of surface area of the Bay is wrong, is 75% of the **sampled** surface area of the Bay (67 % of the total area). Another example is (4697, 9-11): the polluted sampled area is only 10 % but the no sample 10 % might be also polluted (due to its location) and that will make 20 % of the bay. Modify Table 2 and Figure 6 a) accordingly (all/entire sampled bay)

(4678, 29): is this probe also calibrated? Is the same as in (4679, 16)? Do you use discrete sample to calibrate for DO, temperature, salinity or only to converse chl a?

There is an ongoing debate about influence on filter/no filter sampling for TA and DIC. Could you discuss some of this in your method? Did you test for this influence?

Which are pH and pCO₂ accuracy/precision? How are the number of the verification (4679, 26)? How often did you calibrate the sensors? pCO₂ span for long range, is the response still linear? How pCO₂ data fits with SOCAT standards? **Is there any plan to submit the dataset somewhere? Biogeosciences strongly promotes the full availability of the data sets reported in the papers that it publishes in order to facilitate future data comparison and compilation as well as meta-analysis. This can be achieved by uploading the data sets in an existing database and providing the link(s) in the paper.**

(2.3.3) It is nice to try a small intercomparison between pairs but it need more quantifications (are the slopes statistically different from 1? Are the intercept statistically different from 0?) How are the errors propagated to calculate DIC? Is this $\pm 6.5 \mu\text{mol kg}^{-1}$ between calculated from each pair?

Results

(3.1): - Are the sampling period statistically different than the climatology? Without stats is difficult to compare, for example, it seems to me summer period is not warmer and dryer that the average; from Fig. 2 there are 2 months with more rain that climatological and 3 dryer (same with temperature).

- The “driest months” is August 2013 (otherwise state driest months during summer period).

- “precipitation consistent with historical data”: is that true? It seems Jul more rain and Aug really dry

(4681, 24-26): We don't have a table for seasonal variation so it's difficult to follow last part (I miss this table in other part of the ms (i. e.: (4686, 8)), to allow easy follow)

(4682, 5): “rainy season”, remain the reader when is that.

(4682, 7): you haven't defined what's exactly eutrophic/hypertrophic and which are the threefold between both classifications. Readers might be familiars with eutrophic but hypertrophic is more rear.

(4682, 6-9): here is another example on how stats can help: cluster or any other grouping technique to show this difference between areas.

(4682, 10): you haven't defined SD before.

(4682, 15): needs stats to highly or moderate associate something.

(4682, 20-21): what do “outflow” and “inflow” means here?

(4682, 28): “well representative” is hard to believe on the light of such high diurnal changes. Were all done at the same time of the day? To avoid these doubts, it could be nice to have instead of one particular profile an average profile with mean and error bars.

(4683, 27): temporally and spatially correlation need to sets of correlation values. Also defined what R2 is exactly. N in table 1 is different that n here? Please clarify/unify.

(4684, 2): unify the use of DO, AOU or Saturation (not defined) and use the units accordanly (right now is DO with % not correct, also in table 1). Values of 3750 ppmv are not showed in fig (the scale didn't arrive so high)

(4684, 6): “small and protected embayment” means S4, S5?

(4684, 15): here and elsewhere (also in figures) unify the date format. Can you clarify/rewrite brown/red bloom? I understand what you mean but I'm sure some biologist will have some concerns about that ☺

(4684, 23): "open waters" might be misleading talking inside the bay.

(4684, 28): "In the latter" what? Sampling period, S1??

(4685, 1): talking about night time for early morning seems contradiction. Maybe use pre-dawn?

(4685, 4): here and elsewhere, please unify time threshold (sometimes is 9:00, 9:30, 10:00)

(4685, 5): you didn't sample September 2014

(4685, 9): a reference is missing here.

Unify how you write night time (if you are going to keep using it)

(4685, 20): "diurnal variability": I know is logistically difficult (or sometimes impossible) to do a proper night sampling. However, I would like to read something on explaining this caveat. You are claiming diurnal variation is important but you are still missing part of the day when even less data is available.

(4685, 23-26): strange phrase, please rewrite more clear.

(4685, 26- 4686, 4): really long phrase for an important info. Also it will be nice to see this graph and have more quantification as it's an important result, also present in the abstract.

(4686, 5): more than 2000 in S4 during April 2014 is not "slight"

Discussion

(4689, 23): you haven't defined PCA yet, not explain how you did...

(4690, 13): % of what, explain

(4690, 19): 395 ?? units

(4690, 28): discuss or take care of some organism are able to uptake bicarbonate by the enzyme carbonic anhydrase and by the proton pump mechanism

(4691, 25- 4692, 16): move to another section of the methods entitle "temperature and biological control in pCO₂ calculations". Clarify which means you are using: each survey independently or winter/summer as a whole. Explain the ratio (T/B = $\Delta\text{CO}_2\text{bio}/\Delta\text{CO}_2\text{temp}$)

(4693, 26): how does the turbidity influence this? (same question in 4698, 5)

(4694, 11 and elsewhere): plankters = plankton?

(4694, 26): During this period, space missing

(4697, 9-10): “However this region occupies only about 10 % of the surface area of the bay”. The other 10 % you could not sample seems logical to be also polluted. I understand the logistic problem but that will be now 20 % of the bay, just discuss the possible influence of the no sampled area.

(4697, 15): at daytime at nighttime??

Conclusions

(4698, 20): How can nutrient from sewage influence the whole bay but not carbon?

Tables:

1. Abbreviation of salinity (Sal.) has not been used during the ms. DO (%) wrong
2. How can U10 be different if they came only from 2 meteorological station (please clarify)

Figures:

1. Dotted lines don't seem dotted in my file. Missing South and West in lat/long to be able to locate the map.
2. Dez? Mensal?
3. Scales are different (also in 5)
4. Rainbow scales have been under debate not to use them. In (g) it's really difficult to see where is super high (region 2)
5. Letters are small, difficult to read. In the small inner graphs, shadow when is “night time”. Legend >< 9:30 is confusing, better earlier, later (pre/post dawn?).
6. Unify data format and 9:00 or 9:30?