

Dear Referees,

Below we provide point-by-point responses to the minor technical corrections suggested by Referee #1, as well as the major writing and minor technical corrections suggested by Referee #3.

Referee #1:

Minor technical corrections

Line 109: Errant word or incomplete sentence, "...balance of competing..."

Thank you for pointing this out. We rephrased for clarity and conciseness, while keeping the key point clearer and direct. It now reads: "Depth intervals were chosen to detect broader ecological patterns robustly." (Lines 113-114)

Figure 3 – subplots should really be labelled a to e as the subplots are now separate to Figure 2.

Thank you for pointing this out. We have relabeled Figure 3 panels (in response to referee #3, it's now Figure 5) and applied this correction throughout the text.

L281: Presumably a rounding error but text quotes 37%, Figure 7c indicates 38%

You are right, although in response to Referee #3, we have simplified this part focusing only on the contribution of detached coccolith to PIC_{Total} (Lines 279-281).

L396: Please check, but I believe this should read "detached coccoliths" not "detached coccospheres".

Thank you for catching that. We have corrected this in the revised manuscript.

Referee #3:

The topic of the presented manuscript is relevant and the data presented seems to be of good quality. I see potential for a valuable contribution to the field.

However, in my opinion, the manuscript is not well written. The storyline and take-home messages are lost in detail and the analysis lacks streamlining. I could therefore not follow throughout much of the results and discussion. This made it difficult if not impossible for me to judge the scientific soundness and conceptual value of the content presented. While I am not an expert on coccolithophores, I have worked on upwelling systems, phytoplankton and export. Someone like me should be able to understand. In conclusion, I have to recommend rejection of the manuscript in its current form. In my opinion, a complete re-work of the manuscript is needed, prioritizing

storyline and conciseness. If done successfully, the manuscript may be reconsidered. As I said, I am not questioning the quality or significance of the data.

We appreciate your helpful and constructive feedback. In response, we have undertaken a substantial revision of the manuscript to address your concerns. The Results and Discussion sections have been thoroughly rewritten to improve clarity, streamline the analysis, and enhance the overall coherence of the storyline. We have removed excessive technical detail, shortened the text and captions, and consolidated the main figures to make the key messages more accessible. Additionally, we have rewrite the Conclusions highlighting the most important findings in a concise format. We trust these changes will make the manuscript clearer and more approachable to a broader audience, including readers less specialized in coccolithophore research. Detailed responses to each of the associated comments are provided below.

1. The manuscript would benefit from proper and standardized statistics.

1) A “**data analysis**” section in the methods would help incl. assumptions. This can be short but the logic should get across.

Thank you for the suggestion. We have addressed this point by adding a new subsection, 2.6 Statistical analyses, in the Methods. This section outlines the statistical procedures used and explicitly addresses the main assumptions of linear regression and ANOVA tests to clarify the logic behind our analyses.

2) Some of the relationships are only shown visually (e.g. Fig. S9 and 10, Fig. 9), although they are part of the main results (e.g. lines 195-201). Please, also **show the hypothesis tests**. The models in Fig. S9 and Fig 9 are not even plotted with uncertainty. Not showing confidence bands is fine but only if the test results are shown.

Thank you for this valuable observation. As suggested, we have included the confidence ranges for the linear regressions in Fig. 9 (now Fig. 6c) and Fig. S9-S10 (now Fig. S8 and S16) in the revised manuscript (Ocean Data View does not allow plotting confidence bands). We emphasize that our goal is to evaluate associations between selected pairs of variables rather than to test specific hypotheses.

3) I recommend to present all the main **stats tests in a compact format** in 1-2 tables in the supplement, with p-value, df, F-ratios/t-values etc. and any further info you deem relevant. Showing this info in the figure captions (e.g. figure 7) leads to long and technical captions that are hard to absorb. The statistics are also difficult to compare this way. You could show the most critical stats information (e.g. p-value and/or R²) directly in the corresponding subplot.

Thank you for pointing this out. We chose to retain the statistical info alongside the corresponding figures, as this facilitates a more direct association between the statistics and the visualized data, if presented separately. To improve clarity, we have shortened the figure captions, and the most relevant statistics (p-values and R^2) have now been inserted directly into each plot (if sufficient space was available).

2. The storyline is not sufficiently clear and the manuscript lacks conciseness.

To be honest, I was lost throughout much of the result and discussion. I recommend that the authors identify their storyline and the few most important results to support it. All other detailed results are better reduced or removed. This concerns the result text, captions, figures/tables and discussion.

- The manuscript has **9 fully filled pages of figures and tables**. Readers will not be able to absorb that much. Please, make a selection.

Thank you for your suggestion. We have carefully revised the figures, condensing them from 10 to 7—a 30% reduction—retaining in the main text only those most directly associated with the key findings. Less essential panels have been moved to the Supplementary Material. We believe this streamlining enhances the clarity and accessibility of the manuscript.

- The **result text is too long** relative to the primary content it holds (2400 words). Much of the text describes some detail and is filled with highly technical info. The main messages are lost amongst all this. I believe it is the authors' responsibility to pre-digest the data for the reader. Below is a typical result sentence, as example:

“In late-spring 2015, the highest abundances of coccospheres ($> 3.0 \times 10^5 \text{ L}^{-1}$) and detached coccoliths ($> 45 \times 10^5 \text{ L}^{-1}$), along with PICTotal ($> 3 \mu\text{g C L}^{-1}$) and PICCocco pools ($> 2 \mu\text{g C L}^{-1}$), were found in surface or near-surface waters (depths $< 25 \text{ m}$) closer to the coast at $\sim 20^\circ \text{ S}$ (stations T1-T2), extending south to $\sim 24^\circ \text{ S}$ (stations L1-L3; Fig. 3l-o).”

-> Could the info in the parentheses be reduced? The figures are already conveying the absolute values and their range. Make text and figures complementary. I recommend to state absolute values only in situations where they are particularly relevant, to emphasize. What matters rather is the magnitude of change and direction.

- **Figures captions could be simplified**. They are currently very long, technical and redundant and thus hard to read.

As an example, figure 3:

The first sentence states “Spatial variation in POC, PICTotal and coccolithophore...” and the next sentence repeats this “POC (k), PICTotal (l), coccospheres (m), detached-coccoliths (n), and PICCocco (o) ...”. Either merge sentences or make them complementary: e.g. use first sentence as general “topic” sentence and second one to introduce individual variables.

-> Simplify “recorded during late-spring 2015 (left) and mid-summer 2018 (right).”. The year and side (left vs right) are already in the figure. No need to repeat. You could also add “late-spring” and “mid summer” directly into the figure, next to the years.

Thank you for your thoughtful and helpful suggestions. In response, we have rewritten the Results section to improve the logical flow and help readers more easily grasp the main messages, which are further developed in the Discussion.

To achieve this, we reordered the Results, paying attention to remove excessive use of parentheses and reduced reliance on absolute values, retaining them only where they are particularly relevant to highlight key patterns. Figures and text have been made more complementary, with some information moved directly into the figures. Additionally, figure captions have been substantially condensed to enhance readability and reduce redundancy. The Results section has been reduced to 1830 words (not counting captions or subsection titles). We believe these changes considerably improve the clarity and accessibility of the manuscript.

-> Only use “Depth (m)” once on y-axis for each 2015 and 2018. Also, the long-lat axes are difficult to understand. Look at the same/similar figure in Vargas et al 2021 as an example.

We have simplified the axis labels by using “Depth (m)” only once per year (2015 and 2018), as recommended. Additionally, we have revised the long-lat axes and relabeled the station labels following the example from Vargas et al. (2021), to improve clarity and facilitate visual interpretation of the spatial patterns.

-> Remove “POC = Particulate Organic Carbon. PIC = Particulate Inorganic Carbon.” Instead clarify abbreviation directly when you introduce the variables: “Particulate organic carbon (POC) (k), particulate inorganic carbon (PIC) (l), ... “. This is overall shorter and more natural.

Thank you for the suggestion. We have followed the Biogeosciences guidelines: “abbreviations used in the figure must be defined, unless they are common abbreviations or have already been defined in the text.”. Since POC and PIC are defined upon first use in the main text, we now use the abbreviations consistently in the figure captions, shorten and simplify them.

- I feel like the discussion is missing conceptual depth. Several topics in the discussion are approached by re-stating a result, followed by a detailed comparison to literature values. However, the subsequent conceptual discussion (i.e. what do we learn from this) falls short or is lost amongst the detail. If the authors cannot expand this latter part, I recommend to keep to discussion more concise overall (currently 3800 words). The figures and tables in the discussion already provide a substantial comparison to other regions. Maybe there is no need to go into such detail again in the text. That the storyline is not well developed becomes also clear in the conclusion. Here, the authors mainly provide a list of results instead of conceptual take-home messages and their wider significances. This is fine with me. But if this next step is not taken, such a long discussion not justified.

Thank you for this constructive feedback. We have completely rewritten the Discussion section, reducing its length to approximately 2,500 words (a reduction by over one third) and improving its structure to align more closely with the Results. The revised version now builds directly on the results to advance the conceptual interpretation and highlight the broader implications of our findings. We also replaced the bulleted Conclusions with a single concluding paragraph at the end of the Discussion, which specifically focuses on whether our results support the hypothesis posed in the beginning of the Introduction. We believe these changes address your concerns and enhance the overall clarity and conceptual depth of the manuscript.

3. Across the manuscript, assure to not imply causality.

Your observational study can only establish correlations between variables not cause and effect like an experiment. Use wording that conveys the uncertainty (“may”, “possibly”, “indicated” etc.) and/or terms that reflect your observational approach (“associated”, “linked” etc). Here several examples where this was not done:
abstract line 19: “emerged as key factors influencing PIC”.

line 106: “assess the influence of the OMZ on PIC and POC concentrations”

conclusion line 534: “variation in PICTotal and PICCocco pools in the OMZ region strongly depends on temperature”

Thank you for highlighting this important point. We have revised instances where causality was implied, replacing terms like “influencing” with “associated with” or “linked to.” For example:

- Abstract line 19: Revised to “emerged as key factors associated with PIC.”

Also use past tense for statements that refer to your results: conclusion line 524: “Coccolithophores-PIC pools are highest within the first 30 m depth” but also several other conclusion statements.

Thank you for pointing this out. As mentioned above, we have replaced the bulleted Conclusion section in the revised manuscript. Nevertheless, we have ensured that all statements referring to our results are written in the past tense.

4. Detailed comments:

line 11: sentence structure sounds somehow wrong. Correct would be for example: “A predicted consequence of ocean acidification is the decrease in coccolithophore-produced Particulate Inorganic Carbon (PIC) pools.”

Thank you for the helpful suggestion. We have revised the sentence as recommended to improve clarity and readability (Lines 11-12).

line 11 and 12: “Particulate Inorganic Carbon” and “Particulate Organic Carbon” should not be capitalized in my opinion. It infers with readability. There are more such cases across the manuscript.

Thank you for your suggestion. We have corrected the capitalization in the revised manuscript to improve readability.

line 24-25: Structure of concluding sentence too complicated and thus difficult to read. Please revise. Removing “its role” already helps a lot.

Thank you for the helpful suggestion. We have revised the sentence to improve clarity and readability. It now reads: “We emphasize that comparing PIC dynamics across diverse upwelling systems will be valuable for understanding how low pH and O₂ conditions influence POC fluxes mediated by coccolithophores.”

line 35: you mean “feed back”?

Thank you for your suggestion. In this case, we are using “feedback” as a noun, which is the standard term in scientific literature when describing processes that influence a system. Therefore, we have kept “feedback” in the revised manuscript.

line 45: “studies are increasing” sounds strange. Better use “research is increasing” or “studies are becoming more common”

Thank you for your suggestion. We have revised the sentence to read (Lines 44-45): “Nevertheless, research on coccolithophore distributions is increasing in the Indian Ocean, the subpolar Pacific, and the Southern Ocean,” to improve clarity and flow.

line 51: “peaking in austral summer”

Thank you for the suggestion. Now it reads “peaking in austral summer” (L48).

line 58: sentence too complicated. Consider splitting after “coccolithophore-derived PIC”. Alternatively remove “calculated from them” and keep everything in one sentence. This is the first sentence specifically for your study. It should thus be easy to understand and general. It would also help if your “aims and approach intro” is separated from the general introduction. So, consider starting a new paragraph after “OMZ systems” line 57.

Thank you for the helpful suggestion. We have rewritten the aims and approach, and presented them in a separate paragraph following the Introduction.

line 64: “in situ” is not saying much, maybe better state what variables, e.g. “environmental”, “physicochemical”

Thank you for the suggestion. Although this text has been removed, we have ensured that “in situ variables” is no longer used throughout the manuscript.

line 77: Not sure putting several pages of raw data into the supplement like this in pdf format is helpful. Better upload this data to a proper data repository, where users can view and download it in an appropriate format.

Thank you for the suggestion. As recommended, we have removed these tables, and deposited in PANGAEA, being referenced in the Data Availability section.

line 78: “SST”, “SSS”, “Chl-a” etc. spell out at first mentioning

Thank you for pointing this out. We have now spelled out these abbreviations at their first mention in the manuscript to improve clarity.

line 93: “plotted using R” -> “R Studio” is just giving you a nice interface, the actual job is done by R. Also, strictly speaking you would need a reference for R here incl. the R version. You can of course mention Rstudio in addition to R, e.g. “R in RStudio”, but then again with reference. Same for line 171. Actually, best would be to include a general “data analysis” section in the results. Here, you can state once which program was used incl. reference.

Thank you for the helpful comment. We’ve now included the appropriate citation and version for R and RStudio in the revised manuscript.

line 148: “slopes were highly linear”. Do you mean “relationships were linear”?

Thank you for the suggestion. We’ve revised the sentence as suggested (L149)

line 193: “fluorescence” in mg m⁻³ units? Do you refer to a pigment concentration? Then you have to add this info to the variable name for it to make sense. Do you have two different Chla measures and one of them is based on fluorescence and the other on e.g. HPLC? While you reference Vargas et al 2021, you still need to communicate the basic meaning of these variables in your manuscript.

Thank you for this comment. We agree that clarity is important when referring to fluorescence data. In this study, fluorescence was measured using a CTD-mounted sensor that is routinely calibrated with a chlorophyll-a standard. Additionally, we verified post-cruise that the sensor-based fluorescence values showed a strong fit with discrete chlorophyll-a measurements, supporting their expression in mg m⁻³. To avoid confusion, the text now reads (Lines 221-224): “The highest phytoplankton biomass (extracted chlorophyll and calibrated fluorescence values reaching or exceeding 3 mg m⁻³) always occurred shallower than Z_{eu}, though in some stations a defined primary chlorophyll maximum at the base of Z_{eu} was not present and fluorescence was highest near the surface, not near Z_{eu} (Fig. 3d-e)”.