This manuscript presents an extensive and valuable dataset from glacially influenced Svalbard fjords spanning multiple seasons, years, fjords, and glacier settings. The dataset has considerable potential to provide new insights into the interactions between physical forcing, biogeochemistry, plankton communities, and marine snow dynamics.
We would like to thank the reviewer for appreciation and valuable further remarks which provided helpful suggestions how to improve our manuscript.

However, I found that the current version does not yet fully capitalise on the richness of the dataset and the main scientific message remains difficult to identify.

We are going to focus it more on distinction of the most significant factors and to improve the statistical approaches.

What we can do for improvement is to focus on the most interesting observations and to arrange it across the studied spatio-temporal factors and how important they are for which parameter and why. This will be arranged around the questions: Which environmental parameters are the most heterogeneous, where is that heterogeneity greatest, and which factors drive it.

To do that, we start with the analysis of heterogeneity within each parameter and studied factor by the analysis of the coefficient of variation (CV) as a better measure than SD because it normalizes by the mean.

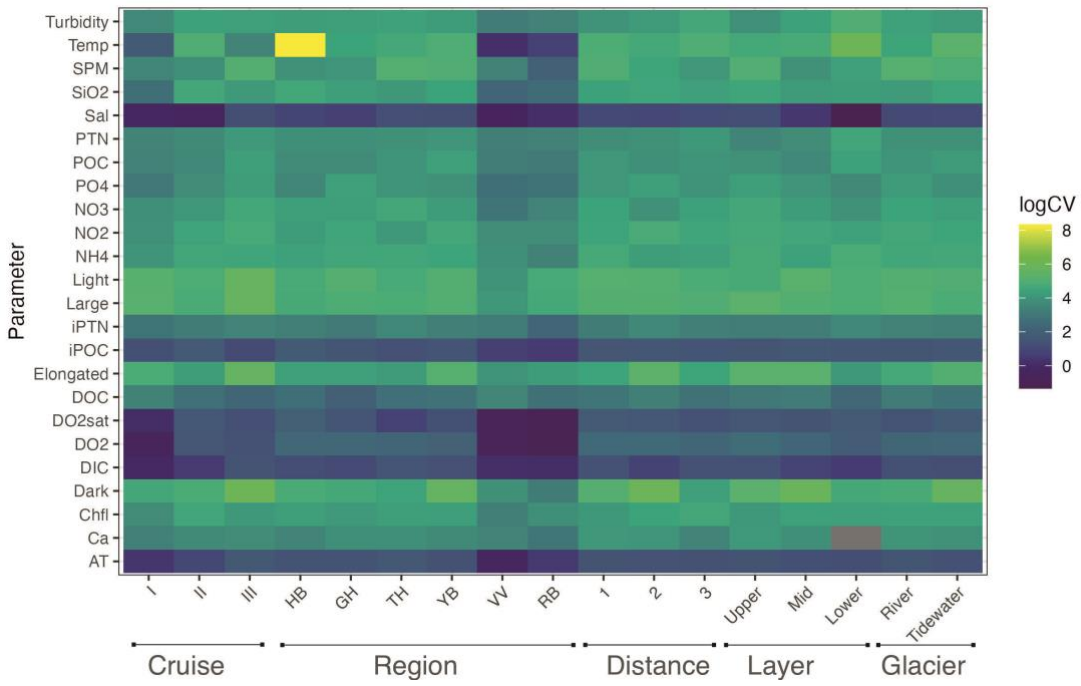
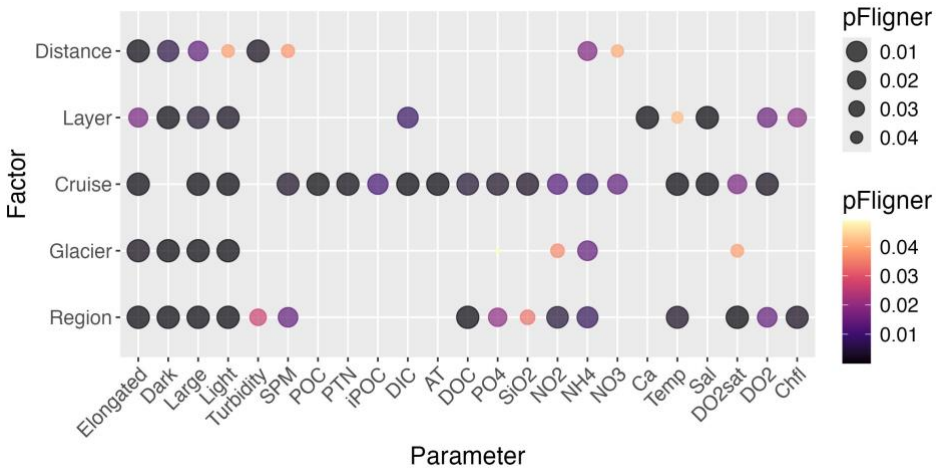
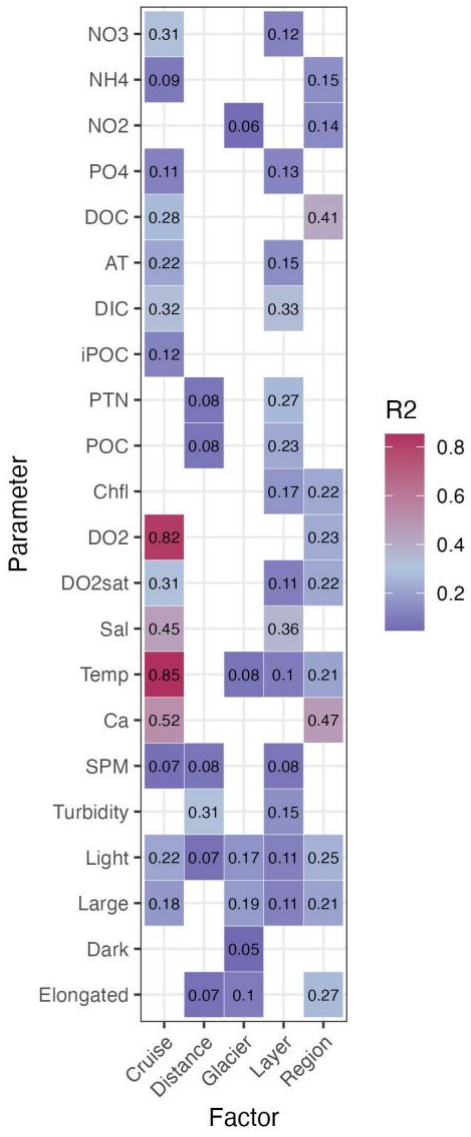


Fig. S11. Heatmap of local heterogeneity: the coefficient of variation (CV) across the studied environmental parameters and factors.

Then, to test among which factors variability differs significantly, we performed the Flinger tests, which showed that for most of the studied parameters temporal effect was significant (Cruise), and that all of the studied factors were significant for marine snow morphotypes. Distance from the glacier was additionally significant for Turbidity, SPM, NH_4, and NO_3. The water column stratification was also significant for temperature, salinity, oxygen concentration, chlorophyll a, and DIC. Glacier type was significant also for NH_4, NO_2, and oxygen saturation.



And finally, we performed ANOVA and linear model as the statistical approach to estimate the Effect Sizes to answer which factor explains most of the variability and how much, which can be visualized by the R^2:



One of my main concerns is that the biogeochemical dataset is not analysed or interpreted in sufficient depth to support the discussion. The study includes numerous informative variables, including nutrients, carbon, suspended particles, and stable isotopes, yet these are not suitably quantitatively interpreted. For example, Figure 4 presents cruise-averaged values that combine different fjords, glacier types, degrees of glacial influence, and depths. This aggregation makes it difficult to distinguish whether the observed physical and biogeochemical differences reflect seasonal variability, spatial gradients, glacier influence, or depth-dependent processes.

We agree with the reviewer that while the interdisciplinary studies are so needed and valuable they meanwhile pose a challenge to compromise the detailed record on multiple parameters with the more focused, condensed format. In our design of results presentation, we decided to go from general observations (such as averages over cruises in Fig. 4) to specific ones (station-by station examples at Figs 5&6). Consequently, the aim of the Figure 4 is to present what are the differences among the cruises, because the temporal effect is the strongest among others, as shown by statistics. Later, we present the station- and depth-resolved data with great detail in the supplement. However, we agree that the manuscript should better resolve the spatio-temporal variability, so the new statistical analyses, as described above will be implemented.

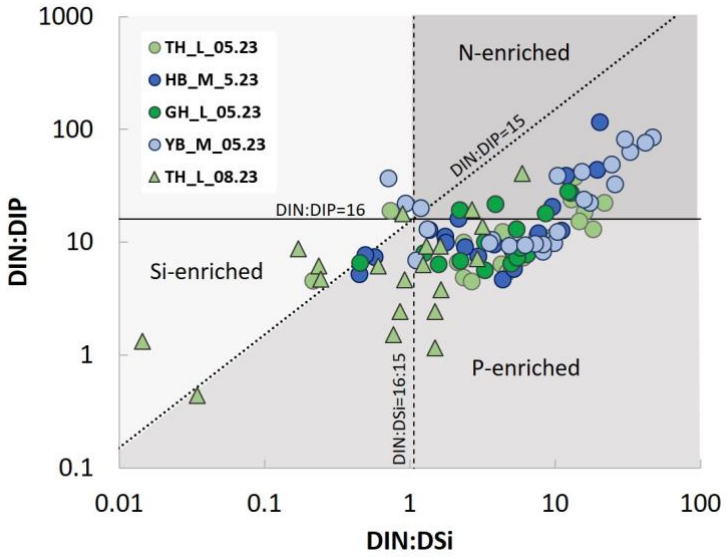
Similarly, several potentially informative variables, particularly $\delta^{13}C$ and $\delta^{15}N$, receive no attention in the discussion despite their potential to provide insight into sources, biological processing, and carbon and nitrogen cycling. Throughout the manuscript, the discussion focuses primarily on the direction of change (for example, increases or decreases indicated by arrows) with no clear supporting evidence for this (maybe this is covered by the many supplementary figures, but this would need to be introduced more clearly) and no discussion on what the measured values themselves imply about the underlying biogeochemical processes is included.

Discussion will be fundamentally re-written according to reviewers' suggestions to shorten it, re-arrange the sequence of paragraphs and to better align interpretations with specific results and figures.

Related to this, several interpretations would benefit from stronger quantitative support. Statements regarding nutrient depletion, nutrient supply, productivity, or glacier-driven differences should incorporate analyses of vertical structure, nutrient stoichiometry, isotope signatures, or differences among fjords and glacier settings. Nutrient limitation is mentioned briefly, but the manuscript does not explore whether nutrient ratios or isotope data support this interpretation. Making fuller use of the available biogeochemical dataset would greatly strengthen the mechanistic interpretation and better exploit what is potentially a valuable observational dataset.

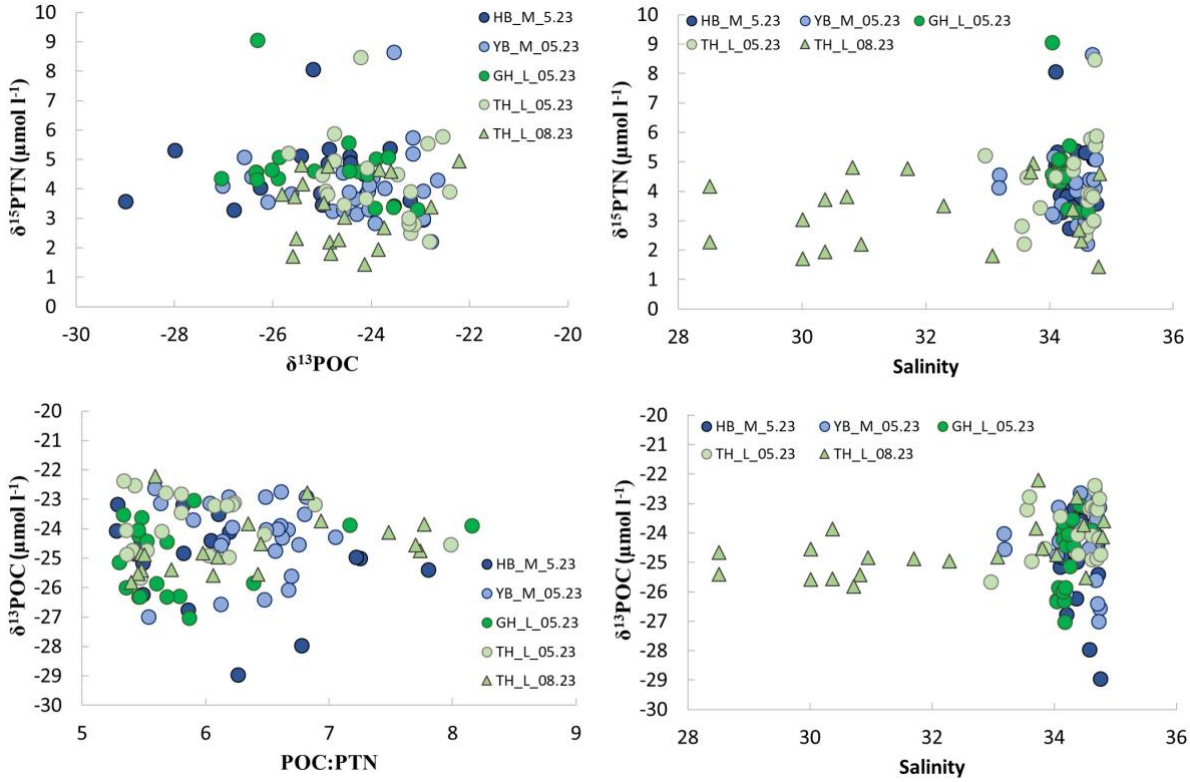
We agree, and consequently we will add the numbers of change/trend whenever we will indicate any gradient/difference to make it more qualitative.

Furthermore, the more in-depth analysis of nutrients can also be added:



Nutrient stoichiometry, expressed as the molar ratios of dissolved inorganic nitrogen, phosphorus, and silica ([DIN]:[DIP]:[DSi]), indicates predominantly P-enriched conditions relative to the Redfield ratio (DIN:DIP = 16), although several samples, particularly from the marine-terminating Ymerbukta (YB), fall within the N-enriched field (Fig. X). The elevated DIN:DIP ratios observed in Ymerbukta coincide with relatively high salinity, suggesting a stronger influence of Atlantic Water, which is typically enriched in dissolved inorganic nitrogen. In contrast, no consistent separation between marine-terminating and land-terminating glacier systems was observed during May, indicating that glacier type alone does not control nutrient stoichiometry.

In August, the nutrient ratios shifted towards the Si-enriched field in the low-salinity samples. This pattern is consistent with enhanced freshwater and glacial meltwater inputs supplying weathering-derived dissolved silica while dissolved inorganic nitrogen became progressively depleted through biological uptake during the productive season. The relationship between decreasing salinity and increasing silica enrichment suggests that seasonal freshwater discharge exerts a stronger influence on nutrient stoichiometry than glacier type itself.

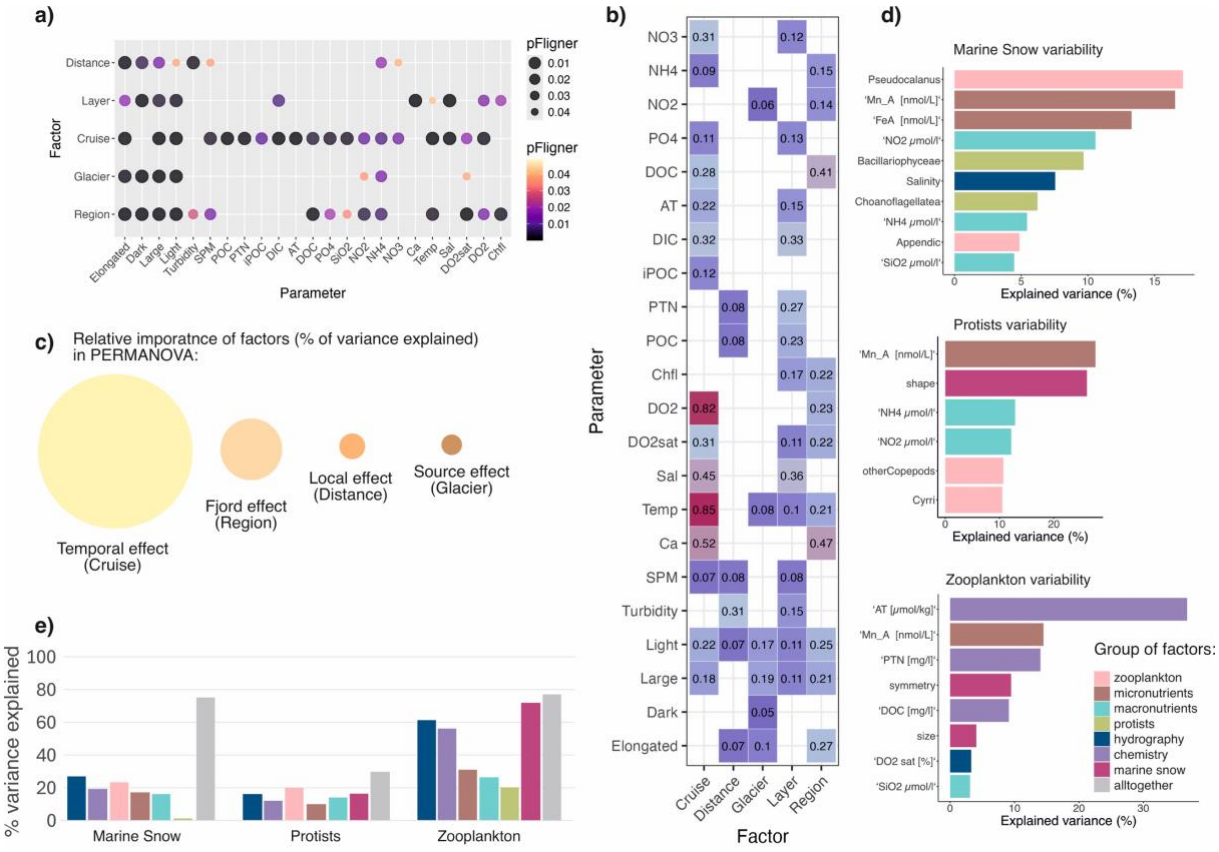


Stable isotope compositions and elemental ratios indicate that suspended particulate organic matter was predominantly of marine origin throughout the study period. POC:PTN ratios remained close to the Redfield ratio, while $\delta^{13}C$ values showed little systematic variation with salinity despite substantial freshwater influence during August. Together, these observations suggest that increased glacier meltwater affected the physical properties of the water column but did not substantially alter the source of suspended organic matter. In contrast, $\delta^{15}N$ values tended to decrease under lower-salinity conditions, indicating seasonal changes in nitrogen sources or nitrogen cycling associated with glacier melt rather than enhanced delivery of terrestrial particulate organic matter. The extensive overlap among fjords and glacier types further suggests that seasonal hydrographic conditions exert a stronger influence on suspended POM characteristics than glacier type itself.

A second major issue concerns the role of glacier type. The introduction places considerable emphasis on the contrasting influences of marine-terminating and land-terminating glaciers, and Section 4.3 argues that these differences are important. However, the conclusions ultimately state that no consistent patterns emerge among glacier types. This may indeed be an important finding, but the reasoning leading to this conclusion is not entirely clear. Because many of the analyses combine fjords, seasons, depths, and varying degrees of glacial influence, it is difficult to determine whether glacier-type effects are genuinely absent or whether they cannot be isolated within the current presentation of the data. Clarifying this distinction would strengthen one of the central themes of the manuscript.

We fully understand the concern raised, and as we explain in the introduction – also other studies show contrasting results (difference vs no difference between the marine- and land-based systems), so there is still no consensus, and our work further reports that for some parameters and in some cases, it may be an important factor, while in others not. To meet the need for the separation of this factor we can add some new statistics. So far, Permanova showed that for the multivariate database the glacier type explained only 5% of the total variation), but now we can test this factor among singular parameters and it shows that glacier type is

important factor for the concentrations of marine snow morphotypes, nitrites, ammonium and oxygen saturation, as analysed by the Fligner test and linear models.



More generally, the conclusions remain rather broad. Statements such as "local heterogeneity is prominent", "marine aggregates are valuable indicators", and "the interdisciplinary approach represents a step towards holistic understanding" are reasonable, but they do not clearly communicate the principal scientific advances arising from this study.

The conclusions in a new version of the manuscript will be more specific, e.g.:

4. Marine aggregates act not only as carriers of organic and mineral matter, but also as valuable indicators of environmental conditions and ecological interactions in the water column and are linked to plankton composition (e.g. presence of *Pseudocalanus* spp., Appendicularians, Diatoms, Choanoflagellates) and seawater biogeochemistry (micronutrients, nitrates, salinity ammonium, silicates).

5. This study provides a zoom-in of the complex costal, glacial-influenced Arctic systems, and based on the studied mosaics of different combinations of factors and parameters, it identifies the temporal effect as the most significant (May vs August), followed by the regional effect of fjords, and the smallest but still statistically significant local effects (distance to the glacier) and the glacier type (e.g. for marine snow composition, nitrites and ammonium).

Similarly, some parts of the discussion remain too general. For example, the opening paragraph discusses broad concepts but does not clearly establish the specific scientific question (what is the “paradigm” that you refer to?) or conceptual framework that motivates the remainder of the discussion. Tightening these sections would strengthen the overall narrative.

We agree with the reviewer and we will do our best to more specific and less general. We also agree that the word paradigm was not appropriate. We would rather say "This study addresses an important knowledge gap by zooming in these complex systems and by investigating them through the lens of several studied factors."

The figures would also benefit from further refinement. Many of them are visually complex, and the legends do not provide sufficient guidance for interpretation. Figure 6 is one example, where comparisons among glacier types, lagoon systems, and seasons are combined into a single schematic. It would be helpful if the legend more clearly explained the purpose of each panel, how the arrows were determined and what constitutes evidence for the reported trends. At present, the arrows appear quantitative, but the basis for assigning them is not sufficiently explained.

We will make the legends more elaborative to better explain the content of the Figures.

e.g., Biogeochemical properties: the increasing/decreasing trends of environmental parameters are based on station-averaged values and visualized as list at arrows of specific direction (increasing values towards the glacier source or decreasing with a distance). Above the solid black line there is list of parameters for which there was no clear trend with distance.

And also, we believe that the headings of the results may support the understanding what is compared with what: e.g.,

3.2.2 Land- vs. marine-terminating glacier: Isfjorden, May 2023 (Fig. 6A&B)

3.2.3 Temporal difference of land-based glacier impacts on Isfjorden (Fig. 6A&C)

3.2.4 Lagoon-based vs. land-terminating glaciers: Rechercherfjorden, August 2022 (Fig. 6D)

I also found that the discussion could be better integrated with the figures. In several places, broad interpretations are presented without clear reference to the supporting data, while elsewhere figure citations do not appear to fully support the accompanying statements. For example, the statement that late summer cruises generally experienced warmer, fresher, more turbid, less oxygenated, and nutrient-depleted conditions is attributed to Figure 3, although the supporting information appears to be distributed across multiple figures. More specific references to the relevant panels would improve readability and make the discussion easier to follow.

Good suggestion, we will refer to specific figures and their specific panels to make clear which data support which statement.

The overall structure of the discussion should be improved. I found that Section 4.2, which establishes the seasonal environmental context, would provide a more natural introduction to the discussion if presented before the more interpretive section on marine snow. At present, several themes are revisited multiple times, resulting in some repetition. Reorganising the discussion to first establish the seasonal and hydrographic setting, then examine glacier- and fjord-related differences, before finally interpreting the implications for marine snow, would produce a more coherent narrative.

Great idea, we definitely like and we will re-structure the discussion accordingly.

There are also a few instances where the interpretation appears stronger than the evidence presented. For example, the manuscript suggests that May represented pre-bloom conditions

with relatively low phytoplankton abundance, yet shortly afterwards states that copepod recruitment "must have been triggered by phytoplankton activity". This argument may ultimately be correct, but additional explanation would be required to reconcile these statements.

We agree that a kind of inconsistency was introduced. We can clarify that as follows:

"The May observations, with cold, saline and highly oxygenated conditions (Fig. 4) most probably experienced the early phase of the spring plankton succession, when phytoplankton concentrations were still low (Fig. 3D) and the availability of nitrate and phosphate were still relatively high (Fig. 4). But the community composition and low silicate concentrations may reflect preceding diatom activity. Zooplankton was overwhelmingly dominated by the meroplankton (Fig. 3C), namely the Cirripedia - larvae of barnacles, which is typical for spring (Stübner et al., 2016; Weydmann-Zwolicka et al., 2021), while the high abundance of nauplii of copepods indicated that seasonal recruitment pulse already occurred, possibly supported by preceding or ongoing phytoplankton production (Gluchowska et al., 2025). Together, these observations suggest that spring production had already begun, although phytoplankton standing stocks were low at the time of sampling. The low protist concentrations may additionally reflect strong grazing pressure, one of the main controls on Arctic primary production alongside light and nutrient availability (Arrigo and van Dijken, 2015; Rysgaard et al., 1999)."

More generally, I encourage the authors to adopt more cautious wording throughout the manuscript, replacing terms such as "shows", "clearly", or "must have" with expressions such as "suggests", "is consistent with", or "may indicate" where the evidence is indirect.

Agree.

In addition, the writing would benefit from a more scientific and concise style in places. There are several instances where the language becomes somewhat philosophical or metaphorical (e.g. referring to marine snow as "vehicles of matter and knowledge" or the title Seen in flakes & drops). While these expressions are engaging, they occasionally distract from the scientific narrative. A more direct scientific style would improve clarity and strengthen the overall presentation.

We intend to send the text to professional proofreading after the preparation of the modified, final version of the manuscript and before the re-submission and we plan to improve the language considerably.

Finally, I believe the manuscript would benefit from careful editing for clarity and structure. The writing is generally understandable but often repetitive, and several paragraphs mix multiple ideas without a clearly defined focus. Improving the organisation of individual sections would help the reader follow the scientific argument and better appreciate the strengths of this substantial dataset.

Manuscript will be edited, re-structured, and checked for repetitions.

Overall, I believe this dataset has considerable value and the study has the potential to make a useful contribution. However, in its current form, the manuscript does not yet fully exploit the richness of the observations or develop a sufficiently focused scientific narrative. I therefore recommend major revision, with particular attention to:

1. Making fuller quantitative use of the biogeochemical dataset, including stable isotopes and nutrient stoichiometry.

As explained above in more detail, we can add statistics in which each individual parameter will be checked for the significance of the factors, also the more in-depth analyses of isotopes and nutrients are prepared.

2. Clarifying the relative influence of season, fjord, depth, distance from meltwater input, and glacier type.

This can be done by incorporation of additional statistical tests described above.

3. Improving figure presentation and expanding figure legends to facilitate understanding,

Figures are very complex, because we aim to out all the multidisciplinary data together, but we agree that the legends should be improved to better explain what is presented.

4. Strengthening the links between the discussion and the supporting figures.

Definitely!

5. Revising the discussion and conclusions to emphasise a smaller number of clear, well-supported scientific messages throughout the manuscript.

Agree, we plan to limit the number of conclusions and make the discussion more straightforward to focus on the main fundings oscillating around the questions: Which environmental parameters are the most heterogeneous, where is that heterogeneity greatest, and which factors drive it.