Responses to the Reviewer' comments

We thank the Reviewer for the constructive comments that helped improve the manuscript!

We have carefully reviewed all the comments and revised the manuscript. Please find below a point-by-point response to the reviewer comments. The responses are highlighted with deep blue colors.

1. The manuscript would benefit from further development of the content across all sections, especially one describing the data synthesis and variables contained, and the quality control methods. Each section should provide additional details, clearer explanations, and sufficient supporting information to strengthen the overall presentation and ensure that the main points are fully addressed. Expanding the content where appropriate would improve the manuscript's clarity, depth, and overall scientific contribution.

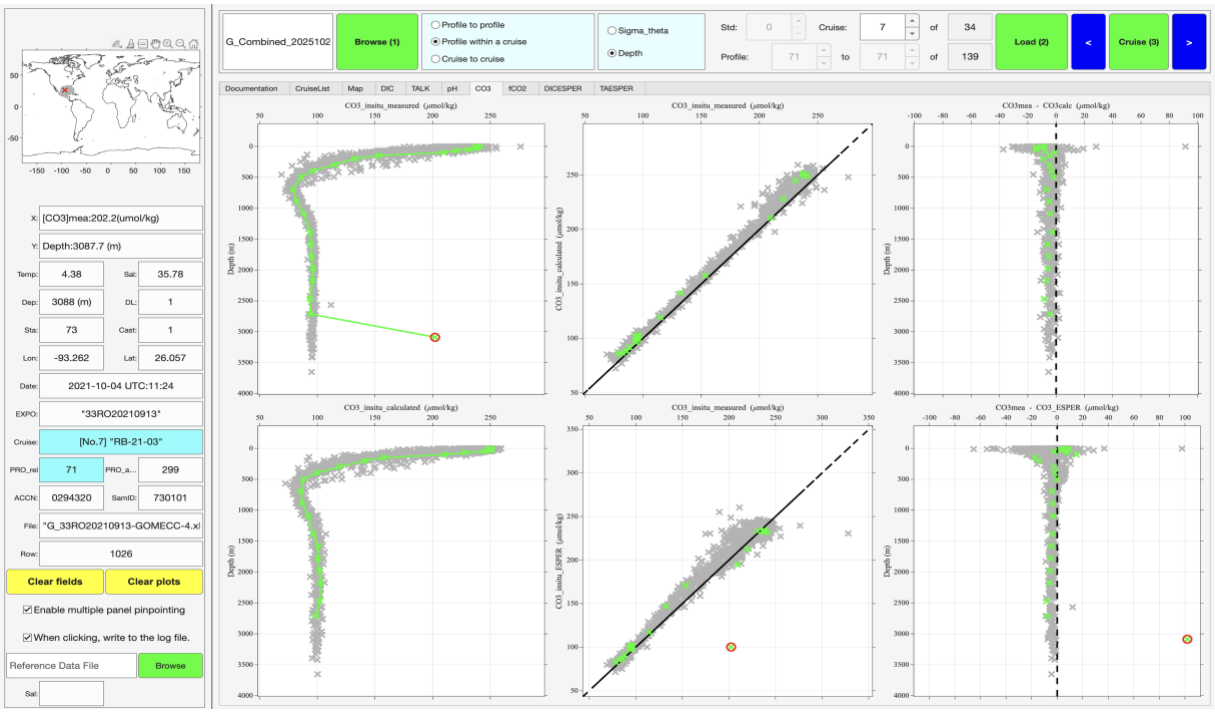
Answer: We thank the reviewer for this constructive feedback. We agree that additional methodological detail and clearer explanations enhance the manuscript's transparency and utility. Accordingly, we have substantially expanded Sections 2–4 (Study Site, Data Sources, and Quality-Control Methods) to provide comprehensive descriptions of the data and workflow, as well as explicit criteria for assigning quality flags.

2. The figures currently focus primarily on the updated temporal and spatial distribution resulting from the data synthesis. While these representations are useful, the manuscript would benefit from including additional analyses that provide further evidence of the quality and internal consistency of the CODAP dataset. For example, the authors could consider presenting information on the detection and treatment of outliers using ESPER, as well as the use of WOA23 for an independent assessment of CTD temperature data.

Answer: Thank you for this constructive suggestion. We have expanded our Data Quality Control section to explicitly detail our outlier detection, flagging, and independent validation procedures.

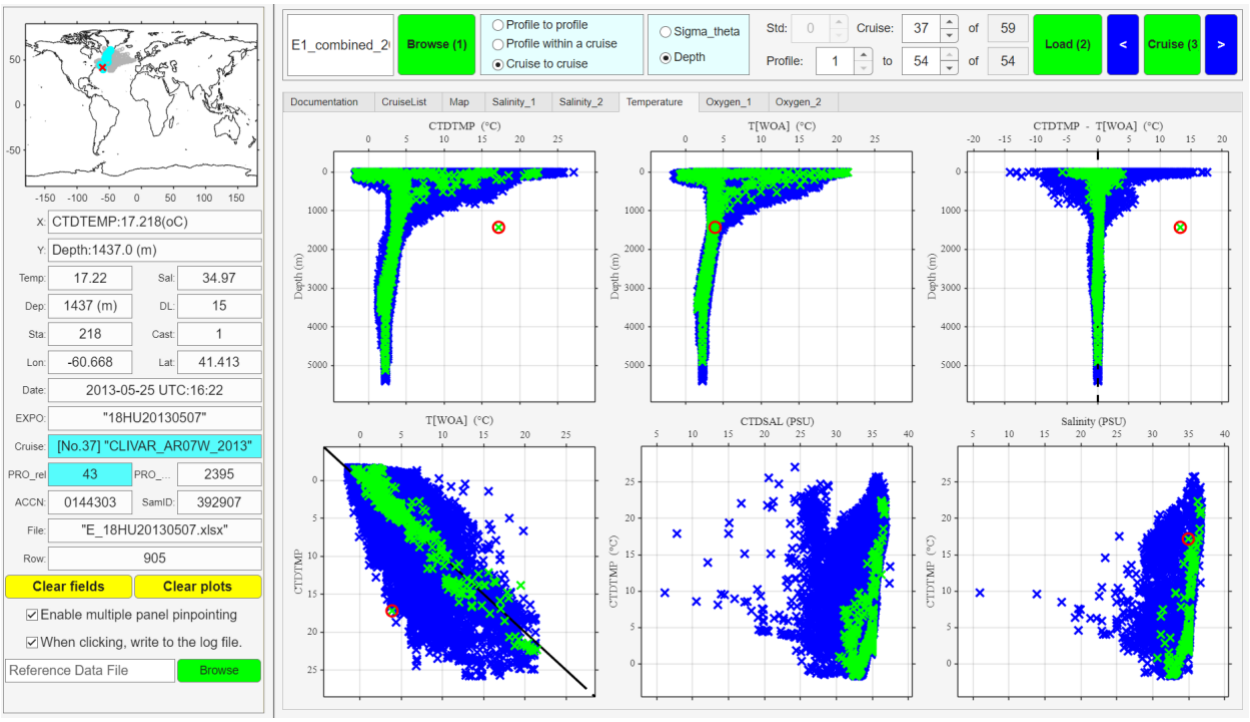
1. **ESPER Outlier Analysis:** ESPER-derived values are not used as the single source of truth for flagging outliers. However, when a variable is determined using multiple approaches—for example, pH measured directly with spectrophotometers and calculated from dissolved inorganic carbon (DIC) and total alkalinity (TA)—ESPER estimates provide an independent reference to help identify which value may be problematic. By calculating residual differences between measured values and ESPER-predicted values (e.g., $\Delta TALK = TALK_{measured} - TALK_{ESPER}$), along with evaluating

multi-panel property-property plots (TA vs. Depth, TA vs. Salinity, TA vs. DIC, TA vs. Silicate), we holistically identify anomalous data points. Points exhibiting significant deviations across multiple property relationships are assigned standard QC flags (e.g., QC Flag 4 = bad data) and excluded from primary analysis. Also, our quality control procedure was evaluated by cross-referencing individual profiles, examining consistency among profiles within a single cruise, and performing cruise-to-cruise comparisons.



This case represents “Carbonate ion value is too high (QC flag of 4)”.

2. **WOA23 Climatological Assessment:** CTD temperature and salinity profiles were independently cross-referenced against historical climatological envelopes from the World Ocean Atlas 2023 (WOA23) to check for sensor drift or depth-calibration errors prior to running ESPER routines.



For example, the measure CTD temperature was recorded at 17.22°C, whereas the corresponding WOA23 climatological baseline at that depth is ~4°C. This yields an anomalous temperature residual of 13.2°C, which is far outside any realistic hydrographic variance for intermediate deep waters in this region. This point was flagged as an outlier (QC flag 4).

3. Providing additional details and supporting analyses of this nature would help substantiate the statement in the abstract that CODAP is internally consistent. Such information would also strengthen the methodological transparency of the study and give readers greater confidence in the reliability and quality of the resulting data synthesis. For example, was CO2 internal consistency analysis used to help improve the data consistency?

Answer: Thank you for this constructive comment. We agree that detailing our internal consistency analysis strengthens the methodological transparency of CODAP and provides greater confidence in data quality. Thermodynamic internal consistency checks were explicitly performed for cruises with overdetermined carbonate system parameters (i.e., simultaneous measurements of three or more parameters among DIC, TA, pH, and pCO2/fCO2). Using CO2SYS, we calculated pair-wise discrepancies between measured values and those calculated from parameter pairs (e.g., comparing measured pH against pH calculated from TA and DIC). These residuals allowed us to identify systematic offsets,

evaluate the constant consistency, and apply bias corrections or adjust quality flags prior to finalizing the synthesis product. We have added a dedicated subsection (Section 4.4: Carbonate System Thermodynamic Internal Consistency).