

We would like to thank **Reviewer # 2** for their positive review of our manuscript and thoughtful suggestions.

Below, we respond to the more significant suggestions, in the order they appear. The reviewer's comment is in italics, while our **Response** follows.

1. *“L177-178: Data from the DuraFET pH sensor were not reported in the dataset (all values for pH are -999 in the files) because the sensor was uncalibrated. However, the manuscript mentions that this data was used for the flagging of CO<sub>2</sub> measurements. To my knowledge the procedure to assess quality flags for CO<sub>2</sub> measurements from the pH data are not described in Sutton et al. 2024 and Sabine et al. 2020. Some information needs to be given on how the pH values were used to do quality checking.”*

**Response:** That section has been revised to add more detail:

“While the ASVCO<sub>2</sub> sensor package also included a DuraFET pH sensor, these data are not included in the files as they are uncalibrated. They were only used (along with internal CO<sub>2</sub> system diagnostics) to quality check and flag of CO<sub>2</sub> measurements. This was done by calculating covariance of pH and CO<sub>2</sub> observations over segments where there were significant CO<sub>2</sub> deviations. Existence (or lack) of covariance between CO<sub>2</sub> and pH outliers was used as independent evidence that CO<sub>2</sub> data were good (or questionable).”

2. *“L210 : Please give a reference to access the “ Mesoscale Eddy Trajectory Atlas ”*

**Response:** That location was placed in the acknowledgements because it is a very long website (and has no DOI that we are aware of). However, we have added an explicit reference in the revision (META3.2, 2025), then add a new reference in the reference list (assuming this is allowed by the Journal, since it does not have a DOI. This is a standard product for users interested in tracking mesoscale eddies and putting the location in the acknowledgements is standard practice.

New reference:

META3.2: Mesoscale Eddy Trajectories. SSALTO/DUACS/AVISO+.

<https://www.aviso.altimetry.fr/en/data/products/value-added-products/global-mesoscale-eddy-trajectory-product/meta3-2-exp-nrt.html>), downloaded January 4, 2025.

3. *“L216 to 227: The methodology used to assess if the Saildrone is outside or inside an eddy is described in this section. I believe that it would be useful to the reader to also indicate that the variable EDDY\_DIRECTION has only three values : 1 for Anticyclonic Eddy, 0 for no Eddy and -1 for Cyclonic Eddy.”*

**Response:** Done. New text reads:

“Because the goal of the SOS mission was to measure pCO<sub>2</sub> within different eddies, we have also provided an estimate of whether the USV was in an eddy or not, along with the type of eddy (cyclonic, anticyclonic) in the main mission datafile. The variable EDDY\_DIRECTION in the file has three values (1 for anticyclonic, -1 for anticyclonic, and 0 for not within an eddy).”

4. *“L260-265: The authors mention a bias between the pCO<sub>2</sub> values from the saildrone and the mean monthly climatology. It should be noticed that the mean monthly value of this climatology is based on the mean for a given month of the values spanning from 1988 to 2020 whereas the measured values are from 2022-2023. The temporal increase of the atmospheric CO<sub>2</sub> fraction could (at least partially) explain this bias).”*

**Response:** Reviewer # 1 also pointed this out and asked for a more thorough analysis, by looking at changes in the atmospheric CO<sub>2</sub> measured at the Crozet station in the Indian Ocean. We have first have added a comparison of the observed atmospheric pCO<sub>2</sub> and that made at Crozet around lines 306-312 of the revised manuscript:

“Atmospheric pCO<sub>2</sub> has a mean value of 410 µatm with a standard deviation of 3.5 µatm for both USVs. Observations of atmospheric CO<sub>2</sub> made at Crozet Island in the Indian Ocean (46.4°S, 51.8°E) between Sept. 4, 2022 and April 26, 2023 has a mean of 415.2 ppm (standard deviation = 0.46). Converting to pCO<sub>2</sub> in µatm using average and fixed air pressure (1 atm) and water vapor pressure (0.015 atm), this corresponds to approximately 409 µatm. Recalling that the accuracy of pCO<sub>2</sub> measurements from the ASVCO<sub>2</sub> system is ± 2 µatm, the USV measurements are consistent with observed pCO<sub>2</sub> in the region. The Crozet CO<sub>2</sub> measurements were downloaded from the NOAA Global Monitoring Laboratory (<https://gml.noaa.gov/data/dataset.php?item=crz-co2-flask>; Lan et al., 2025) on 30 Jul 2025.

In the following paragraph, we discuss the bias and explain it is primarily due to change in time from the mean of the climatology. Note that the climatology documentation never explicitly states the reference time, but we reached out to P. Landschützer and he provide it:

“... We do note a bias between the measurements of both SD1038 and SD1039 and the climatology (Fig. 5) of approximately 25-30 µatm (SD1038/1039 higher). The climatology was based on an average of observations from 1998 to 2015. Although the exact epoch represented by the climatology is not explicitly given in the reference paper or dataset (Landschützer et al., 2020a,b), P. Landschützer confirmed to us via email that the mean epoch is 2006-2007. The mean rate of change in atmospheric pCO<sub>2</sub> at Crozet since 2005 is ~ 2 µatm yr<sup>-1</sup> (based on the approximate pressure values stated previously). Multiplying this rate by the time difference (15-16 years) between our observations and the climatology epoch gives a climate-induced change of 30 to 32 µatm. Since oceanic pCO<sub>2</sub> should follow trends in atmospheric pCO<sub>2</sub> assuming an equilibrium state (e.g., Fay et al., 2024), one would expect measurements of oceanic pCO<sub>2</sub> to have changed by this much on average. This is approximately the bias we observe, so we conclude the observed bias with the climatology is primarily due to increasing CO<sub>2</sub> concentrations since 2006-2007 and any

smaller deviations are interannual fluctuations and using direct pressure/temperature observations instead of climatological means.”

5. L251 : *I would suggest renaming this section. The current title for this section “Analysis of the Chemistry data” is maybe confusing. I believe that the authors only make a preliminary illustration of the potential of the data rather than a real analysis of the data.*”

**Response:** We have renamed the Section to “Discussion of Observations.” Note that we have added figures of SST and SSS as well and added some brief discussion of changes of those parameters as the USVs move across fronts, at the Request of Reviewer # 1.

6. *“Figure 1 : This figure could certainly be improved. It is sometimes difficult to distinguish the trajectory of the saildrone due to the choice of the colors. The legend of the figure should also mention white more detail what type of data have been used for the standard deviation of the surface height variability.”*

**Response:** We recognize this is a busy figure. And Reviewer # 1 asked us to add even for information (the STF, location of Crozet, the Kerguelen Plateau, and bathymetry). We have adjusted the size of the dots and diamonds indicating the USV tracks and changed the colors to orange and dark blue to provide more contrast. We hope this is sufficient. Otherwise, we feel like we would need to create multiple figures to convey the information. We also note that the USV track information is also shown in other figures (4, 7, and 8) when we show pCO<sub>2</sub>, SST, and SSS.

7. *“Figure 2 and figure 3 : The color of the dots used to describe the center of the eddies is easy to distinguish. Maybe, it is not useful to give this information to these figures.”*

We feel the color of the central dot is not that distracting so choose to keep it.

8. *Several typos/minor corrections.*

**Response:** All have been made. We found several more incorrect subscripts in the revision review. “Ocean color” was removed and we now state “Chlorophyll  $\alpha$  based on fluorescence” throughout. This also occurred in the abstract.