We thank reviewers 1 and 2 for their constructive comments that we feel have helped to strengthen the manuscript. Throughout, we have increased the number of relevant references, and due to our limited number of samples (and thus statistical robustness), we have toned down the language regarding the potential predictive capacity of the PCCratio vs. POC flux relationship. Our individual responses to the reviewer's comments are below in bold.

Reviewer 1:

Overall recommendation: Major Revision

This manuscript presents a valuable observational dataset from the northwestern Weddell Sea continental shelf, a region where in situ observations remain logistically challenging and scientifically important. The combination of phytoplankton pigment analyses with sediment trap measurements addresses a timely and relevant question concerning the links between phytoplankton community composition and biological carbon export in the Southern Ocean. The dataset itself is valuable, the manuscript is generally well organized, and the analytical procedures appear appropriate.

Thank you for your positive remarks.

However, I believe that the manuscript, in its current form, substantially overstates both its novelty and the strength of the conclusions that can be supported by the available evidence. My concerns therefore relate primarily to the interpretation of the results and their positioning within existing literature, rather than to the quality of the observations themselves.

Overall, I believe the manuscript has the potential to become an important contribution, but substantial revision is necessary before it can be considered for publication.

Thank you, we have revised the manuscript to address these concerns.

Major comments

1. Positioning of the study within existing literature

The manuscript repeatedly states (including in the Abstract, Discussion and Conclusions) that this dataset represents "one of the only, if not the only, HPLC dataset" and one of the only phytoplankton community composition datasets available from the Weddell Sea continental shelf. I do not believe these statements accurately represent the current state of knowledge.

Over the last decade, several studies have investigated phytoplankton community composition using HPLC/CHEMTAX approaches across the Antarctic Peninsula and adjacent Weddell Sea sectors, providing information on phytoplankton functional groups, environmental controls and regional ecological variability. While these studies differ in spatial coverage and scientific objectives, they represent important regional context and should be considered when positioning the present contribution.

Importantly, acknowledging this previous work does not reduce the novelty of the present study. Instead, it allows the authors to more accurately define what is genuinely novel here, namely the coupling of pigment-derived phytoplankton community composition with sediment trap observations from this particular continental shelf environment.

I therefore encourage the authors to revise statements regarding the uniqueness of the dataset and to distinguish more clearly between the scarcity of observations from this specific shelf region and the broader availability of HPLC/CHEMTAX observations across the Antarctic Peninsula-Weddell Sea sector.

Examples include, but are not limited to, previous HPLC/CHEMTAX studies from the Antarctic Peninsula and adjacent Weddell Sea (e.g., Mendes et al., 2012, http://dx.doi.org/10.1016/j.dsr.2012.03.002; Mendes et al., 2018, https://doi.org/10.1016/j.dsr2.2017.12.003), recent regional studies investigating the role of phytoplankton community composition in biogeochemical processes and carbon cycling (e.g., Senger et al., 2026, https://doi.org/10.3354/meps15088), and additional regional investigations from other research groups addressing pigment-based community reconstruction and Southern Ocean biogeochemistry.

We thank the reviewer for providing these valuable references. We agree, placing our dataset in the context of studies in the broader region of the Antarctic Peninsula, and other areas of the Weddell Sea, would help improve the framing of our study. As the reviewer acknowledges, the dataset presented here is likely still the most comprehensive dataset of pigment samples from this very undersampled region, but in light of the comment raised, we have now changed the text to acknowledge studies from the larger Weddell Sea region and Western Antarctic Peninsula. See lines 61 -63:

"Phytoplankton community composition sampling in the ice-heavy Weddell Sea is sparse, with most of our knowledge coming from several independent cruise programs occurring broadly in the Weddell Sea sector of the Southern Ocean, over varying months and years (Kang and Fryxell, 1993; Schloss and Estrada, 1994; Wright et al., 2009; Xi et al., 2020; Flynn et al., 2023)."

2. The relationship between phytoplankton community composition and carbon export is not sufficiently demonstrated

The Title, Abstract and Conclusions all emphasize that phytoplankton community composition influences particulate organic carbon export. While this represents an important scientific hypothesis, I do not believe the analyses presented fully demonstrate this relationship. The manuscript convincingly characterizes the spatial variability of phytoplankton communities and presents valuable sediment trap observations. However, these two components remain largely independent lines of evidence rather than being quantitatively linked through robust evidence. In addition, the manuscript would benefit from a more explicit discussion of the potential temporal and spatial mismatch between the phytoplankton community sampled in the water column and the integrated particulate flux collected by the sediment traps. **We thank the reviewer for raising this point. We have now modified discussion between phytoplankton community composition and carbon export, to suggest a possible relationship rather than implying it has been sufficiently demonstrated. See lines 24-26:**

"While additional measurements are needed to verify these relationships, these findings highlight the need to consider frequently overlooked phytoplankton types, alongside diatoms, in Southern Ocean models of carbon export due to the key, but differing, roles these groups play in production-export dynamics."

Lines 533-536:

"*The substantial ecological differences between the Kramer et al. (2025) dataset and this study highlight the potential utility of this relationship to predict the magnitude of POC flux across diverse ecosystems. While further in situ Antarctic sampling and analysis is clearly required, even the limited number of samples shown here suggest that a strong relationship exists."*

Line 606-608:

"While more research is needed to robustly test this relationship through space and time, particularly in multiple bloom stages and during a Phaeocystis bloom, the potential predictive capacity of diatom + photosynthetic hacrobia community composition to estimate the magnitude of POC flux appears strong and holds across oceanic systems."

The application of the PCCratio following Kramer et al. (2025) is an interesting exploratory exercise. However, in the present manuscript this relationship is evaluated using only four sediment trap deployments. Consequently, statistical significance is not achieved ($p > 0.05$), and the available evidence does not support statements referring to a "strong predictive capacity" or broad conclusions regarding the influence of phytoplankton community composition on carbon export. Throughout the manuscript, the distinction between exploratory evidence, statistical association, ecological interpretation and predictive capability should be made much clearer. **We appreciate the reviewer's comment and have toned down some of the language regarding the PCCratio to discuss a possible**

relationship rather than definitive (as mentioned above). See lines 24-26, 533-536, and 606-608 (shown above).

3. The Discussion and Conclusions extend beyond the strength of the evidence

Several sections of the Discussion and Conclusions extrapolate from a single cruise and a limited number of sediment trap observations to broader implications for Southern Ocean biogeochemistry and Earth System Models. Although these implications are scientifically interesting and certainly worthy of discussion, they should be presented as hypotheses or future research directions rather than as conclusions demonstrated by the present study. Overall, I recommend moderating several statements throughout the Discussion and Conclusions so that the level of inference remains proportional to the strength of the available evidence. **We agree with the reviewer and have now altered text in the discussion and conclusion as suggested to present the implications of our study as hypotheses or future research directions. See lines 588-589:**

"More concurrent in situ community composition and carbon export observations are needed to better test the relationships found here within the Weddell Sea continental shelf and the wider Southern Ocean."

4. Interpretation of the haptophyte signal as *Phaeocystis*

Throughout the manuscript, the pigment-derived haptophyte signal is frequently interpreted as representing *Phaeocystis*. While this is certainly a plausible interpretation, I encourage the authors to discuss this result more cautiously. Unlike other sectors of the Southern Ocean (e.g., the Ross Sea), where large *Phaeocystis* blooms are a characteristic feature of the seasonal phytoplankton succession, the northwestern Weddell Sea and Antarctic Peninsula are generally characterized by more heterogeneous phytoplankton assemblages in which diatoms, small flagellates (e.g., cryptophytes) and athecate dinoflagellates frequently coexist, and *Phaeocystis* generally represents a less dominant component of the phytoplankton community than in regions such as the Ross Sea.. **The reviewer brings up a good point about the pigment-derived haptophyte signal not necessarily representing *Phaeocystis*, and we have added clarifying language. However, we also want to point out that the interpretation of a *Phaeocystis* bloom at Larsen-C is supported by Flowcam data. For the PCCratio, the Kramer et al. method discusses hacrobia (photosynthetic haptophytes and cryptophytes), not *Phaeocystis*, so this method is not subject to such uncertainty regarding which phytoplankton genus is present. We have clarified this in the text to justify our interpretation. See lines 353 – 355:**

"Caution should be taken to assume all haptophytes represent Phaeocystis antarctica, but for the Larsen-C region, this assessment is supported by Flowcam data collected during the PICCOLO cruise sampling, which show the presence of Phaeocystis colonies (Fileman et al., 2026)."

In addition, several regional studies have demonstrated that pigment-based discrimination between *Phaeocystis* and small Type B athecate dinoflagellates (e.g., *Gymnodinium* spp.) is not always straightforward (e.g. Mendes et al. 2018). These groups may exhibit sufficiently similar pigment signatures to complicate their discrimination using standard CHEMTAX parameterizations. Previous regional CHEMTAX applications (e.g. Mendes et al. 2018) have shown that improved discrimination can be achieved by refining the initial pigment ratio matrices using diagnostic accessory pigments characteristic of the dinoflagellates. Consequently, the attribution of the haptophyte pigment signal exclusively to *Phaeocystis* may depend on the specific CHEMTAX parameterization adopted and should therefore be discussed explicitly as a potential source of uncertainty. **The reviewer raises an excellent point, we have now altered our discussion as suggested to explicitly discuss the potential source of uncertainty arising from attribution of the haptophyte pigment signal exclusively to *Phaeocystis*. See lines 196-198:**

"For example, for Phaeocystis, an important Southern Ocean taxon, shared pigments can confound the interpretation of assemblages which may be either Phaeocystis or dinoflagellates based on traditional CHEMTAX methods (Mendes et al., 2018)."

A brief discussion of the initial pigment ratio matrix adopted and its suitability for this particular region would therefore strengthen the manuscript. **A thorough description of the pigment ratio matrix is available in the paper by Hayward et al. (2023), so rather than repeating this information in our text, we have explicitly directed the reader to this work for these details and cited it in the paper. We have also provided a discussion of the application of *phytoclass* to this region and directed the reader to the Hayward et al. (2023) paper for further details. See lines 127 – 130:**

"This model is specific to the Southern Ocean and assesses the distribution of diatoms, dinoflagellates, haptophytes, cryptophytes, and Synechococcus from simulated annealing of accessory pigment concentrations (Hayward et al., 2023). phytoclass uses the same basis and statistical assumptions as the CHEMTAX method (Mackey et al., 1996) but is tuned for the Southern Ocean."

This issue is particularly relevant because the manuscript's ecological interpretation relies heavily on the inferred relative contribution of haptophytes. Unless supported by independent taxonomic observations (e.g., microscopy or molecular analyses), I recommend moderating interpretations that directly equate the haptophyte pigment signal with *Phaeocystis* throughout the manuscript. **As mentioned above,**

the presence of *Phaeocystis* is supported by Flowcam data, so we are confident of our interpretation. See Lines 353-355:

"Caution should be taken to assume all haptophytes represent Phaeocystis antarctica, but for the Larsen-C region, this assessment is supported by Flowcam data collected during the PICCOLO cruise sampling, which show the presence of Phaeocystis colonies (Fileman et al., 2026)."

5. Additional justification for the PCCratio

The application of the PCCratio proposed by Kramer et al. (2025) is potentially valuable. However, the manuscript would benefit from a clearer explanation of the ecological rationale underlying this metric, particularly the justification for placing dinoflagellates (together with *Synechococcus*) in the denominator. **Thanks! In light of this helpful comment, additional explanatory language to describe the motivation for designation of the numerator (Kramer et al., 2025) and the denominator (*phytoclass*) are now provided on lines 167-169:**

"Kramer et al. (2025) decided to separate diatoms and hacrobia from all other phytoplankton after testing the statistical power of six pigment-based eukaryotic phytoplankton groups to reconstruct POC flux."

Furthermore, while this metric represents an interesting framework for exploring relationships between phytoplankton community composition and carbon export, its application to the present dataset should be interpreted cautiously given the limited number of observations available. Finally, I recommend avoiding direct comparisons, suggesting that the present relationship is stronger than that reported by Kramer et al. (2025), since the substantially different sample sizes and associated uncertainties make such comparisons difficult to interpret. **We agree, and have now added additional text to suggest caution when interpreting the relationships and have removed some of the more definitive language. See lines 533-535.**

"The substantial ecological differences between the Kramer et al. (2025) dataset and this study highlight the potential utility of this relationship to predict the magnitude of POC flux across diverse ecosystems."

Minor comments

Throughout the manuscript, terms such as "association", "influence", "control", "prediction" and "predictive capacity" should be used more consistently, as they imply different levels of inference. **Thanks for this comment. We have reviewed the use of this language, and made appropriate alterations, as suggested. For example, see lines 550-552:**

"To test whether diatom abundance alone could be used as an indicator of POC flux (i.e., carbon export) in the euphotic zone, the percent contribution of just diatoms was regressed against POC flux (Figure S5)."

As well as, lines 601-603:

"The results presented here showcase the importance of understanding variable phytoplankton community composition and show a strong positive relationship between POC flux and high proportions of diatoms, typically thought to enhance flux, and hacrobia, typically thought to reduce flux."

Statements regarding the uniqueness of the dataset should be revised following a more comprehensive review of the regional literature. **Now clarified, as discussed above.**

Several conclusions should be moderated to better reflect the statistical evidence presented. The Conclusions would benefit from emphasizing that this study provides valuable observations and generates promising hypotheses regarding links between phytoplankton community composition and carbon export, while recognizing that additional observations are required to establish robust predictive relationships. **Additional text has now been added to emphasize that more research is needed. See line 588-589:**

"More concurrent in situ community composition and carbon export observations are needed to better test the relationships found here within the Weddell Sea continental shelf and the wider Southern Ocean."

Lines 606-608:

"While more research is needed to robustly test this relationship through space and time, particularly in multiple bloom stages and during a Phaeocystis bloom, the potential predictive capacity of diatom + photosynthetic hacrobia community composition to estimate the magnitude of POC flux appears strong and holds across oceanic systems."

Final assessment

In summary, I believe this manuscript contains a valuable dataset from an important and under-sampled region of the Southern Ocean and has the potential to make a meaningful contribution to our understanding of phytoplankton community composition and carbon export. However, its scientific impact would be substantially strengthened by (i) a more complete and balanced review of the regional literature, (ii) a clearer distinction between observations and inference, (iii) a more cautious interpretation of pigment-derived taxonomic assignments, and (iv) conclusions that remain fully consistent with the strength of the evidence presented. With these revisions, I believe the manuscript would provide a more

robust and balanced contribution to Southern Ocean literature. **As discussed above, we have now directly addressed all four of these points. We thank Reviewer 1 for** raising them and helping us improve the paper.

Reviewer 2:

Within this manuscripts spatial patterns in phytoplankton community composition and their linkage to carbon export on the northwest Weddell Sea continental shelf are presented. Results are based on surface water phytoplankton (HPLC based) pigment data and POC data analyzed from sediment trap samples. The dataset itself is valuable, however, very limited to meet the objective to identify the influence of phytoplankton community composition on carbon export. Too few results (only 2 Figures in the main manuscript show results, one more Figure shows the study site with the sampled stations) are presented to justify a thorough manuscript publication. Besides, the study lacks clarity in method description, profound discussion of limitations of the chosen approach, appropriate visualization of major results in figures, citation of appropriate references and more observations affirming their hypothesis that cryptophytes play an important role in this region for carbon flux and export. I provide many details below which provide a basis for improving the manuscript so it can meet the journal's standards for publication. **We thank Reviewer 2 for reviewing our paper and for providing these helpful suggestions to help us improve it and meet the journal's standards for publication.**

Specific Comments:

1. The Introduction can benefit from some additions to relevant references, or systematic referencing:

Line 29: This was also shown in more details for the last 22 years in the latest Ocean State Report #9: Xi et al. (2025, doi.org/10.5194/sp-6-osr9-7-2025), reference should be provided. **Additional reference added. See lines 32 and 63.**

Line 36: I suggest to provide in addition to Cetinic et al. (2024) two other very relevant references here: **Additional references added. See lines 49-50.**

Dierssen, H. M., Ackleson, S. G., Joyce, K. E., Hestir, E. L., Castagna, A., Lavender, S., and McManus, M. A. (2021). Living up to the hype of hyperspectral aquatic remote sensing: science, resources and outlook. Frontiers in Environmental Science, 9.

IOCCG (2026). A Scientific Roadmap of Aquatic Hyperspectral Remote Sensing: Overview of Status, Challenges and Future Perspectives. Bracher, A., Dogliotti, A., Werdell, J. (eds.), IOCCG Report Series, No. 22, Version 1.0, International Ocean Colour Coordinating Group, Dartmouth, Canada

Thanks for these suggestions. We have now added these references to the introduction.

Line 42: I suggest just to cite the reviews by IOCCG (2014, the correct citation should be: IOCCG (2014). Phytoplankton Functional Types from Space. Sathyendranath, S. (ed.), Reports of the International Ocean-Colour Coordinating Group, No. 15, IOCCG, Dartmouth, Canada. and not Sathyendranath et al. 2014), Bracher et al. (2017) and IOCCG #22 (see above) and not single algorithm publications (Chase et al. 2017, Kramer et al. 2022, Lange et al. 2020 – as then many more would be needed to be cited …. !). **Thank you for providing the IOCCG citation. We have added that as a good, overview publication, but we opt to also include Kramer et al. (2022) as it has direct relevance to the Kramer et al. (2025) paper that is heavily referenced in this analysis. See lines 47-51:**

"The increase in hyperspectral capabilities on satellites (Gorman et al., 2019) and remotely-operated instruments (Suomalainen et al., 2021) has been instrumental in increasing the amount of phytoplankton community composition data collection to a level previously not possible (Dierssen et al., 2021; Kramer et al., 2022; Cetinić et al., 2024; IOCCG, 2026)."

Line 54: add Xi et al. 2020 data, as here HPLC data from the Weddell Sea are presented (in the global evaluation of the algorithm) which are from the RV Polarstern Expedition PS103 in the Southern Ocean: https://doi.pangaea.de/10.1594/PANGAEA.898941 (Bracher, 2019). **Thank you for pointing out this oversight. The Xi et al. paper adds data from the larger Weddell Sea region, so while it does not provide a substantial amount of information for the unique Weddell Sea continental shelf, we have added it for regional context. See lines 275-277:**

"Phytoplankton community composition sampling in the ice-heavy Weddell Sea is sparse, with most of our knowledge coming from several independent cruise programs occurring broadly in the Weddell Sea sector of the Southern Ocean, over varying months and years (Kang and Fryxell, 1993; Schloss and Estrada, 1994; Wright et al., 2009; Xi et al., 2020; Flynn et al., 2023)."

Xi H., Losa S., Mangin A., Soppa M.A., Garnesson P., Demaria J., Liu Y., Fanton d'Andon O., Bracher A. (2020) Global retrieval of phytoplankton functional types based on empirical orthogonal functions using CMEMS GlobColour merged products and further extension to OLCI data. Remote Sensing of Environment 240: 111704 . https://doi.org/10.1016/j.rse.2020.111704

Method description lacks clarity:

Chapter 2.1: it is also not clear from the map in Figure 1 and the text if station 32 contains three stations, then in the text you cite station names with YD, why is that?

Apologies for the confusion. We have now clarified in the caption to Figure 1 that the numbers refer to yearday (YD) of sampling, not station. We have added a sentence to section 2.1 to clarify that on some YDs, multiple CTD casts were conducted, and the results are presented individually to show the greatest amount of geographic detail. Hence, that is why YDs are sometimes repeated in Figure 2 or refer to multiple dots on Figure 1. See lines 85-86:

"Sometimes multiple CTD casts occurred on the same YD. These CTD casts are presented individually to show the greatest amount of geographic variability."

It would be helpful to have a table where all stations with their number, classification in oceanic regimes, sampling depths for pigment samples, sediment trap sample depths for POC samples are indicated. **Thank you for this helpful comment. This suggested table is now included in the supplemental and referenced on lines 94-95:**

"For full details on collection dates and locations, see Table S1."

Chapter 2.2: Line 78 – from which depths you sampled exactly? Easiest is to add this information to the above-mentioned table. **We have added this information to the above-mentioned table (Table S1) as suggested.**

Chapter 2.3, Line 103: You mention emerging studies, but no reference, can you provide one, if not published at least a link to a personal communication. **The relevant reference was added as suggested. See lines 133-136:**

"Emerging studies have also shown general agreement between phytoclass outputs with microscopy and Flowcam data in open-ocean regions of the Southern Ocean, providing enhanced confidence in applying the method in this ecosystem (T. Ryan-Keogh, personal communication)."

Can you add an explanation why Phytoclass and not Chemtax was chosen here, as Phytoclass for now has no verifications for your study area? **Thank you for the suggestion. *phytoclass* was chosen as it is a Southern Ocean specific method (Hayward et al., 2023). Because of the unique physiological characteristics of Southern Ocean phytoplankton, this method was deemed more appropriate than the general CHEMTAX (see discussion in the Hayward et al 2023 paper on benefits over CHEMTAX). We have now added this explanation to the text in lines 127-130:**

"This model is specific to the Southern Ocean and assesses the distribution of diatoms, dinoflagellates, haptophytes, cryptophytes, and Synechococcus from

simulated annealing of accessory pigment concentrations (Hayward et al., 2023). phytoclass uses the same basis and statistical assumptions as the CHEMTAX method (Mackey et al., 1996) but is tuned for the Southern Ocean."

The section lacks to explain how % HPLC-derived accessory pigments on total pigment concentration (and % CHla phytoplankton groups on TChla), I assume, are calculated. **Thank you for the suggestion. We have added an equation to explain how the % HPLC-derived accessory pigments on total pigment concentration are calculated in section 2.2, see lines 118-121:**

"Proportional contributions of each key accessory pigment were calculated as shown in the following equation (1):

$$\boldsymbol{Proportional\ contribution}\ (\%) = \frac{\boldsymbol{accessory\ pigment\ concentration}}{\sum \boldsymbol{all\ accessory\ pigment\ concentrations}} \qquad \textbf{(1)}$$

Where the concentration of each key pigment is divided by the sum of the total concentration of all accessory pigments."

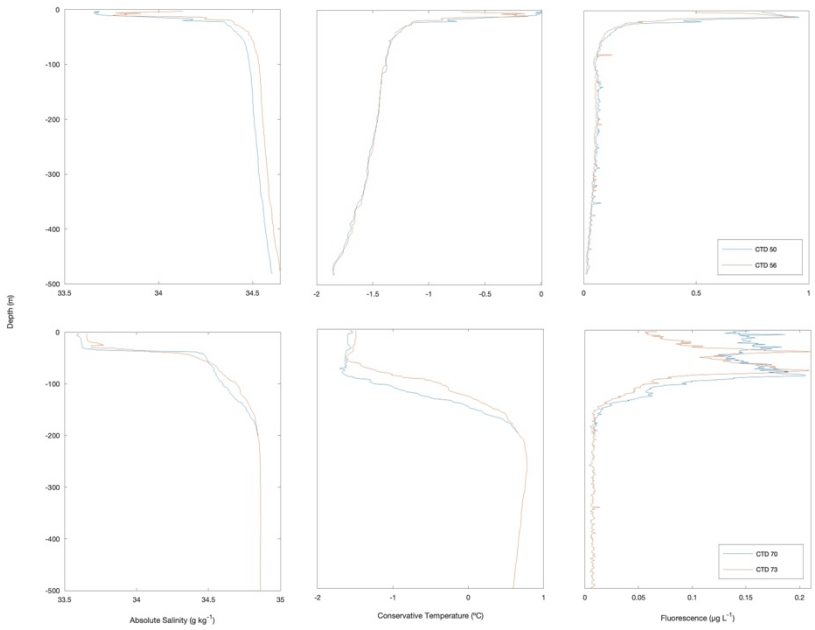
Chapter 2.4: Can you add the exact procedure how POC export flux was calculated, Kramer et al. 2025 is cited but a short summary should be provided here as well. **Thank you for the suggestion. A short summary of the procedure is now included in section 2.6 on lines 158-161:**

"Rates of POC flux were calculated according to the following equation (2):

$$\boldsymbol{Flux} = \frac{\boldsymbol{POC}}{\boldsymbol{A} * \boldsymbol{d}}$$

Where POC is the concentration of particulate organic carbon, A is the area of the cannister opening, and d is trap duration (days). For full details, see Atherden et al. (2026)."

Chapter 2.6: Method uncertainty – as the pigment and POC data do not coincide in sampling I think additional data must proof that the trajectory of the surface phytoplankton/pigment data is associated with the depth trap measurements. Particle track modelling could be added to verify here (or better in the discussion) why you still consider your analysis robust. In other words "Do you have any understanding on the physical conditions during your sampling so you can verify that the two sample types can be connected?" **While particle track modelling is a nice idea, it is beyond the scope of this paper. However, in order to investigate potential oceanographic change, we analysed the absolute salinity, conservative temperature, and fluorescence profiles from CTD casts immediately before and after the trap deployment (Figure S3 and shown below):**



These profiles show minimal change. Unfortunately, we were not able to do this for all sediment trap deployments, as CTD profiles were not conducted close enough in time to allow representative profiles. While some small geographic variability may still exist, we have tried to minimise this and have added additional text to the manuscript to acknowledge this possibility. See lines 207-211:

"In this study, rates of POC flux were paired with HPLC samples that were co-located upon trap recovery. The sediment traps travelled varying distances (between 1 and 5 km; Figure S2) between deployment and recovery and thus include some spatial biases in flux. For two trap deployments, CTD casts occurred before and soon after deployment allowing for the assessment of absolute salinity, conservative temperature, and fluorescence which showed minimal change before and after deployment (Figure S3)."

Results and Discussions require more details on results and more results overall and better referencing of other work and discussion

- Line 170ff: you should also show the total chl-a conc. on a figure! **Thank you for the suggestion. We have now added a figure showing total Chl-*a* concentration (Figure 2).**
- Line 172ff: I recommend to have a look at some pan-Antarctic phenology studies using in-situ or satellite data, e.g., Alvain et al. 2013, Soppa et al 2016, Thomalla 2023a, b, Hayward et al. 2025). This also regards other sections of the dicussions! (e.g. line 235 ff.) **We have added a discussion of the non-uniform, pan-Antarctic phenological changes shown by Thomalla et al. (2023) and Hayward et al. (2025). See lines 256-258:**

  "Many studies have shown that climate change is already having noteworthy and nonuniform impacts with substantial taxonomic shifts on phytoplankton blooms across the Southern Ocean (Thomalla et al., 2023; Hayward et al., 2025)."

Additional references:

Alvain, S.; Le Quéré, C.; Bopp, L.; Racault, M.F.; Beaugrand, G.; Dessailly, D.; Buitenhuis, E.T. Rapid climatic driven shifts of diatoms at high latitudes. Remote Sens. Environ. 2013, 132, 195–201.

Soppa et al. 2016. Remote Sensing 8: 420, doi:10.3390/rs8050420

Thomalla et al. 2023a https://doi.org/10.1098/rsta.2022.0068

Thomalla et al. 2023b https://www.nature.com/articles/s41558-023-01768-4

- Line 176-178: this sentence may fit (if there would have been more evidence) in the conclusion section but definitely not in the results section. **Altered language to make it more appropriate for the Results and Discussion section. See lines 256-277:**

"These pigment concentration patterns and phytoclass output (Figure 2; Figure 3) provide new insight on the region's ecosystem structure and biogeochemical processes as well as motivation for future investigations of the region using advanced technology, including hyperspectral satellites such as PACE. Our results provide quantifiable relationships between key phytoplankton groups and indicate co-location of diatoms, haptophytes, and cryptophytes in nearly all samples, throughout the upper 100 m (Figure 3). However, size fraction and depth patterns exist with haptophytes accounting for a larger proportion of pigments in the smaller size fractions and higher proportions of haptophytes and cryptophytes at the surface to mid-water column (Figure 3A-F; discussed further below). Additionally, the current impact of the PACE satellite is limited by validation data, namely HPLC samples, in remote regions, particularly at high latitudes (Cetinic et al., 2024). The pigment algorithms being implemented by NASA for PACE (Chase et al., 2017; Kramer et al., 2022) were trained and validated only with HPLC data collected between 60S - 60N. The new data presented here represent one of the

only HPLC datasets and one of the only phytoplankton community composition datasets from the Weddell Sea continental shelf. Therefore, these data provide valuable information to improve current pigment algorithms, without which satellite retrievals in this region will continue to be misrepresented (Chen et al., 2021; Xi et al., 2025).”

- Line 182: Pigment data are not only relevant for validating PACE satellite products only, but also for many other sensors as well! – You could cite here e.g. the in-situ data collection: Valente et al: 2022 org/10.5194/essd-14-5737-2022 and its (lacking) coverage or global pigment data collections presented in Xi et al. 2025 or specifically for the Antarctic in Hayward et al. 2024, 2025. **Amended as suggested. See lines 275-277:**

“Therefore, these data provide valuable information to improve current pigment algorithms, without which satellite retrievals in this region will continue to be misrepresented (Chen et al., 2021; Xi et al., 2025).”

- Line 198 ff.: A study by Trimborn (2017) shows that opposite, that also inshore and offshore in the WAP P. antarctica can be dominating. Trimborn, S et al. (2015): https://doi.org/10.1016/j.dsr.2014.12.010 **An additional statement was added to acknowledge this paper’s findings. See lines 347-350:**

“This represents a noteworthy deviation from community composition observations from the Western side of the Antarctic Peninsula where despite some exceptions (Trimborn et al., 2015), blooms are typically diatom- or cryptophyte-, not haptophyte-dominated (Brown et al., 2021).”

- Line 255: also check and add citations to Dubischar et al. 2006 (*Biol.* **149**, 625–632), Pulm et al. 2020 *Sci Rep* **10**, 5911 (2020). https://doi.org/10.1038/s41598-020-62829-8 **Thank you for these suggested references. However, given the first paper was written before the influential stepwise decline in sea ice concentrations in 2016, and the second paper’s focus on zooplankton, not phytoplankton, we still believe that Nardelli et al. is the most appropriate reference to support this statement, so we have not made the suggested change.**

Figures require clarifications / revisions

Figure 1: is it true that for stations # 32, 56 and 58 several locations were sampled, or are station numbers missing for the extra stations which have no labelling? Other comments see above und 2.1 comments. **As mentioned above, multiple CTD**

casts occurred on some YDs, and to preserve as much detail as possible, we present samples from individual CTD casts rather than averaging them.

Add in the figure caption that when a station is marked Trap, sediment traps were deployed and samples for POC were taken from 50m, 100m, and 150m depth in addition to the surface water samples. **Thank you for the suggestion. We have altered the caption to figure 1 as suggested.**

Figure 2: The caption is not descriptive enough. It is not explained to what % HPLC-accessory pigments are contributing to. It lacks the information that also % contribution of each specific phytoplankton group to TChl-a is shown. **Thank you for the suggestion. We have altered the caption to Figure 2 (now Figure 3) to add in the information as suggested. The caption now reads: "Figure 3. Percent contribution (%) of HPLC-derived accessory pigments to total accessory pigments by depth of sampling and yearday."**

The 2nd sentence in the caption is wrong and should be "Samples collected from <20 m were partly filtered for size fractions, producing <3 µm (A-B), <25 µm (C-D), and total (E-F) concentrations.", as there are also data from station 61 for total only. **Thank you for spotting this. We have altered the caption as suggested**.

You should also highlight that at some stations at a specific depth more samples were available (stations 56,32, 57?). In Fig. 2 20-40 m shows3 stations 32 (3 are on the map, but why do they have the same station number?). **Apologies for the confusion. We have now clarified in the text and the caption that YD refers to yearday, not station.**

Figure 3: subfigures B-D x-axes miss labelling **Apologies for the confusion. They were actually there in the bottom left-hand corner, but we have made them bigger to aid the readers.**