Response to reviewer 1 comments

I appreciate the constructive comments from the reviewer to improve the manuscript. Below, I respond to each comment with the original comments copied in black font and my responses in blue.

Du et al. presents a worthwhile comparison of nine different oceanic dissolved oxygen datasets from differing methods. As a key biogeochemical property to understand current climate, including deoxygenation, patterns, this analysis is extremely worthwhile and valuable to the community. Despite some significant regionality, I am thoroughly impressed with how well these datasets align and only have minor questions for the authors.

Thank you for the positive comments on this study.

Major comments:

- I would like to see more information on how much of the data was from Winkler's vs. how much from sensors. That would be useful to understand some of the spatiotemporal biases.

Thank you for this comment. As the O_2 observations used to construct the eight climatologies are different in observation instruments/platforms and time coverage, but the major data sources (which constitute >95% of the data in WOD) are three: OSD, CTD, and Argo. Thus, we present the spatial distribution and annual number of profiles from these three instruments and added a new figure in the manuscript. The total numbers of OSD, CTD, and Argo profiles are 744,141, 215,345, and 188,497, respectively, for 1960-2024. It is clear that before 1990, OSD dominated; from 1990~2010, CTD dominated; and since ~2010, Argo has been widely used.

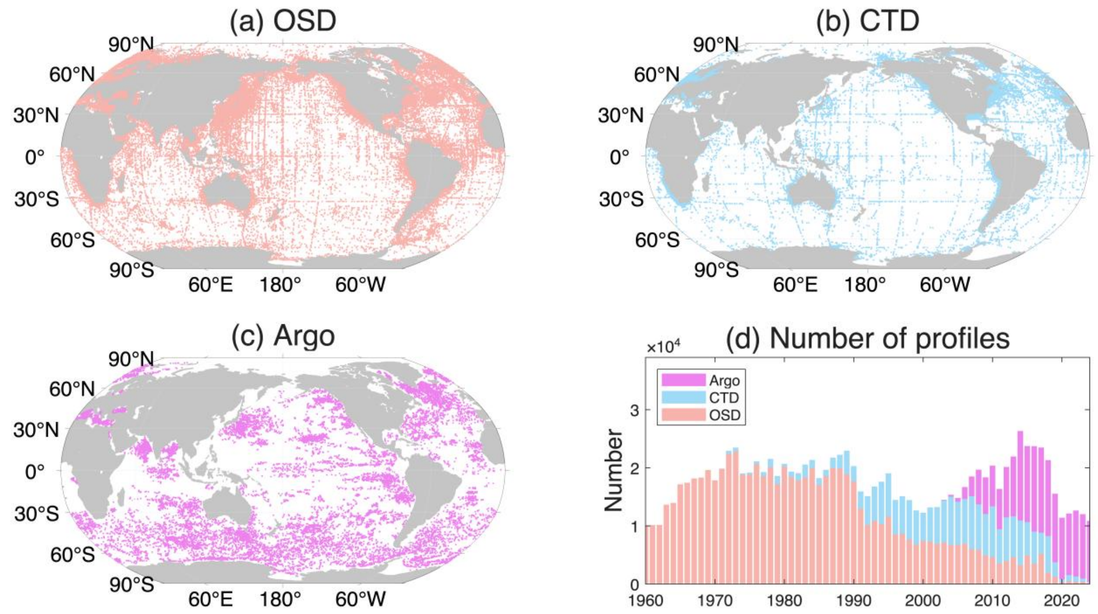

Figure 1 Spatial distribution (a: OSD, b: CTD, c: Argo) and annual number (d) of observation profiles.

Minor comments:

Line 65: Please define IPCC.

Thanks for the comment. The full name of IPCC, Intergovernmental Panel on Climate Change, has been added in Line 65.

Lines 66-68: Please keep numerical range formatting consistent.

Thanks for the comment. The numerical range in Line 66 has been changed from '0.3 %~2 %' to '0.3 %-2 %' and now the formatting are consistent for Lines 66-68.

Lines 75-77: Should be commas not semi colons.

Thanks for the comment. Semi colons in Lines 75-77 have been changed to commas as suggested.

Line 77: I would add "Since the late 19th century, oceanographers have measured ocean O_2 using many instruments with varying sampling resolutions."

Thanks for help improve the manuscript. The content 'with varying sampling resolutions' has been added to Line 77.

Lines 78-85: Similar to my comment from above, I would expand on this by noting that Winklers are labour intensive, leading to lower sampling resolution, whereas sensor-based measurements have better spatiotemporal resolution, and the proliferation of the BGC-Argo program has dramatically increased observations.

Thanks for the suggestion. The extended discussion, 'The Winkler data are labour intensive thus leading to less sampling, whereas sensor-based measurements have better spatiotemporal resolution, and the proliferation of the BGC-Argo program has dramatically increased observational capability.', has been added in this section.

Lines 118-122: Personally, I don't think this type of paper outline is necessary, but that is up to you.

Thanks for the comment. After consideration, the paper outline has been retained here to follow the journal style.

Lines 188-190: Have you trimmed both GOBAI and IAP so that the exact years match up (i.e., 2004-2022)? That should correct for any bias specifically due to the dataset age.

We haven't done this in our study because we aim to provide a direct comparison of the existing datasets. We believe that climatologies constructed from observation profiles with exactly the same data age will be of great importance and more consistent in understanding the mapping method. Such exercises will be conducted in an internationally coordinated group (GO-DIP) (Ito et al. 2025).

Line 307: Gradients, plural.

Thanks. Corrected.

Lines 338-349: I appreciate the discussion of biological and physical controls on the annual cycle, but this feels like the first time underlying mechanistic drivers are being discussed. Can you similarly discuss biological and physical controls on spatial patterns or zonal structures?

Thanks for the comment. Some discussions have been added for the zonal mean annual cycle analysis (Fig. 8) in the manuscript: 'For both 0-100 m and 100-600 m, the phase transitions of the zonal mean temperature anomaly occur around June and January for all datasets, which are consistent with the annual variation analysis of O_2

anomaly in Fig. 5. The phase change of O_2 lags about one month behind the temperature change (June and December as shown in Fig. S12), reflecting that some biological and ventilation processes also impact the O_2 seasonal variations besides the solubility'. The figure of zonal mean annual cycles of temperature anomaly is added in Supplementary material as Fig. S12.

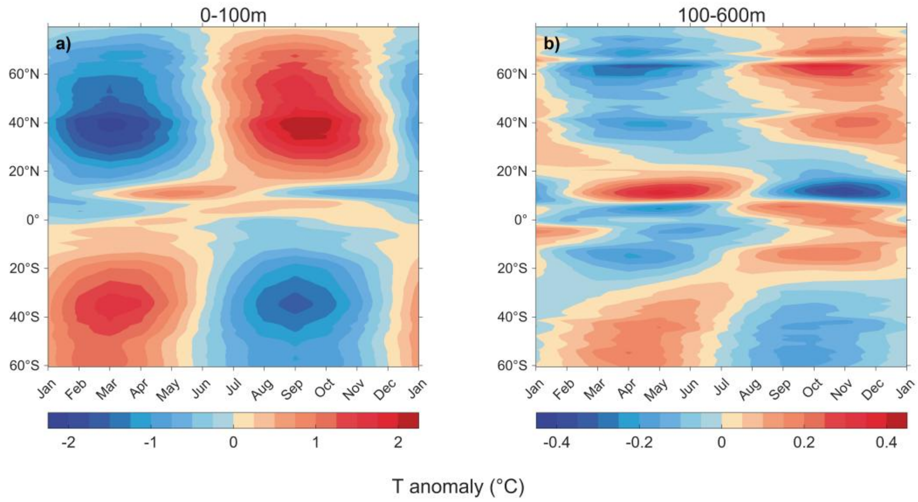

Figure S12 Zonal mean annual cycles of temperature anomaly for 0-100 m (a) and 100-600 m (b) for IAP temperature data product (unit:°C).

We also added some discussions about the zonal mean annual cycles of solubility and Apparent Oxygen Utilization (AOU) in the manuscript with a new figure as following:

The zonal mean annual cycles of solubility and Apparent Oxygen Utilization (AOU) of different data products for 0-100 m and 100-600 m are shown in Fig. 10. The solubility is calculated using the gridded temperature and salinity products of IAP (Cheng et al., 2024) following the Garcia and Gordon (1992) method. Generally, the zonal 0-100 m O_2 seasonal cycle is mainly dominated by the solubility, whereas the AOU dominates the 100-600 m O_2 pattern.

For 0-100 m, the AOU seasonal cycle in the mid-latitude is about two to three months lagging that of the temperature/solubility seasonal variation (Figs. 6, 10, S12). Within 20° N-60° N, the zonal mean AOU anomaly of 0-100 m is mostly negative from March to August. The phase transition of AOU occurs in March, which corresponds to the temperature minimum/solubility maximum. And AOU reaches a minimum in about May/June, corresponding to the phase transition of the zonal mean temperature/solubility anomaly (Fig. S12, 10). A possible explanation is from the combined impacts of biological and physical processes. The spring phytoplankton bloom lags the onset of temperature increase (starting in Mar.) because phytoplankton proliferation requires sufficient light from increasing spring insolation and nutrient entrainment due to a shallower mixed layer (Martin, 2012). And the net community production (NCP, the difference between gross community photosynthesis and community respiration) reaches a maximum in about May (Wang et al., 2022). The solubility reaches a minimum in September, which corresponds with the phase change of AOU. And the maximum of AOU lags about two months behind the temperature maximum/solubility minimum, which is also a combined effect of the prolonged response time of biological processes and the physical processes possibly induced by the deepening autumn mixed layer. The situation in 20° S-60° S is similar to 20° N-60° N for 0-100 m, mainly with the signs reversed. For 100-600 m, the annual variation in temperature/solubility is relatively small, and the pattern of AOU variation dominates, with the underlying processes requiring further investigation.

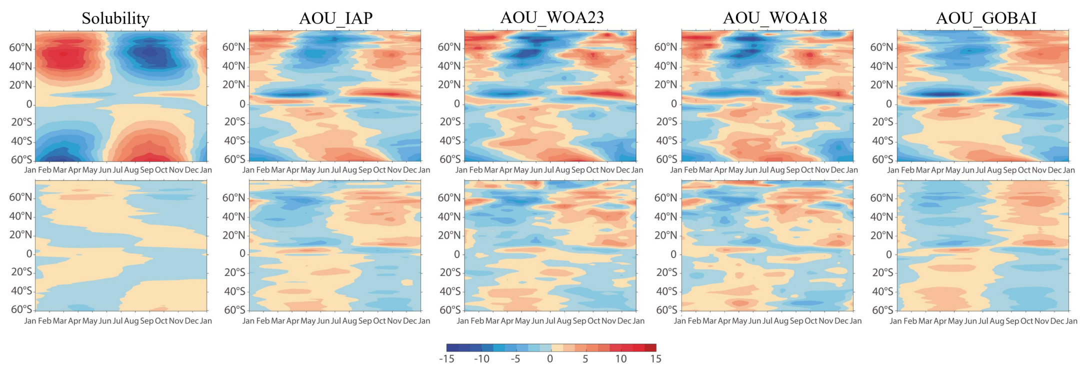

Figure 10 Zonal mean annual cycles of the solubility and AOU anomaly of different data products for 0-100 m (upper) and 100-600 m (lower) (unit: μmol kg^{-1})