Anonymous Referee #1, 26 Oct 2025

General comment:

The North Atlantic Ocean is an important CO2 sink (Takahashi et al. 2009) and this region contains high concentrations of anthropogenic CO2 in the water column (Khatiwala et al., 2013; Steinfeldt et al, 2024). Thanks to numerous observations in this basin since the seventies, it is now well known that simulated carbonates systems properties, including CO2 fluxes, OA and Cant, present significant bias. Quoting Perez et al., 2024: "The largest disagreement in the CO2 flux between GOBMs and pCO2 products is found north of 50°N". Bias between models and data-based estimates are also observed for the Cant inventories in the North Atlantic (Perez et al, 2024, their figure 7). This calls for new analysis based on series of cruises to investigate the Cant variability, from seasonal to multi-decadal, such as recently presented by Bajon et al (2025). In this context, it is also important to extend and/or revise the data when observational bias are suggested or identified (e.g. Wang et al , 2025 for oxygen). Here the authors suggest that a correction of their pH data obtained along the OVIDE-BOCATS sections should be applied (by 0.011 on average). As an example, the comparison of data presented in the NEADW is convincing. Although this has apparently no impact on the pH trends, they show that the correction leads to a shift for the ASD. This new dataset (including 2021 and 2023 cruises) represents an important product, not only to re-investigate the drivers of ASD (Lauvset et al, 2020) but also for comparisons of pH data from BGC-Argo floats in this region (Wimart-Rousseau et al, 2024) as well as for model validation. The dataset includes 23500 corrected pH data from 11 cruises that will be probably revisited in the next GLODAP version. I wondered why authors did not include their AT data in the file that would help to calculate CT and Cant as well.

The document is well structured, figures and tables adapted. I recommend publication after minor revision. Below are listed specific comments.

We would like to thank Anonymous Referee #1 for the thoughtful review and the constructive feedback provided. We have carefully considered all comments, as detailed below. We specifically address the question regarding the AT data in our response below. Anonymous Referee #1's evaluation is reproduced in black, *the author's responses appear in green and italics, the original manuscript text appears in black and italics,* and *the changes introduced in the manuscript are shown in blue and italics.*

Specific comments:

C-01: Title: "Two decades of pHT measurements along the GO-SHIP A25 section". For readers not familiar with GO-SHIP and cruises numbers, maybe specify this is in the North Atlantic: Two decades of pHT measurements along the GO-SHIP A25 section in the North Atlantic. *We agree, corrected.*

C-02: Line 59: Not sure that Ishii et al (2025) is a correct reference for OA and BGC-Argo data. *Deleted, thank you.*

C-03: Line 139: "as well as the ocean's capacity to absorb, store, and transport CO2 (Pérez et al., 2013; Zunino et al., 2015)." You can add reference to Bajon et al, (2025) when published.

Thank you for the reference. We have included as follows: "(...) as well as the ocean's capacity to absorb, store, and transport CO_2 (*Bajon et al., 2025, manuscript in review;* Pérez et al., 2013; Zunino et al., 2015)*."*

C-04: Line 141: "and understanding the SPNA's response to climate change (Rodgers et al., 2023)." Is it the correct reference for the response to climate change ? DeVries et al, (2023) would be more appropriate.

The article by Rodgers et al. (2023) discusses and focuses on the challenges that GOBMs face in modeling the impact of the biological pump on CO_2 fluxes in subpolar regions, so we prefer to keep this citation. However, we agree that DeVries et al. (2023) is also highly relevant, and we have included it as well as: "(DeVries et al., 2023; Rodgers et al., 2023)."

C-05: Figure 1: I guess one of the cruise in 2014 (GEOVIDE) extended to the west off Greenland (stations south of Labrador Sea). Are these stations included in the new dataset ? If yes, this should be shown in figure 1.

Absolutely, these stations are included in the dataset. However, the previous version of Figure 1 displayed only the stations along the A25 line, and this was not indicated in the caption. We apologize for the oversight. We have revised Figure 1 to include all stations included in the dataset, and we have updated the caption accordingly: "Figure 1. Bathymetric map showing the main water masses and circulation patterns within the SPNA region covered by the OVIDE-BOCATS program (station locations indicated by black dots). Stations outside the main OVIDE-BOCATS (A25) section are opportunistic stations, dependent on the ship's route, whose data are also included in the final database product: "plus" symbols near Iceland and Greenland are stations sampled in 2006; "pentagon" and "rhombus" located in the Labrador Sea are stations sampled during 2012 and 2014 cruises; and "asterisk" symbols are stations sampled in 2023, near Greenland and in the Irminger Sea. The inset (…)".

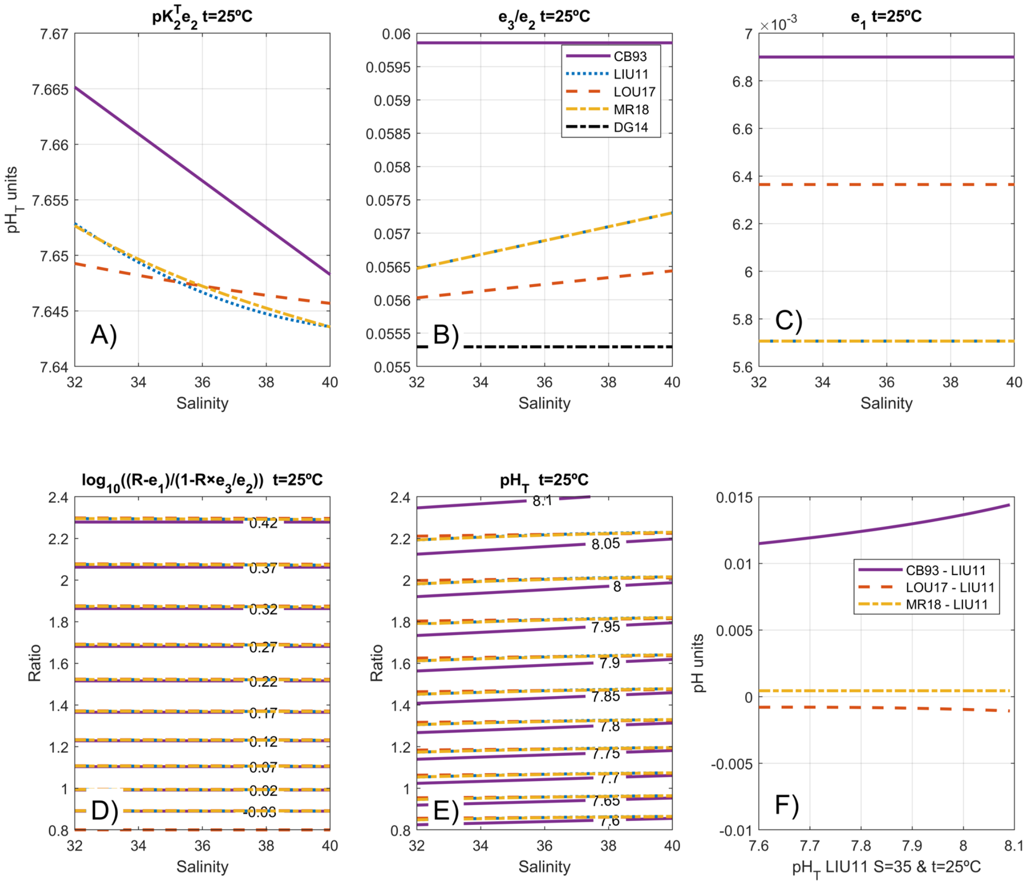
C-06: Line 176: "…should be adjusted by +0.0047 pHT units (Lee et al., 2000)." I think the reference should be DelValls and Dickson (1998). Lee et al used this correction to revise the dissociation constants.

Thank you for pointing this out. Lee et al. (2000) explicitly stated that "consequently, spectroscopic pH values obtained in the laboratory [Lee el al., 1996] and in field studies [Millero el al., 1993; Claylon el al., 1995; Lee el al., 1997] may need to be revised upward by 0.0047 pH units.". However, we agree with Anonymous Referee #1 that DelValls and Dickson (1998) is the most appropriate reference to cite for this correction. Therefore, we have retained the reference to Lee et al. (2000) and added DelValls and Dickson (1998). The revised sentence now reads: "These corrected TRIS pH_T values have recently been confirmed by Müller et al. (2018). Consequently, spectrophotometric

pH_T values obtained using the CB'93 parameterization should be adjusted by +0.0047 pH_T units (DVD'98; Lee et al., 2000)."

C-07: Line 188: "(see Fig. S1 in Álvarez et al.,submitted)." The paper by Álvarez et al. is not available at that stage (but would be happy to read it).

We regret that it is not yet accessible. The paper is currently accepted, and we expect it to become available soon. Here is the Figure S1 kindly provided by M. Álvarez.



Supporting Information Figure S1. *Graphical representation of the terms in Eq. 1 according to the four different parameterizations CB93 (Clayton and Byrne 1993), LIU11 (Liu et al, 2011), LOU17 (Louicaides et al., 2017), MR18 (Muller and Rehder 2018) (See Supporting Information Table S1). Parameterizations and bibliographic references are given in Supporting Information Table S1. The terms (A) $pK^T{}_2e_2$, (B) e_3/e_2 (where the parameterization by DG14 is also represented), and (C) e_1 are represented as a function of salinity and referred to 25ºC. Plot (D) shows the composite term $log_{10}((R-e_1)/(1-R·e_3/e_2))$, which is added to (A) $pK^T{}_2e_2$ to obtain (E) seawater pH referred to 25ºC as a function of the absorbance ratio (R) and salinity. Plot (F) shows the pH difference between parameterizations CB93, LOU17, and MR18 and that of LIU11 at 25ºC, and salinity of 35. All pH values are provided on the total hydrogen ion scale.*

C-08: Line 387: "This fit, based on 6,910 samples from the 2018, 2021, and 2023 cruises (Supporting Information Fig. 3)". In Figure S3, N= 2673. Is the fit based on 6910 or 2673 samples ?

We apologize for the confusion. There was a typo in the legend of Supporting Information Figure 3. The fit is indeed based on 6,910 samples. We have corrected the figure legend accordingly. Thank you for catching this oversight.

C-09: Line 530: "While corrections related to the mCP dye addition effect were included in the data published in GLODAPv2.2023 (Lauvset et al., 2024), the 488A-based correction described in Sect. 2.2.3 had not yet been incorporated". This is an important information for those who used and will use GLODAPv2.2023. Maybe also indicate here if the most recent cruises (2021 and 2023) have been submitted to GLODAP for the next version ?

The 2021 and 2023 cruise data have not yet been submitted to GLODAPv2. The submission of the data has been delayed while we prepared this study, in order to avoid duplicating the submission of incomplete datasets. The dataset will be finalized with the measured and interpolated total alkalinity values and deposited in the SEANOE and DIGITAL-CSIC repositories under a single DOI. They will then be available for integration into GLODAP

C-10: Line 536: "We present a new database comprising 23,535 seawater samples with spectrophotometric pHT values,…". I wondered why authors did not include their AT data. **C-11: Line 597**: "To assess this impact, aragonite saturation horizons were recalculated using in situ temperature, salinity, AT, and pHT values,…". Interesting sensitivity test, but the AT data are not in the files (correct ?).

Correct, the total alkalinity (AT) data is not included in the current database files. The AT sampling strategy of the OVIDE-BOCATS cruises differed of pH: AT samples were collected only every two stations and with fewer samples per profile, which means that different processing is required before the two datasets can be combined. We plan to develop an interpolating approach to estimate AT at the pH sampling resolution while preserving the natural variability of the AT field. This work will evaluate different interpolation methods and proxies (e.g., salinity-based relationships, neural-network approaches). On the other hand, AT data from 2002 to 2018 are already available through GLODAP, where they have undergone extensive quality control. The AT data from the 2021 and 2023 cruises will soon be accessible via SEANOE and DIGITAL.CSIC.

C-12: Line 600: "This reevaluation reveals a more pronounced reduction in aragonite saturation at the surface (from -0.040 to -0.065),…". I suspect this is reduction from pre-industrial period. Please clarify.

Yes, this reduction refers to the change relative to pre-industrial conditions. We have clarified it in the text as follows: "This reevaluation reveals a more pronounced reduction in aragonite saturation at the surface (from -0.040 to -0.065), relative to pre-industial conditions, (...) ".

C-13: Line 622: "Notably, a persistent pHT minimum appears in the Iceland Basin between 500 m and 1,000 m, associated with intermediate waters with high Apparent Oxygen Utilization". On this topic, the impact of biological processes on pH distribution was quantified by Lauvset et al (2020).

Thank you, reference included.

C-14: Line 651: "The highest OA rates (< -0.002 pHT yr-1) are observed in the surface layers (0—500 m) due to direct air-sea CO2 exchange." Interestingly, such rate was also deduced in the NASPG from other surface data (-0.0021 pHT yr-1, Reverdin et al, 2018).

Thank you for this remark. We have added this contextual information as follows: "The highest OA rates (< -0.002 pH_T yr^{-1}) are observed in the surface layers (0—500 m) due to direct air-sea CO_2 exchange, consistent with the rate reported by Reverdin et al. (2018) for surface waters in the NA subpolar gyre."

C-15: Line 652: "These upper layers also exhibit high interannual pHT variability (Fig. 10), which correlates negatively with AOU (Supporting Information Fig. 6b)." Figure 10 does not show the interannual variability. Maybe refer to Figure 9 here or present another figure for surface layer (in Supp Mat ?).

Thank you for this suggestion, we agree. We have included a new figure to the Supporting Information (Supporting Information Fig. 7), which shows the standard deviation of pH_T across the 11 cruises (panel A) and the standard error of the pH_T rate (panel B). We have updated the text to direct the reader to this new figure as follows: "These upper layers also exhibit high interannual pH_T variability (~~Figure 10~~ Supporting Information Fig. 7), which correlates negatively with AOU (Supporting Information Fig. 6b)."

C-16: Line 673: "NEADW originates from Antarctic Bottom Water, formed in the Vema Fracture Zone, and is largely devoid of Cant (Steinfeldt et al., 2024)." See also Mercier and Morin (1997) who first investigate the AABW in the Atlantic Fracture Zones.

Thank you for this valuable reference. We have included it into the revised text as follows: "NEADW originates from Antarctic Bottom Water, ~~formed~~which flows into the Eastern North Atlantic Basin from ~~in~~ the Vema Fracture Zone (Mercier and Morin, 1997), and is largely devoid of C_{ant} (Steinfeldt et al., 2024)."

C-17: "6. Data availability" I wanted to explore the files but unfortunately, no access. On "zenodo" the message is: The record is publicly accessible, but files are restricted to users with access.

We sincerely regret that you were unable to access the dataset. When submitting the article, following the options offered by ESSD, we opted to keep the data in the permanent repository (DOI Zenodo) under embargo until the article's publication. Simultaneously, we provided a temporary public repository containing the exact same content for reviewers. This temporary link is: https://saco.csic.es/s/kKqDXFYGKsKbaXj. According to ESSD procedures, this link should have been sent upon acceptance of the referees. We apologize for the oversight and any inconvenience it caused.

Reference added in this review, not listed in the MS:

Bajon, R., Carracedo, L. I., Mercier, H., Asselot, R., and Pérez, F. F.: Seasonal to long-term variability of natural and anthropogenic carbon concentrations and transports in the subpolar North Atlantic Ocean, EGUsphere [preprint], https://doi.org/10.5194/egusphere-2025-4425, 2025.

DeVries, T., Yamamoto, K., Wanninkhof, R., Gruber, N., Hauck, J., Müller, J. D., et al. (2023). Magnitude, trends, and variability of the global ocean carbon sink from 1985 to 2018. Global Biogeochemical Cycles, 37, e2023GB007780. https://doi.org/10.1029/2023GB007780

Khatiwala, S., Tanhua, T., Mikaloff Fletcher, S., Gerber, M., Doney, S. C., Graven, H. D., et al. (2013). Global ocean storage of anthropogenic carbon. Biogeosciences, 10(4), 2169–2191. https://doi.org/10.5194/bg-10-2169-2013

Lauvset, S. K., Carter, B. R., Perez, F. F., Jiang, L.-Q., Feely, R. A., Velo, A., & Olsen, A. (2020). Processes driving global interior ocean pH distribution. Global Biogeochemical Cycles, 34, e2019GB006229. https://doi.org/ 10.1029/2019GB006229

Mercier, H and Morin, P: Hydrography of the Romanche and Chain Fracture Zones, 1997 JOURNAL OF GEOPHYSICAL RESEARCH-OCEANS, VL 102, 10373, DI 10.1029/97JC00229

Reverdin, G., Metzl, N., Olafsdottir, S., Racapé, V., Takahashi, T., Benetti, M., Valdimarsson, H., Benoit-Cattin, A., Danielsen, M., Fin, J., Naamar, A., Pierrot, D., Sullivan, K., Bringas, F., and Goni, G.: SURATLANT: a 1993–2017 surface sampling in the central part of the North Atlantic subpolar gyre, Earth Syst. Sci. Data, 10, 1901-1924, https://doi.org/10.5194/essd-10-1901-2018, 2018.

Takahashi, T., et al, 2009. Climatological Mean and Decadal Change in Surface Ocean pCO2, and Net Sea-air CO2 Flux over the Global Oceans. Deep-Sea Res II, doi:10.1016/j.dsr2.2008.12.009

Wang, Z., et al, 2025. Bias Evaluation for Sensor-Based Dissolved Oxygen from CTD and Profiling Floats in the World Ocean Database JOURNAL OF ATMOSPHERIC AND OCEANIC TECHNOLOGY, 42, DOI: 10.1175/JTECH-D-25-0027.1

Wimart-Rousseau, C., Steinhoff, T., Klein, B., Bittig, H., and Körtzinger, A.: Technical note: Assessment of float pH data quality control methods – a case study in the subpolar northwest Atlantic Ocean, Biogeosciences, 21, 1191–1211, https://doi.org/10.5194/bg-21-1191-2024, 2024.