

## **Review of Gregor and Gruber et al. (2020)**

### **General Comments:**

This manuscript introduces a new global dataset for carbonate chemistry parameters (DIC, TA, pCO<sub>2</sub>, pH, and omega for CaCO<sub>3</sub>) over 1985–2018. The development and production of this dataset was clearly a significant effort, and should prove useful to the broad ocean biogeochemistry community. In general, I found the paper to be logically structured / readable and the figures are of good quality. The section on uncertainty assessment was a useful contribution and most welcome. However, some revisions are required to improve the overall quality of the text and discussion section of the paper.

### **Specific Comments:**

Discussion: it would be good to add 1–2 paragraphs on potential issues in the coastal zone compared to open ocean and recommendations for future efforts. It would also be useful to connect to this recent paper: Landschützer, P., Laruelle, G. G., Roobaert, A., and Regnier, P.: A uniform pCO<sub>2</sub> climatology combining open and coastal oceans, *Earth Syst. Sci. Data*, 12, 2537–2553, <https://doi.org/10.5194/essd-12-2537-2020>, 2020.

Discussion: you mention ocean models briefly in the introduction (L45). It would be helpful for the community if you could make some recommendations (based on what you have learned in the development of this paper) for accurately simulating and benchmarking ocean acidification in numerical ocean models.

Appendix A3.4 seems to be missing, please correct this.

### **Technical corrections / comments:**

General: omega symbol and “omega” are used interchangeably, please stick to one throughout the text to be more consistent and readable.

General: “In situ” is italicized in some sections and not in others. Please make this consistent.

Table 4: Suggest shading “this study” rows as light gray to set it apart from the other methods.

Figure 1: Would be helpful to add a label for steps 1–3.

Figure 4: Suggest making the gray scatters and shading darker, it is difficult to see.

Figure 5 (caption): Add hyphen between “zonally” and “averaged” (same in Figure 10). Add “Section” before “4”.

Figure 9 (caption): Need comma after “calcite”).

Figure 10: Need labels for colors shown in *f-j*.

Figure 11: Can you move location labels for top figures above the plots? Especially in (a) where the label overlaps the blue line.

Figure 1A: Need comma after “July”.

L1: Consider moving “profoundly” to before “altered”.

L2: Add comma after “long-term”; suggest rewording from “that permits to study” to “allows for the study”.

L4: Add hyphen between “methodologically” and “consistent”.

L10: Suggest replacing “higher” with “improved”.

L24: Suggest changing “lowering” to “moderating” and changing “But” to “However,”.

L25: Need space between “acidification” and “(Doney ...)”.

L26: Suggest removing “the” before “global mean”.

L28: Remove “the” before “H+”.

L29: Add “ocean” between “surface” and “pCO<sub>2</sub>”.

L30: Suggest changing to: “due to the ~1-year timescale”.

L32: Would be good to add a reference for the decadal atmospheric CO<sub>2</sub> increase timescale.

L34: Add “the” before “mineral”.

L36: Would be good to define “calcium carbonate” on L34, then use abbreviation of CaCO<sub>3</sub> in rest of text.

L39: Suggest rewording to “cross critical saturation thresholds”.

L44: Add comma before “respectively”.

L50: Suggest changing to: “local-to-regional”.

L54: Remove “among others”.

L62: Change “And” to “Additionally,”.

L63: Change “slaved to” to “dependent on”.

L64: Add hyphen between “well” and “measurable”.

L65: Add comma after “pH”.

L76: Add comma after “(2013)”.

L77: Suggest rewording to: “all surface ocean carbon system parameters”.

L78: Add comma before “due”.

L84: Change “accessibility to” to “accessibility of”.

L85: Need parenthesis before “Olsen”.

L88: Remove comma after “historically”.

L89: Change to “have permitted a tremendous increase in the number of pH” and remove “the” before “deployments” and “biogeochemical Argo”.

L96: Add “us” before “to address” and change “But” to “However,”.

L108: Change “But” to “However,” and change “:” to “;”.

L109: Add hyphen between “data” and “sparse”.

L113: Add hyphen between “highly” and “linear”.

L115: Change to: “a globally-application, multi-linear”.

L121: Change to: “5<sup>th</sup>”.

L124: Add hyphen between “regionally” and “specific”.

L126: Remove “only”.

L127: Remove “concretely”. Suggestion joining sentences with “map TA; however, their application”.

L128: Remove “then”.

L133: Suggest changing to: “map TA and pCO<sub>2</sub> globally,” and removing “will” before “use a newly”. Also add hyphen between “newly” and “develop” and “two” and “step”.

L137: Add hyphen between “methodologically” and “consistent”.

L149: Suggest rewording to: “First, we develop a statistical”.

L153: Change “to the globe” to “globally”.

L170: Change “permits to overcome” to “overcomes”.

L181: Change hyphen “-“ to em dash “—“. Same on L206.

L183: Add hyphen between “computationally” and “expensive”.

L196: Suggest adding “(NO<sub>3</sub>)” after nitrate and then using “NO<sub>3</sub>” and “PO<sub>4</sub>” instead of “nitrate” and “phosphate” on L206 (and throughout the rest of the text too). These are shown in Table 2, but the reader doesn’t see that until Section 2.3. Also, the name and abbreviation for silicic acid are used interchangeably in the text, please make that consistent.

L212: Change “But” to “However,” and add comma after “Arctic” and “layer depth” on L213 and L214, respectively.

L232: Need parenthesis around block of references, i.e., right after pCO<sub>2</sub>.

L240: Add hyphen between “temporally” and “averaged”.

L249: Add comma after “so”.

L253: Remove extra “the”.

L259: Can you explain and justify why you take the log(10) of Chl-a here?

L294: Note that you have degree symbols after both 1’s here. This is not consistent throughout the text, please adjust accordingly.

L301: Add space between “2.5” and “μatm”.

L311: Add comma after “phosphate”.

L326: Add hyphen between “statistically” and “modeled”.

L328: Remove “established”.

L334: Suggest showing equation for E with sqrt symbol and not E<sup>2</sup>.

L349: Add hyphen between “closely” and “related”.

Table 3 caption: need closing parenthesis for “(see”.

L361: Add hyphen between “overly” and “conservative”.

L362: Need space between “5” and “μmol”.

L367: “In-situ” does not need to be capitalized; add hyphen between “satellite” and “based”.

L385: Change hyphen to en dash in “1990-2018”, also L386 add comma after “HOT -2 μmol kg<sup>-1</sup>”

L394: Missing period at end of sentence.

L401: Add space after “0.5x0.5” and “x 15-days”. Also, add degree symbols to be consistent with rest of text.

L428: “/kg” should be “kg<sup>-1</sup>” to be consistent with rest of text.

L439: Again, “/kg” should be “kg<sup>-1</sup>” to be consistent with rest of text. Also, on L465.

L480: Need comma after “pH”.

L500: Subscript “2” in “[CO<sub>2</sub>]”. Also, add “Figure” before “10c,g”.

L520: Need degree symbols instead of “deg”.

L522: Change hyphen to em dash.

L538: Suggest changing “not so” to “not as”.

L570: Add hyphen between “monthly” and “gridded”.

L595: Change “estimates” to “estimate”.

L611: Need to subscript “2” in “pCO<sub>2</sub>”. Also, on L638, 640, and 641 (for “CO<sub>2</sub>”).

L651: Need comma after “γ”.

L663: Suggest changing “further” to “furthermore”.