

Interactive comment on “GLODAPv2.2020 – the second update of GLODAPv2” by Are Olsen et al.

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General comments:

Since 15 years GLODAP data-bases (from 2004 to 2019, including CARINA, PACIFICA) are widely used in the community, not only to evaluate the change of CO₂ in the ocean or acidification (e.g. Gruber et al 2019; Jiang et al 2019), but also to compare and validate ocean and climate models (e.g. CMIP5, Bronselaer and Zanna, 2020 for a recent publication). The GLODAP data-set is also an important synthesis for GOA-ON activities and to construct climatology (e.g. Broullón et al, 2020).

Here, authors present an updated version of the GLODAP effort. This includes 106 new cruises quality controlled (QC), inclusion of new fCO₂ observations (not QCed) and comparison of secondary QC with reconstructed properties using neural network methods (named CANYON-B and CONTENT).

The effort consists mainly in (i) format and check the data received from PI or available in different locations (NCEI/OCADS, PANGAEA, CCHDO), (ii) performed a secondary QC to identify data biases (if any) and separate from real temporal changes of the properties that could be low relative to the mean concentrations and (ii) construct final formatted products with adjusted data and associated flags for easy use at global or regional scales.

The paper is basically structured from the previous manuscript (Olsen et al 2019) and I therefore have only few comments regarding this new version (v2020). Most suggestions are for clarity, here thinking to readers that would discover only now the GLODAP project (e.g. new students in the field).

As fCO₂ data are now included, GLODAP is in a way a companion data-base to SOCAT dedicated to surface fCO₂ data (Bakker et al 2016) also annually updated (Bakker et al 2020). Both products were already used together for specific analysis (e.g. comparing pH fields from GLODAP and SOCAT, Jiang et al 2019). It might be useful for future to attempt incorporate fCO₂ data that are in GLODAP but not yet in SOCAT. In this context few words might be added at the end in the conclusions/perspectives.

In this version, authors used CANYON-B and CONTENT methods (I think this was not systematically performed in v2019). This is a new and an elegant way to check and compare secondary control (and bias if any). This is a new step in GLODAP that might be recalled in the abstract for this version.

Something not very clear concerns the QC for historical cruises. With the new cruises in hand, I was not sure at the start if the QC of previous cruises in the same regions has been checked again and would lead to new corrections for cruises already in GLODAP-v1, CARINA or v2019. However, as specify in the manuscript (line 145) I understand that a complete revision of QC would be performed in 2023 (after 3d GO-SHIP).

Also, many colleagues used the GLODAP gridded products that were constructed from GLODAP-v2 (Lauvset et al 2016). Will you also revisiting this gridded product now or

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wait for the 2023 version ? This might be specified in the manuscript.

Another remark concerns the new cruises to be added in GLODAP. I understand that new cruises (106) were recently obtained from NCEI or PANGAEA or from PIs. However, I suspect there are many other cruises in the community (published) and it would be useful to find the best way to get more cruises in the future and invite new PIs to contribute.

Overall, I recommend publication after few minor revisions.

Below I list specific and minor comments (mostly details for clarity for a reader who discover Glodap for the first time). At the end of the review few technical questions regarding the files on-line.

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Specific comments:

C-01: Title: The title includes only acronyms of the project (GLODAP). Would it be useful to recall that this concerns Ocean biogeochemical observations in the water column? A Suggestion for a title: “An updated version of global interior ocean biogeochemical observations, GLODAPv2-2020”.

C-02: Page 2, line 44: “the inclusion of available discrete fugacity of CO₂ (fCO₂) values in the merged product files”. Does this new inclusion concerns only the new cruises added in v2020 or did you also add this parameter for historical cruises ? (this is specify later, Line 369).

C-03: Page 4, Line 121: “The data collected across the Davis Strait”. Maybe specify where is the Davis Strait for those not familiar with the Indian Ocean... (. . .Atlantic of course)

C-04: Page 5, Line 175: For new users: Not sure to clearly understand all Flag definitions listed in Table 2.

C-05: Table 2: for clarity, it might be useful to assign different flag for interpolated and calculated values (both flag 0). Maybe for the next version.

C-06: In table 2, you list “b” “Data are not included in the GLODAPv2.2020 product files and their flags set to 9. “ Does that mean that original flag 3 (Questionable but sometimes maybe real signal) are not included in the files ? However this is explained later, line 395. . .

C-07: In table 2, you list “c” for replicate: “Data are included, but flag set to 2 “. This suggests that all replicate are acceptable (or some were also identify as outliers and thus moved to flag 9 or deleted ?).

C-08: Page 6, Line 197: “comparison of deep-water averages”. Specify the layers here ? How this is selected in the high latitude (e.g. bottom water formations, where anthropogenic CO2 is found to be relatively high in water column ?).

C-09: Page 6, Line 200: Add reference to CANYON-B and CONTENT (first time listed here) ?

C-10: Page 6, Line 226: “In areas where a strong trend in salinity was present”. Any example for this version ?

C-11: Page 7, Line 235: “convection occurs (such as the Nordic, Labrador, and Irminger seas)”. How do you select the layer in region of bottom water formation (e.g. SR03 for this version) ? Might be interesting for new readers to show another QC example (as presented in Figure 3 for the North Pacific).

C-12: Page 7, Line 238: Maybe recall that 49UP20160109 is new while 49UP20160703 was QCed in v2019.

C-13: The example in Figure 3 shows in 3a blue dots on the map, but I suspect these stations (far east) were not used to evaluate the QC.

C-14: Page 7, Lines 245-250: For 49UP20160109, maybe specify that no temporal

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changes was observed for salinity (i.e. you used TCO₂ here, not normalized TCO₂ as suggested in Line 227 for some cruises).

C-15: Page 7, Line 245: Figure 4 shows the TCO₂ cross-over for 49UP20160109 versus GLODAPv2-v2019. The cruise 49UP20160703 is also plotted and thus was in GLODAPv2-v2019, although conducted after 49UP20160109 (just to clarify for a new user).

C-16: Page 7, Line 256: “they are included in the product but with a secondary QC flag of 0 (Sect.6)”. Sect 6 (?)

C-17: Page 7, Line 259: “A few new cruises had no or very few valid crossovers with GLODAPv2 data.” Which cruises ? Would it be relevant to add a column in Table-Annexe 1 with a remark specifying what kind of secondary QC has been performed for each cruise (e.g. Standard QC, MLR, no QC) ?

C-18: Page 8, Section 3.2.3: I understand the description but what are the results and which cruise ? Would be interesting to show an example for a cruise that is QCed using MLR.

C-19: Page 8, Line 277: “Altogether 82 of the 106 new cruises included pH data.” Here specify this is measured pH, not calculated (so there is no confusion with pH calculated for other cruises).

C-20: Page 8, Line 291: “The pH data of 840 of the 936 cruises in GLODAPv2.2020”. Again, specify if pH data here were measured or calculated or both.

C-21: Page 8, Line 305: Maybe recall the mean uncertainty associated to CANYON-B and CONTENT (see table 1 in Bittig et al 2018, i.e. about twice the adjustment limits fixed for GLODAP listed in Table 3).

C-22: Page 8, Line 305: As it is new results presented here (and probably also used in the next version), I think some more information is needed. For CANYON-B and CONTENT are you using results based on GLODAP-v2 data (Bittig et al 2018) or an updated

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version using GLODAPv2-2019. Is the comparison presented here (Figure 5) validate the QC for the new cruises or validate CANYON-B and CONTENT reconstructed fields ? It is reassuring to get about the same results as CANYON-B and CONTENT were trained with GLODAP.

C-23: Page 8, Line 308: Figure 5: not easy to see the black dots (measured values).

C-24: Figure 5: there is no units (to be added in captions ?).

C-25: Figure 5: Like for Figure 3 and 4, it would be nice to show another example, e.g. SR3 or Davis Strait ? Or an example where the comparison between QC from GLODAP and CANYON-B/CONTENT does not work (if any). This is a suggestion not absolutely needed.

C-26: Page 9, line 320: “Another advantage of CANYON-B and CONTENT is that by considering the each data point in it self, primary QC issues has been revealed and corrected for some of the cruises.” Which cruises ? Give some examples ?

C-27: Page 9-10: Section 3.3.1. Lines 332-358: This is a list of revisions and would be better to move this section in an Annex but keep in Section 3.3.1 the fCO₂ information (lines 359-375) as it is new data added in v2020.

C-28: Page 10: Concerning fCO₂, in the GLODAP files there are now both fCO₂ measured and calculated in the same column. Authors indicate that all values were converted to 20°C. However, in the data-files, there are fCO₂ values with fCO₂temp fixed at -9999. I missed something here and not sure if all fCO₂ values in the files are at the same temperature, pressure or at local temperature etc. . . Also, there are fCO₂ values with flag 0 or 2. What was the criteria for fCO₂ with flag 2 ? How users can easily separate the fCO₂ measured and calculated in the files ? This is important to clarify if one uses both GLODAP (in surface) and SOCAT to merge both products.

C-29: Page 10, line 364: “These calculated TALK values were, however, not included in v2.2019.” Does that mean that all TALK values with flag 0 in the files are only

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interpolated values (i.e. not calculated as an option suggested in table 2).

C-30; Page 11, Lines 397-398: For flags 6 and 7 now set to flag 2, recall that this only applied for valid data (i.e. obvious outliers deleted also for these replicates ?).

C-31: Page 11, Line 399: “Missing sampling pressures or depths were calculated following UNESCO (1981).” This is obvious but maybe rewrite following: “Missing sampling pressures (resp. depths) were calculated from depths (reps. pressures) following UNESCO (1981).”

C-32: Page 11-12, Lines 405 and 432: Flag 0 is used for both interpolated and calculated values. Why not using different flag ? (for next version)

C-33: Page 11, Line 416. Concerning the “Missing seawater CO₂ chemistry variables”. Are the calculated properties used only measured data (i.e. TALK and TCO₂) or also interpolated values ? In other words, are the fCO₂ and pH interpolated values based on calculated fCO₂ and pH or recalculated with interpolated TALK/TCO₂ ?

C-34: Page 13, Line 486: “For example, Arctic Ocean phosphate, Indian Ocean silicate and TCO₂, and Pacific Ocean pH data all show considerable improvements.” For Indian, in Table 6 improvement is for TALK, not TCO₂ ?

C-35: Page 15, Line 544: Weatherall et al., (2015): not in references.

C-36: Now concerning the files, for curiosity I had a look at the Indian.cvs file and have few questions that could be also valid for other basin. The questions below are obvious for someone familiar with Glodap, but mainly addressed here to help new users.

C-36a: Why the QC flags for S or O₂ are 0 for several cruises although flag WOCE are 2 ? Is it because the secondary QC is not available for these cruises ?

C-36c: There are data with WOCE flag=0 for O₂, Nitrate, Silicates, Phosphates, TCO₂, TALK, pH, and associated to QC flag = 1. Is it because these are interpolated values for a cruise/station for which a secondary QC was performed ? If QC has been performed

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(QCF=1) one would expect a WOCE flag different from 0 ? I thought the QC is based on original data (not interpolated or calculated). Could that be clarified ?

C-36d: There are data with flag 9 associated to QC flag=1. Again, is it because QC flag (0,1) are assigned for a cruise/station not for each data?

C-37: In the data files on-line (e.g. GLODAPv2.2020_Indian_Ocean.cvs) I would suggest to add units for each column.

C-38: And for next versions, I think for clarity a different flag should be assign for calculated (e.g. fCO₂, pH) and interpolated values. This might help some users to select only measured+interpolated values.

In references:

I think each reference should now have a DOI

Line 663: "Hood, E. M., Sabine, C. L., and Sloyan, B. M.: The GO-SHIP hydrography manual: A collection of expert reports and guidelines, 2010." Specify the publisher ? DOI ?

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