Review of Pickup et al. "Cold lenses in the Amundsen Sea: Impacts of sea ice formation on subsurface pH and carbon" submitted to Ocean Science.

We are grateful to the reviewer for their helpful comments and suggestions. Below we provide the reviewer's comments in plain black text and our responses to their feedback are provided in bold. Revised text to be added to the paper is shown in blue

Overall this is a well written, scientifically rigorous study focused on observations of subsurface cold water lenses and a selection of their physical and biogeochemical signatures in the vicinity of the Dotson Ice shelf and the Dotson-Getz trough and surrounding environs. The observations presented here warrant prompt publication as they are incredibly difficult to capture and scientifically novel.

Thank you for your positive comments and appreciation of our novel data set.

Specific comments are below:

Introduction: There is a new Nature Reviews article on Antarctic coastal polynya's that may be worth referencing https://www.nature.com/articles/s43017-024-00634-x

Thank you for this helpful suggestion. This reference has been added in two places in the introduction:

Coastal polynyas are formed by katabatic winds that push sea ice away from the coast; the newly exposed surface water cools and refreezes before being blown offshore, continually generating open areas for new ice formation during winter (e.g. Golledge et al., 2025).

A recent review on Antarctic polynyas by Golledge et al. (2025) highlighted that many gaps in understanding processes in polynyas - including the role of long-term carbon sequestration in the Amundsen Sea- stem from limited observations.

A paper by Couto et al., 2017 https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2017JC012840 similarly used gliders to track subsurface eddy features (with very different water mass characteristics) on the Western Antarctic Peninsula. It would be a nice reference to highlight and compare methodologies.

Thank you for bringing this paper to our attention and we agree. The reference and some discussion have been added to the introduction:

The Rossby radius in this region is less than 10 km (Chelton et al., 1998), so mesoscale features, such as eddies and meanders, are only a few kilometres in radius. Gliders have been used previous on the West Antarctic Peninsula to detect eddies on the order of 10 km (Couto et al., 2017). With biogeochemical sensors, including a novel pH sensor, we identify the properties of observed mesoscale features in the Amundsen Sea, and discuss their formation.

We have also used this study as a way of supporting the fact that our glider profiles likely captured all of the lenses as they were 2-3x bigger than the eddies seen by Couto et al. 2017. This sentence is located towards the end of the discussion:

In our study, glider profiles were spaced 1–2 km apart, comparable to the spacing used by Couto et al. (2017), who successfully resolved eddy features with scales of 10 km. Given that the lenses we observed were up to 2–3 times larger than those eddies, we are confident that our glider resolution was sufficient to capture the full and representative distribution of lenses present in the study area.

Methods:

Line 72 - 80: How significant were the observed salinity spikes prior to removal? What approximate vertical resolutions were the data collected at at the 5s intervals? Was CTD data used from both downcast or upcast, or just the upcast data in conjunction with the slow upcast sampling for the pH sensor? I am surprised there's a thermal lag issue for such slow vertical speeds on upcasts for pH sampling and wonder if upcast only data is considered if the Garau method is necessary. How meaningful are the corrections to the final results of the paper?

Salinity spikes, were on the magnitude of up to ± 1 PSU. There is approximately a salinity measurement every 0.5 – 1 m with a 5s interval sampling time. The Garau method is included in the Seaglider processing toolbox used for this dataset (Queste et al., 2012, doi: 10.1109/AUV.2012.6380740), and we have added this reference for clarity:

Temperature and conductivity sensors (Sea-Bird CT Sail) were integrated on both Seagliders with sampling intervals of 5 seconds which corresponded to a measurement approximately every 0.5 - 1 m. The raw outputs were processed using the UEA Seaglider Toolbox (Queste et al., 2012) which incorporates corrections for the thermal lag of the un-pumped conductivity cell that produced artificial salinity spikes (on the scale of ± 1 PSU) following Garau et al. (2011).

For all variables, except for pH, both the upcast and downcast are used. We have added a sentence to clarify this as well as the speed of the descent:

For pH, only measurements taken during the ascent are reported in this study due to the nature of the glider flight which was programmed to travel relatively slowly during the ascent at a speed of 0.09 m s−1, yielding a higher vertical resolution of pH measurements. For all other sensors, both ascent and descent measurements are included.

The mean difference between the raw and final dataset of salinity is -0.0011 and the RMS difference is 0.0075. These values have been added to the methods.

The mean difference and root mean squared difference between the processed and raw versions of salinity measurements were -0.0011 and 0.0075, respectively.

Line 85: 3km is quite far and 6 profiles are not very many. I don't have an issue with the offset, but I suspect it would be helpful to say that this correction is small relative to the scale of the measured oxygen differences between the lens features of interest and surrounding waters.

We agree and have added this clarification:

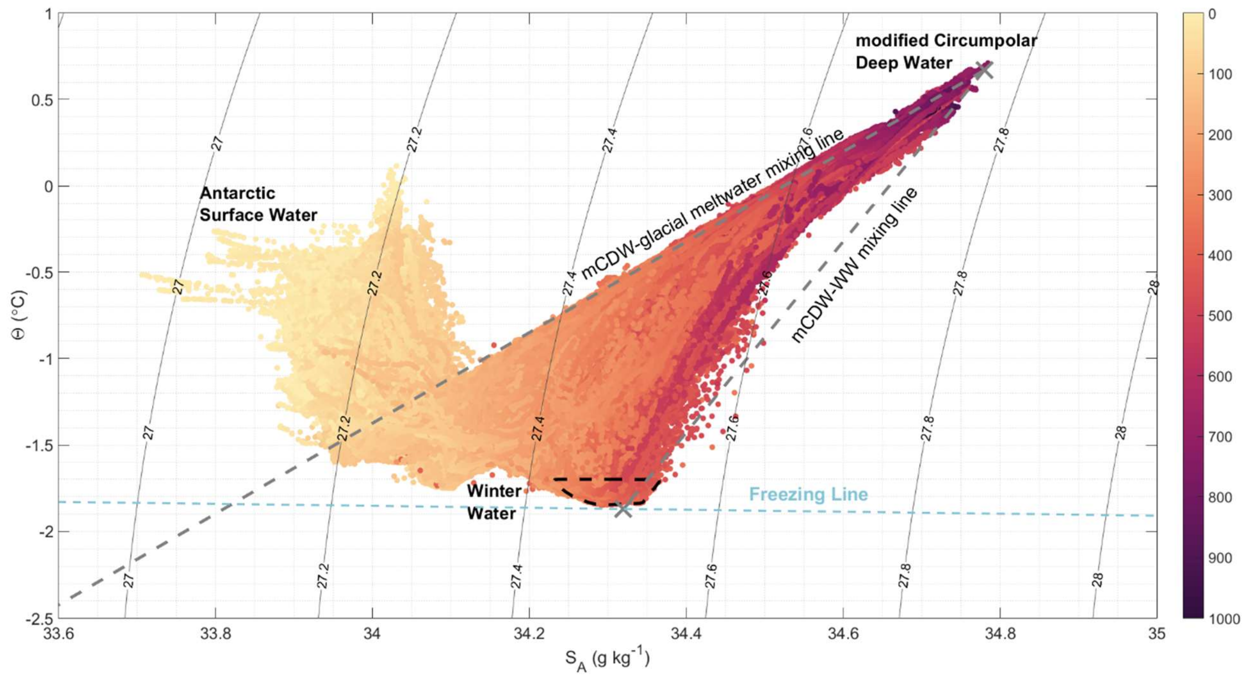
This correction is small relative to the magnitude of the O2 differences observed between the lenses and the surrounding waters.

Results:

lines 140 - 142: I found this section confusing. I understand what you're going for referring to two temperature minima, but for the full dataset there's really only one minimum, consider rephrasing to clarify or highlighting that it is the minimum of temperature on either side of a salinity value in the first sentence. Furthermore, including a box or marker on Figure 2 of what 'minima' you are referring to would be helpful.

We agree and have amended the text to make it clearer. In Figure 2 we have outlined the range in Θ/SA values that were detected inside the lenses to better distinguish those values from the Θ/SA values of the overlying WW at the lower salinity

Analysis of the water masses in temperature-salinity space reveals two distinct salinity ranges where Θ is less than -1.60 ◦C (Fig. 2) The more saline water mass (with SA greater than 34.2 g kg−1) is denser with temperatures closer to the freezing line (as calculated using TEOS-10 (McDougall et al., 2010). The less saline water mass (with SA less than 34.2 g kg−1) is the WW layer that lies below the AASW (Fig. 3a and b), with an SA between 34.05 and 34.15 g kg−1 (Fig. 2).

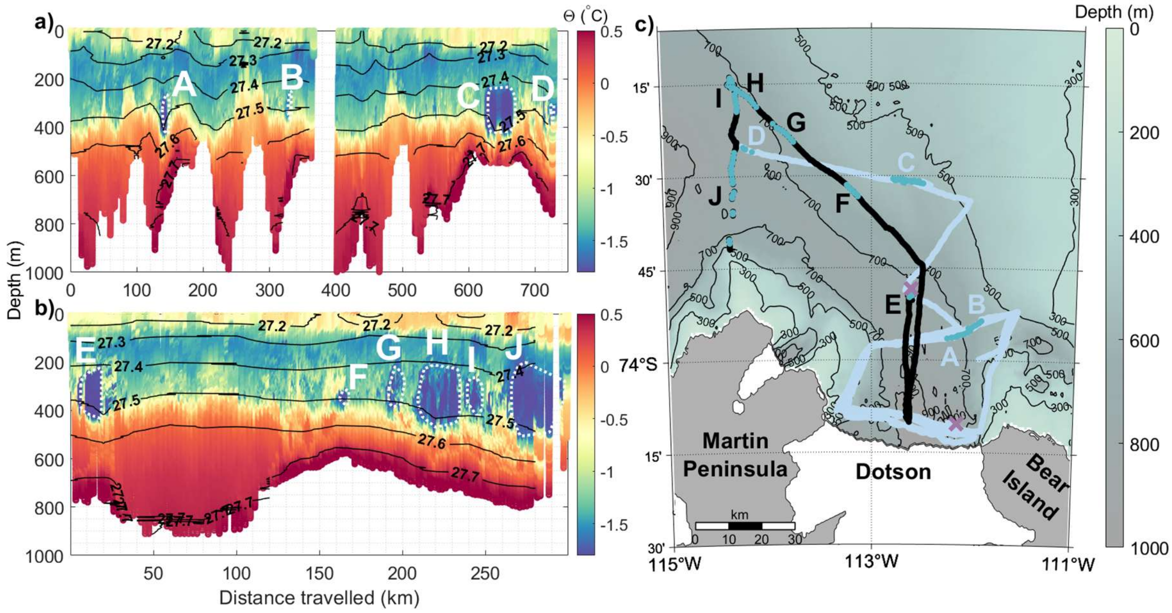


Line 142: You refer to the melting-freezing line here, but in the figure it only says 'freezing line.' I recommend consistency for clarity.

This has been amended in the text.

Figure 3: I recommend plotting the start and end locations on the map so it's easier to reference the figures on the left, which are in distance traveled. The light gray tracks are very difficult to make-out.

Markers for the start have been added to Figure 3c as purple crosses. The colour has been changed to blue to make the track clearer.



Discussion:

Line 264: The reference formatting looks incorrect.

Yes, there was a typo in the citation for Rysgaard et al., 2011. This has been corrected now.