SUPPLEMENT FOR AUTHOR RESPONSE TO REFEREE #2 COMMENTS

egusphere-2026-3268 — From surface flux to seafloor function: vertical carbon export and benthic communities in high-latitude coastal systems

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We thank Referee #2 for a careful and constructive review, and in particular for the detailed engagement with the attenuation calculation and the trait data, which identified issues we would not otherwise have caught. We are grateful for the positive comments throughout. Together with the comments from Referee #1, we have taken the feedback on board and, where we felt it appropriate, have undertaken substantial new analysis rather than revising the text alone. This applies in particular to the two major methodological concerns raised across both reviews: the classification of water masses and the wet-mass to carbon conversion factor underlying the benthic invertebrate carbon estimates. In both cases we have re-run the relevant analyses, tested the sensitivity of our results, and reported the outcome in full, including where it changed our original interpretation.

This response is structured according to the comments provided, beginning with major comments and then minor comments. Referee Comments (RC2) appear in black text with our replies (Author Comments; AC) in blue. Where a comment relates to one raised by Referee #1 we cite it as RC1 followed by the comment number (e.g. RC1.1), and where the two comments are addressed by the same revision, we give the full response in both documents so that each can be read independently. Where relevant, we have extended our replies beyond the specific point raised to set out the resulting changes to the Methods, Results and Discussion. Line numbers refer to the preprint. New tables and figures created for this response are numbered R1–R8 and Fig. R1; items revised from the preprint retain their original numbers, and all will be renumbered into the supplementary material on submission of the revised manuscript. We thank the referee again for the feedback, which we believe has made the paper more defensible and more useful to the readership of Biogeosciences.

Major/general comments

RC2.1: This trans-disciplinary study utilized an innovative approach combining hydrographic and ecological trait-based analyses to explore dynamics in carbon supply and stores within NE Greenland fjord systems. The study finds that benthic community structure and carbon pathways (inferred from traits) are influenced by both vertical POC flux, sedimentary carbon stores, as well as the bathymetric position which is assumed to be related to local advection and depositional dynamics. Overall the study, though complex, is very well-written and supported thoroughly by published literature. There are 4 clear hypotheses stated in the introduction, although only some aspects of the first two are evaluated directly and the manuscript really focuses on the latter two hypotheses. For instance, hypothesis two refers to "stratification" which is inferred through the water mass distributions namely the change from Surface and Polar Water masses to Atlantic Water. In addition, the penetration of Atlantic Water into the fjord systems is seen through the water mass distribution along the transects but is not the focus of the study and not discussed at length. Rather, the explanatory power of water mass structure in relation to benthic community

and trait structure is the focus. Regardless, the study does address aspects of all hypotheses presented. Inferences made about the study results are well thought out and described in the discussion section albeit with some very complicated and long sentences at times. The study clearly leads to the final conclusion and additional perspectives on future work are given.

AC2.1: We thank the reviewer for this helpful overview of the study. We agree that the first two questions primarily characterise the hydrographic and carbon setting across the study systems, whereas the latter questions form the main analytical focus of the manuscript. We have therefore revised the research questions and consolidated the original four questions into three to better reflect the structure and focus of the analyses. We have also revised the wording of the second question to refer to water mass structure rather than stratification, as stratification was not quantified directly in this study. Note that in RC/AC1.1, we have also expanded the discussion regarding water masses. The third question now combines the original questions on carbon pathways, benthic biomass and trait composition, and the role of carbon-related variables as explanatory factors. These changes better align the framing of the questions with the analyses presented. Additional text regarding water masses is addressed in RC2.19 and RC2.20, and extensively in Reviewer 1, RC1.2.

New proposed text:
"Specifically, we ask: (1) how does water mass structure vary among systems, and how do bathymetry and fjord geometry influence Atlantic Water penetration? (2) How do vertical POC flux and sedimentary carbon stocks vary in relation to water mass structure across the study systems? (3) How is benthic invertebrate carbon partitioned among trait strategies (feeding habit, mobility, and environmental position), and do vertical POC export, sedimentary carbon stocks, and their interaction explain which functional strategies retain that carbon? Together, these questions characterise pelagic–benthic coupling across contrasting glacial systems and examine how carbon pathways relate to benthic biomass and functional organisation."

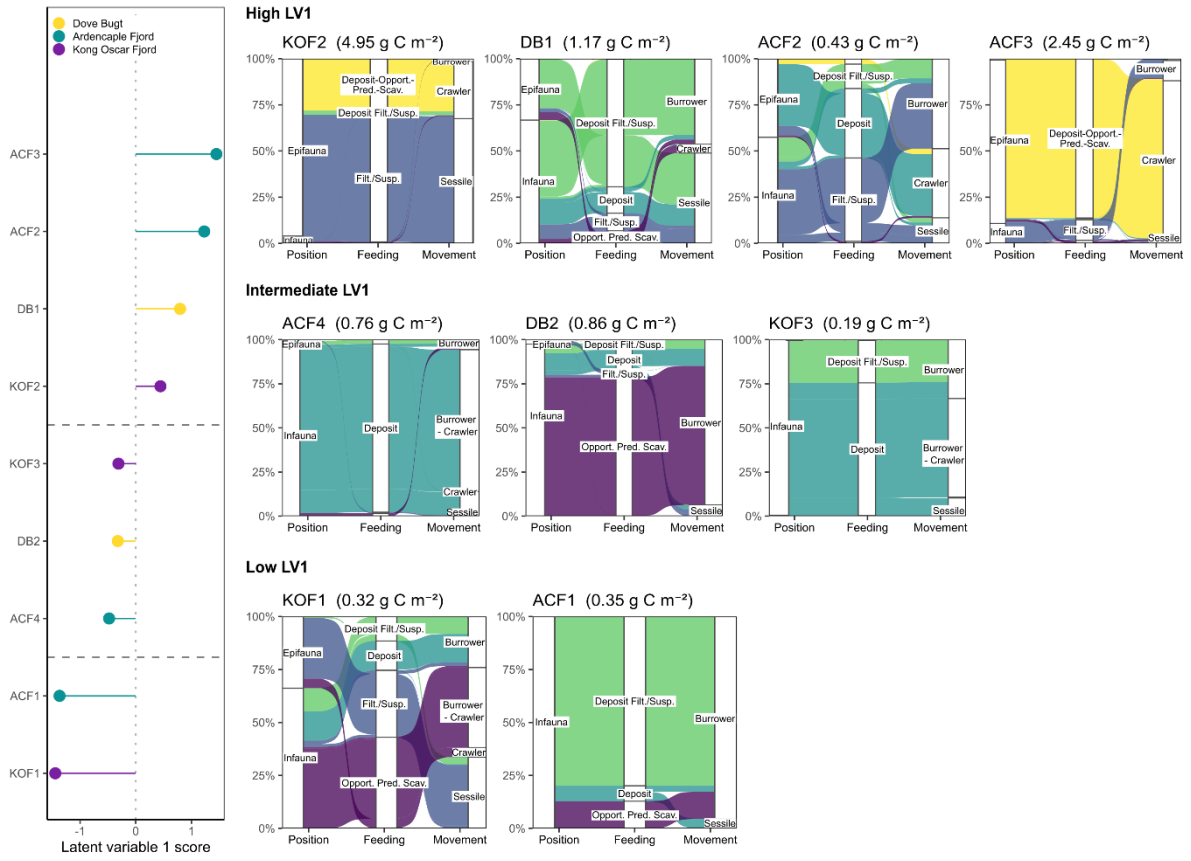
RC2.2: The figures are generally of very high quality and, although complex, illustrate well the findings of the study. Figures 4-6 are the most difficult to interpret but paired with the text I can follow for the main findings from them.

AC2.2: We thank the reviewer for this positive assessment of the figures and acknowledge that Figures 4–6 were comparatively difficult to interpret, particularly when comparing trait patterns across the latent variable gradient. In response to this comment and a related comment from Referee #1 (RC1.7), we have restructured these figures to facilitate direct comparison. They are now a single figure, restructured rather than merged: stations are ordered by LV1 score and grouped into low, intermediate and high blocks alongside the LV1 panel itself, so the ordination and the trait composition can be read against one another at a glance (New Fig. 4). Flows are scaled to proportion within station, so ribbon width has one meaning throughout, with total benthic carbon biomass given in each panel title. The repeated feeding-habit labels, which appeared nine times in the previous version, are replaced by a single multi-panel figure.

Relatedly, we propose promoting the fjord schematic as a graphical abstract. It was drafted to convey where each station sits within its system and why the latent gradient is interpretable in physical terms, but with the trait figure now carrying the LV1 ordering directly, the schematic no longer fits well in the Results. As a graphical abstract, the updated version provides an overview

of the study context, spatial and environmental setting, and main results, allowing the reader to understand the study design and key findings at a glance.

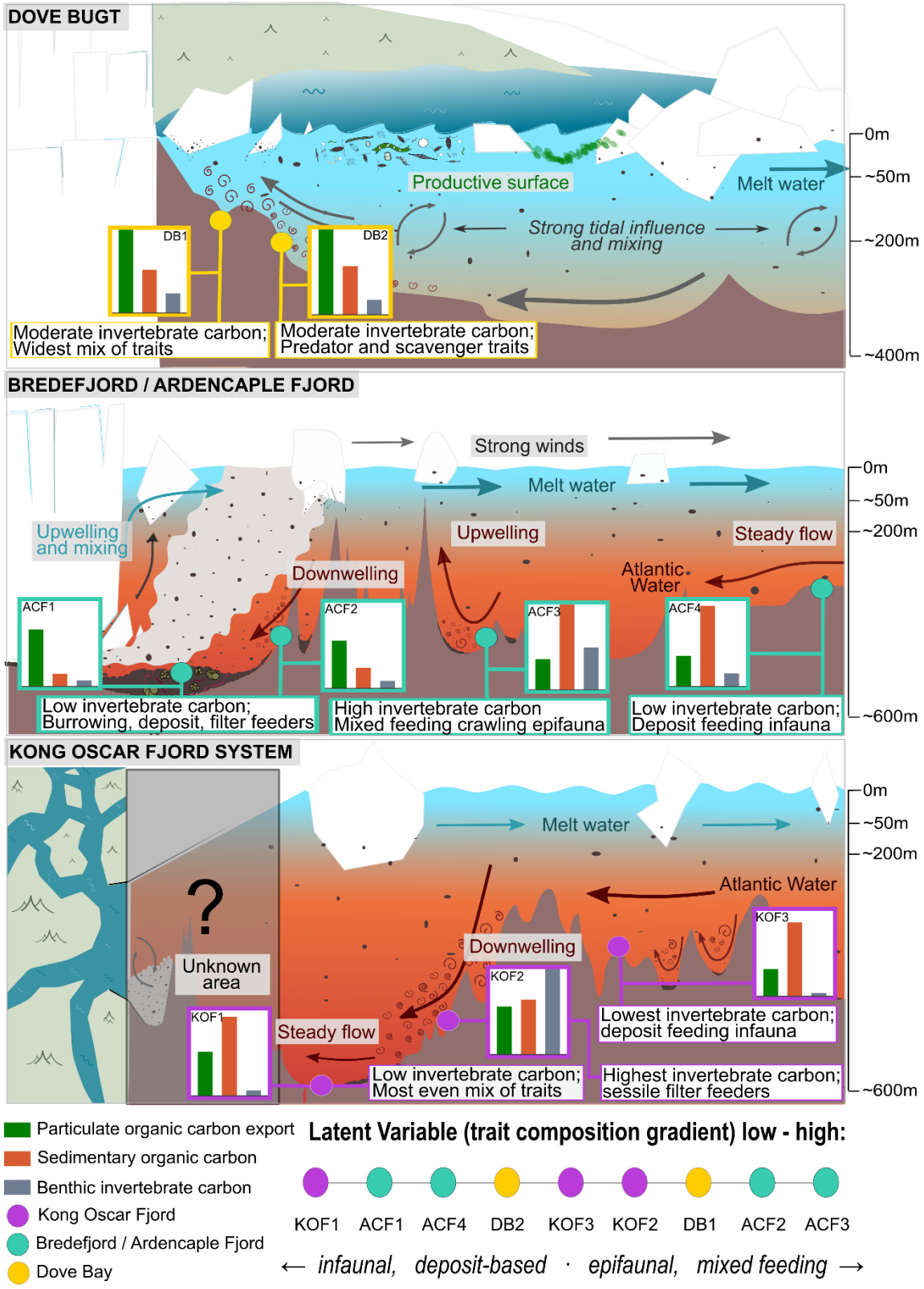
New main text figure (edit to figs. 4-6):



New Figure 4 *| Benthic trait carbon biomass composition across trait families at each station, ordered along the first latent variable (LV1). Left: station scores on LV1 from the GLLVM, coloured by coastal system, with dashed rules marking the divisions between low, intermediate and high LV1 groups. Right: alluvial diagrams for each station, arranged in the same three groups and in the same top-to-bottom order as the LV1 panel. Each diagram partitions that station's benthic invertebrate carbon across three trait families — environmental position, feeding habit and movement — with ribbons linking the modalities co-expressed by the same taxa, so the same carbon is followed across all three axes rather than treated as three independent quantities. Ribbon width is the share of that station's carbon, allowing composition to be compared between panels; total benthic carbon at each station is given in the panel title (g C m $^{-2}$). Ribbons are coloured by feeding habit (shared legend); position and movement modalities are labelled within panels. Flows show only the trait modalities retained by the 95 % biomass truncation.*

New Graphical Abstract:

Carbon supply alone does not explain benthic carbon; local seafloor setting shapes which strategies hold it.



*"**Graphical abstract** | Conceptual overview of the physical and biological processes shaping benthic invertebrate carbon and taxon-level traits across fjord systems in Northeast Greenland. The highly dynamic physical environment, including freshwater input, tidal mixing, upwelling, downwelling and the presence or absence of Atlantic Water at depth, influences surface water conditions and primary production, which in turn regulate the export and redistribution of particulate organic carbon to the seafloor. Benthic invertebrate carbon biomass as traits determines how this carbon is processed and contributes to variation in ecological functioning among stations and fjord systems. The schematics illustrate contrasting environmental settings and associated patterns of benthic invertebrate carbon and trait composition across Dove Bugt, Brede Fjord / Ardencaple Fjord, and the Kong Oscar Fjord system."*

RC2.3: The manuscript would benefit from very few minor adjustments made (suggested below) to improve clarity in some sections and a few comments are given regarding interpretations of the data which can be considered by the authors. These are considered very minor and the manuscript overall warrants publication.

AC2.3: We thank the reviewer for this positive assessment and for the constructive suggestions throughout the manuscript. We have carefully considered each comment and have made revisions where appropriate to improve clarity, methodological transparency, and the precision of our interpretations. Detailed responses to each comment are provided below.

Minor/specific comments

RC2.4: Line 16: fix "pelago-benthic coupling" to "pelagic-benthic coupling" for consistency with the rest of the manuscript.

AC2.4: Thank you for noting this. We will change “pelago-benthic coupling” to “pelagic-benthic coupling” for consistency with the terminology used throughout the manuscript.

RC2.5: Line 47: change "seafloor topology" to "seafloor topography" or "seafloor bathymetry" for consistency with the rest of the manuscript

AC2.5: Thank you for noting this. We will change “seafloor topology” to “seafloor topography” for consistency throughout the manuscript.

RC2.6: Line 59: The sentence starting with "different benthic strategies" is a little unclear - consider changing to "Organisms employing different benthic feeding strategies" for clarity

AC2.6: Thank you for this suggestion. We will revise the sentence to improve clarity, changing “different benthic strategies” to “organisms employing different benthic feeding strategies”.

RC2.7: In line 65-66 it is stated that communities may shift toward strategies adapted to lower carbon supply. What are these strategies? Consider giving 1-2 as example for contrast.

AC2.7: Thank you for this helpful suggestion. We will clarify the types of strategies referred to and provide examples, specifically greater reliance on deposited organic matter by deposit

feeders and increased representation of small-bodied, tolerant taxa. We will revise the sentence accordingly.

Proposed new text:
Conversely, under strongly stratified conditions that reduce the delivery of particulate organic matter, communities may shift toward strategies adapted to lower carbon supply, such as greater reliance on deposited organic matter by deposit feeders or increased representation of small-bodied, tolerant taxa (Pineda Metz et al. 2020; Komendić et al. 2024).

RC2.8: Line 113: abundance and biomass data were standardized to m^-2. This may also be clearer if box core is presented as 0.1 m2 rather than in cm2.

AC2.8: Thank you for this suggestion. We will present the box core area as 0.1 m^2 and clarify that abundance and biomass data were standardised to m^{-2}.

RC2.9: Section 2.2: Little discussion was given to the choice of a single wet-weight to carbon conversion factor despite significant literature regarding the variability in such conversion factors and published conversion factors which could have been employed. In addition, no detail is given as to the treatment of individual groups (e.g., shelled organisms, tube-dwellers) to understand what the data truly represent or for repeatability. The manuscript lacks discussion or evaluation of the potential error associated with the wet-weight to carbon conversions which form the basis of the data used throughout the study. It is suggested that the authors include an evaluation of the potential error and discuss this in the context of the study results. In addition, this section lacks a description of the identifications made i.e. to what taxonomic level which is important for the trait data. A statement in the following section (2.3) mentions species-level carbon biomass values which implies that all taxa were identified to species level. However, it seems unlikely that all species had available trait information in the Arctic Traits Database. It is suggested that the authors add methodological details to these sections (2.2 + 2.3) indicating to which taxonomic level taxa were identified to and how trait retrieval was done if traits were lacking in the database. It is acknowledge that such a statement may be missing if traits for all species were available - this is simply unclear in the manuscript.

AC2.9: We thank the reviewer for raising these important methodological points. Since Reviewer #1 (RC1.3) also raised this issue, we believe this warrants an expanded response. Therefore, to strengthen the analyses and highlight potential errors associated with the wet-weight to carbon conversions, we have A) substantially expanded the description of the wet mass to carbon conversion and evaluated the sensitivity of our carbon estimates and subsequent analyses to the conversion approach, and B) clarified the taxonomic resolution of the benthic identifications and completeness of trait information.

A. Carbon conversion and uncertainty

As this section is a re-analysis with sensitivity testing, we have divided it into three subsections: (1) the carbon conversion factor and our reanalysis, (2) its impact on trait selection, and (3) its impact on the GLLVM analyses. Each subsection includes a separate response and, where necessary, associated new proposed text.

The carbon factor and our re-analysis

The original 4.3% conversion factor followed Rowe et al. (1994) and Wiedmann et al. (2020) to facilitate comparison with previous estimates of carbon for Arctic benthic invertebrates. We recognise that a blanket conversion does not account for taxon-dependent differences in water and organic matter content, and that this could potentially introduce bias where taxonomic composition varies among stations. We therefore addressed this concern through a taxon-specific reconstruction of the trait-carbon matrix and a sensitivity analysis.

The benthic invertebrate carbon matrix was rebuilt using taxon-specific wet mass to AFDM conversion factors, followed by a single AFDM to carbon conversion of 0.5 (Brey, 2001). Conversion factors were assigned using a documented hierarchy: Behrisch and Zwerschke (2026), where a single family in our dataset matched their Greenland shelf dataset (mainly due to this study being an epifaunal trawl dataset against our infaunal box core dataset), Gogina et al. (2022) for the remaining taxa, and Ricciardi and Bourget (1998), where neither source provided an appropriate match. Every taxon was assigned a conversion factor, with the source and taxonomic level of each match documented in a new data table (Table R6; located at the end of the document). The combined references vary in geographic origin and taxonomic resolution, allowing us to derive a primary factor for each taxon, along with lower and upper estimates based on the published range of values. This captures uncertainty both among taxa and within taxonomic groups, as well as being highly useful for any future work using a similar dataset. We also clarified the treatment of specimens prior to weighing, including the retention of shells and tests, consistent with the convention used to derive the Gogina et al. (2022) factors.

We repeated the carbon reconstruction matrix using taxon-specific factors and both the lower and upper published conversion factors to assess the sensitivity of our estimates to the choice of conversion factors (Tables R2 & R3). The taxon-specific conversion reduced total estimated benthic carbon from 15.03 to 11.48 g C m^{-2}, while the lower and upper scenarios gave 6.23 and 18.07 g C m^{-2}, respectively. Importantly, the taxon-specific conversion also reduced the contribution of the dominant taxon from 53.4% to 28.5% of total benthic carbon. The two highest stations accounted for 64.4% of the carbon under the taxon-specific conversion, compared with 75.8% under the blanket factor. Thus, accounting for taxon-specific conversion reduces rather than amplifies the concentration of estimated carbon in the dominant taxon. Importantly for the final outputs, the relative positions of stations were largely stable across the four conversion scenarios. The same station held the lowest benthic carbon (KOF3) and the same station the highest (KOF2) in every case, and the same four lowest-carbon and two highest-carbon stations were identified throughout; station totals remained strongly rank- correlated with the blanket-factor version (Spearman ρ = 0.90–0.98; Tables R2 and R3). Only four adjacent, closely-spaced pairs exchanged position, and no station shifted by more than two rank places (Table R3).

Table R2. Effect of the wet-mass to carbon conversion on benthic invertebrate carbon estimates. Values are given for the blanket 4.3 % wet-mass factor used in the preprint, for the taxon-specific reconstruction adopted as the primary analysis, and for low and high bounding scenarios derived from the published range of factors for each taxonomic group. Spearman ρ compares station-level carbon totals against the blanket-factor version (n = 9 stations).

	Blanket factor	Taxon-specific	Low	High
Total benthic carbon (g C m^{-2})	15.03	11.48	6.23	18.07
Largest single taxon (% of total carbon)	53.4	28.5	21.9	39.8
Two highest stations (% of total carbon)	75.8	64.4	55.1	69.6
Spearman ρ vs blanket factor	—	0.98	0.98	0.90

Table R3. Station-level benthic invertebrate carbon biomass (g C m^{-2}) under four wet-mass to carbon conversion scenarios. Blanket factor applies a single 4.3 % wet-mass to carbon conversion; taxon-specific applies group-specific wet-mass to ash-free dry mass factors followed by a single AFDM-to-carbon conversion; low and high are bounding scenarios derived from the published range of factors for each group. Stations are ordered north to south.

Station	Blanket factor	Taxon-specific	Low	High
DB1	1.09	1.17	0.86	1.29
DB2	0.92	0.86	0.50	1.10
ACF1	0.27	0.35	0.23	0.69
ACF2	0.41	0.43	0.32	0.47
ACF3	5.31	2.45	0.96	4.91
ACF4	0.56	0.76	0.51	1.34
KOF1	0.28	0.32	0.24	0.33
KOF2	6.07	4.95	2.47	7.67
KOF3	0.12	0.19	0.14	0.27
Total	**15.03**	**11.48**	**6.23**	**18.07**

The sensitivity analysis nevertheless highlights an important uncertainty that we now make explicit. Even under taxon-specific conversion, *Strongylocentrotus droebachiensis* accounts for 28.5% of the reconstructed benthic carbon, and two of the nine stations contain approximately 64.4% of the total. This reflects the underlying composition of the samples rather than the blanket conversion itself. Importantly, we do not consider this dominance a limitation of the trait-based approach, as the contribution of dominant taxa to the carbon pool is itself part of the ecological signal captured by the trait-carbon matrix. Published wet-mass-to-AFDM values for echinoids also vary substantially, including 0.011 from Behrisch and Zwerschke (2026), flagged as low confidence; 0.035 from Ricciardi and Bourget (1998); and 0.077 for Echinodermata in Gogina et al. (2022). As this taxon represents the largest share of our biomass, it is consequently the largest contributor to uncertainty in the reconstructed carbon estimates. We will now report this uncertainty explicitly and frame benthic carbon biomass primarily as a comparative measure among stations rather than as an absolute estimate of standing stock (see proposed new text at the end of the section).

Additionally, while revisiting the carbon calculations, we identified two issues in the manuscript that we have corrected. First, the current description at L114–115 may be misinterpreted, as the

preprint's wording could imply that the fourth-root transformation was applied before aggregation. The correct procedure was to first sum taxon-level carbon across trait modalities to obtain a station × modality matrix, after which the fourth-root transformation was applied to the modality totals prior to modelling. Second, some per-station biomass values in Sect. 3.4, and the corresponding y axis in the station level alluvial diagrams, were incorrectly labelled as g C m^{-2} as they represented sums of fourth root transformed carbon. These values and units have now been corrected throughout, where the fourth root was used for analyses and converted back to g C m^{-2} for the alluvial figures.

The taxon-specific carbon reconstruction matrix is now used as the primary analysis, while the original blanket factor is retained in the supplementary material for comparability with Wiedmann et al. (2020). The station-level carbon estimates for the original, taxon-specific, low, and high conversion scenarios will be provided as a new table in the supplementary material (Table R3).

Proposed new text (Sect. 2.3, following construction of the trait–carbon matrix**):**

"Taxon-level carbon biomass was first summed across taxa within each trait modality to give a station × modality matrix. The fourth-root transformation was then applied to these modality totals to reduce the influence of the most carbon-rich modalities prior to modelling. Transformation was therefore applied after aggregation, not to individual taxon values. Station-level carbon biomass reported in the Results and in Fig. 4 is given on the untransformed scale (g C m^{-2}*)."*

Proposed new text (replacing preprint Methods Sect. 2.2 L113–115**):**

"Wet mass was recorded on blotted whole specimens with calcareous shells, tests and plates retained, so that shelled taxa are represented on the same basis as the source measurements. Tubes and other externally secreted structures were also included in the wet mass of tube-dwelling taxa. Macrofaunal wet mass was converted to carbon using taxon-specific wet-mass to ash-free dry mass (AFDM) conversion factors, followed by a single AFDM-to-carbon conversion of 0.5 (Brey, 2001). Conversion factors were assigned to each taxon using a fixed source hierarchy: Behrisch and Zwerschke (2026), derived from Greenland shelf benthos, was applied first, where a taxonomic match was available; Gogina et al. (2022) was applied to the remaining taxa; and Ricciardi and Bourget (1998) was used where neither source provided an appropriate match. Matches were made at the finest taxonomic level available in the source, and every taxon in the dataset was assigned a factor. The factor applied to each taxon, the source, and the taxonomic level of the match are documented in the published dataset (Zenodo). Because published factors for a given group vary across sources, we also derived lower and upper factors for each taxon from the published range, and recalculated the full carbon matrix under both scenarios. These bounding scenarios, together with the original blanket 4.3 % wet-mass conversion used for comparability with previous Arctic estimates (Rowe et al., 1994; Wiedmann et al., 2020), are reported in SM Tables R2 and R3. The taxon-specific carbon matrix is used as the primary analysis throughout."

Proposed new text (Discussion Sect. 4.3**):**

"These estimates depend on the conversion from wet mass to carbon, and this is a substantive source of uncertainty. Applying taxon-specific conversion in place of a single blanket factor reduced total reconstructed benthic invertebrate carbon from 15.03 to 11.48 g C m^{-2}, and bounding scenarios built from the published range of factors span 6.23 to 18.07 g C m^{-2} (SM Table R2). The dominant taxon, Strongylocentrotus droebachiensis, accounts for 28.5 % of reconstructed carbon under taxon-specific conversion, and two of the nine stations together hold approximately 64 % of the total. This concentration reflects the composition of the samples rather than the conversion itself; taxon-specific conversion in fact reduced the share attributed to the dominant taxon relative to the blanket factor (from 53.4 % to 28.5 %). We do not treat this dominance as a limitation of the trait-based approach, since the contribution of dominant taxa to the carbon pool is itself part of the ecological signal the trait–carbon matrix is designed to capture, and it is consistent with the concentration of carbon in single modalities described above. Published wet-mass-to-AFDM values for echinoids nevertheless vary by close to an order of magnitude: 0.011 in Behrisch and Zwerschke (2026), flagged there as low confidence; 0.035 in Ricciardi and Bourget (1998); and 0.077 for Echinodermata in Gogina et al. (2022). Because this taxon carries the largest share of the biomass, it is also the largest single contributor to uncertainty in the reconstructed estimates. We therefore treat benthic invertebrate carbon primarily as a comparative measure among stations rather than as an absolute standing stock. The comparison among stations is robust to this choice: station carbon totals were strongly rank-correlated across all four conversion scenarios (r^2 = 0.90–0.98), and the trait–environment relationships underpinning our conclusions were unchanged (SM Table R4)."

The impact on trait selection

We also tested whether the conversion approach affected the trait structure used in the subsequent analyses. We found the conversion approach did slightly alter the first step of truncating the biomass to 95%, but the overall analyses and results still stand; we discuss this here. Trait modalities were ranked by their contribution to total macrofaunal carbon within each trait family and retained in decreasing order until adding the next modality would cause cumulative biomass to exceed 95%. Because modalities are retained as whole categories rather than divided to reach the exact threshold, the achieved coverage depends on their relative sizes and therefore falls below the nominal 95% threshold. Under the original blanket 4.3% conversion, the retained modalities represented 94.6% of biomass for environmental position, 94.7% for feeding habit, and 94.0% for mobility. With the taxon-specific conversion, the same set of retained modalities was selected, but their cumulative contribution was slightly lower, representing 91.4% of biomass for environmental position (2 of 6 modalities), 91.6% for feeding habit (5 of 19), and 92.2% for mobility (4 of 15). Including the modality that crossed the 95% threshold would increase coverage to 96–99% but would also retain a larger, sparser set of modalities; we therefore retained the conservative criterion and assessed its consequences in Sect. 4.3. Critically, the same set of retained modalities was obtained using the taxon-specific carbon reconstruction as in the original analysis. Thus, the revised conversion altered the magnitude of carbon estimates but did not change the trait modality structure used in subsequent analyses. Given the importance of this methodological decision, we now explicitly discuss its implications in Section 4.3 as part of the proposed new text in our joint response to RC1.24 and RC2.22 (proposed new text below; combined with the next section).

The impact on GLLVM analyses

Most importantly, we tested whether the conversion approach affected the trait-environment relationships (e.g., the GLLVM approach) underpinning our main conclusions. Models were refitted using the taxon-specific carbon matrix under the same specifications as the original analysis. Models were fitted with zero to three latent variables, and with our new approach, all four converged. However, the information criteria did not agree, and disagreed at opposite ends of the candidate set: AIC and BIC both favoured three latent variables, while AICc favoured none (Table R7; at the end of the document). This is a symptom of the parameter-to-observation ratio rather than a genuine ambiguity in the data. With 99 observations and 55 to 85 estimated parameters, the AICc small-sample correction term ranges from 143 to 1125, an order of magnitude larger than any difference in AIC across the candidate set, so AICc returns the smallest model mechanically, irrespective of fit. AIC fails in the opposite direction: log-likelihood rises monotonically with each additional latent variable (9.7, 53.7, 87.4, 125.9) and the AIC penalty is too weak to offset it. Neither criterion is therefore informative here, and selecting on either alone would not have been defensible.

Instead, we based the choice on the estimated latent variance, which does not depend on the parameter count. In every fit, a single axis accounted for the majority of the latent variance, with additional axes contributing substantially less. The data support a single interpretable latent gradient, and the higher-dimensional models differ mainly in how many weakly supported axes they include. We therefore report the single latent variable model, as this was the most parsimonious model supported by the data. We have assessed the consequences of this choice directly rather than assuming it is unimportant. Trait–environment coefficients were compared across all four latent models and are reported in a new supplementary table (Proposed new Table R8; at the end of the document). Five terms are significant under every specification, with tightly constrained estimates. For example, POC flux × burrower ranges only from 0.213 to 0.224 across the four models, and POC flux × opportunist-predator-scavenger from 0.535 to 0.560. A further eight terms are significant under two or three specifications, and three under only one. The conclusions we draw in the revised Discussion rest on the five robust terms and are therefore unaffected by the number of latent variables fitted; terms significant under some specifications are described as suggestive, and terms significant under one are not used to support claims.

Table R4. Trait–environment coefficients that were significant under all four latent-variable specifications, compared between the blanket-factor and taxon-specific carbon conversions. Values give the range of the estimate across models fitted with zero to three latent variables. All terms retained the same sign and remained significant under both conversions. POC, particulate organic carbon flux; SOC, sediment organic carbon.

Term	Blanket factor	Taxon-specific
POC flux × SOC × filter + suspension	1.571 to 2.799	1.598 to 3.100
SOC × filter + suspension	0.688 to 1.627	0.687 to 2.033
POC flux × SOC × sessile	1.077 to 1.316	0.955 to 1.197
POC flux × opportunist + predator + scavenger	0.569 to 0.582	0.535 to 0.560
POC flux × burrower	0.213 to 0.232	0.213 to 0.224

Importantly, the latent gradient under the taxon-specific carbon scenario ('primary') was identical to the preprint analysis, with stations ordered KOF1 < ACF1 < ACF4 < DB2 < KOF3 < KOF2 < DB1 < ACF2 < ACF3. The five relationships supporting our main conclusions remained significant under both the original blanket conversion and the taxon-specific conversion across models (Table R4). Since LV1, rather than absolute carbon, is the axis along which the trait results

are interpreted, we find no evidence that the original conversion factor drove the relative spatial patterns or the trait-environment relationships on which our main conclusions are based.

The impact on trait structure results and Latent Variable interpretation

While the latent gradient itself was unaffected by the change in conversion factor, the trait composition underlying it was not, and we report this explicitly. Because the taxon-specific factors differ by close to an order of magnitude between taxonomic groups, the relative contribution of individual taxa to each trait modality was substantially reweighted, even though the set of retained modalities and the station ordering along LV1 were preserved. The station panels in New Fig. 4 therefore differ from those in the preprint, and several descriptive and interpretive statements in Sects. 3.4.1–3.4.3, 4.3 and 4.4 require revision revision (written at the end of the section).

The most consequential change concerns functional diversity. The preprint described functional diversity as increasing toward the high-LV1 end of the gradient, and this framing recurred in Sects. 3.4.3, 4.3 and 4.4. Under the taxon-specific reconstruction, it is not supported. Testing the relationship directly, functional evenness (Pielou's J) shows no association with LV1 (Spearman $\rho = -0.15$, $p = 0.70$; leave-one-out $\rho = -0.45$ to $+0.21$), and neither do Shannon diversity or Hill numbers ($\rho = +0.10$, $p = 0.80$) or Simpson's index ($\rho = -0.10$, $p = 0.80$). The number of trait combinations expressed is likewise unrelated ($\rho = +0.47$, $p = 0.20$). The most evenly distributed functional composition in the dataset now occurs at a low-LV1 station (KOF1, evenness J' = 0.69) and the most concentrated at a high-LV1 station (ACF3, evenness J' = 0.22). We have therefore removed the statements describing functional richness, functional integration and redistribution across co-occurring feeding modes, rather than weakening them.

The revised results support a clearer, more specific claim. LV1 is a gradient in which functional strategies hold the carbon, not in how many. The strongest relationship in the dataset is the proportion of carbon held by taxa capable of mixed deposit–opportunist– predator–scavenger feeding, which increases monotonically along LV1 ($\rho = +0.91$, $p = 0.0006$). Crawling taxa show a comparable pattern ($\rho = +0.82$, $p = 0.007$). Epifaunal contribution increases toward high LV1 but only marginally ($\rho = +0.58$, $p = 0.099$), and filter/suspension feeding shows no significant relationship ($\rho = +0.43$, $p = 0.24$). This revised interpretation is more directly consistent with the GLLVM coefficients themselves, in which filter/suspension feeding and sessile mobility show the strongest and most robust responses to POC flux, SOC and their interaction, while deposit feeders and burrowers show none (Table R8). It is also more consistent with the trait–environment framework on which the study is built, since a gradient in dominant functional strategy is precisely what a trait–carbon matrix is designed to resolve. We consider the revised interpretation both better supported and more specific than the original, and we note that it required no change to the model, the latent ordering, or the trait–environment coefficients on which our main conclusions rest.

A final observation on the revised model outputs: the relationship between LV1 and epifaunal contribution is not monotonic: the intermediate-LV1 stations are the most strongly infaunal in the dataset (mean epifaunal contribution 1.2 %, against 16.9 % at low-LV1 and 66.0 % at high-LV1 stations). We now describe this explicitly rather than presenting the gradient as a smooth progression, since the intermediate group represents a distinct infaunal, deposit-associated configuration rather than an intermediate state between the two ends.

Results

Proposed new text (Sect. 3.4)

"To characterise the gradient, we tested the association between LV1 rank and both the composition and the diversity of benthic trait carbon biomass across the nine stations. Compositional measures showed clear associations: the proportion of carbon held by taxa capable of mixed deposit–opportunist–predator–scavenger feeding increased monotonically along LV1 (Spearman ρ = 0.91, p < 0.001), as did the contribution of crawling taxa (ρ = 0.82, p = 0.007), while epifaunal contribution increased less consistently (ρ = 0.58, p = 0.10). Measures of functional diversity showed none: functional evenness (ρ = −0.15, p = 0.70), Shannon diversity and Hill numbers (ρ = 0.10, p = 0.80), and the number of trait combinations expressed (ρ = 0.47, p = 0.20) were all unrelated to LV1. Benthic trait carbon itself tended to increase along the gradient but not significantly at this number of stations (ρ = 0.57, p = 0.11). LV1 is therefore best interpreted as a gradient in the functional strategies that hold benthic carbon, rather than in the amount of carbon held or the diversity of strategies present."

Proposed new text (Sect. 3.4.1 — Low LV1: infaunal and mixed-strategy assemblages)

"The two stations with low LV1 scores held low benthic invertebrate carbon (KOF1 = 0.32, ACF1 = 0.35 g C m^{-2}), among the lowest recorded in the study, although the lowest total of any station occurred at KOF3 (0.19 g C m^{-2}), which has an intermediate LV1 score. The two low-LV1 stations differed markedly from one another in functional composition. ACF1 was composed entirely of infauna, with mixed deposit–filter/suspension feeders holding 79.9 % of its carbon and burrowers 95.5 %, and expressed the fewest trait combinations of any station among the retained modalities (n = 4). KOF1, by contrast, showed the most even functional composition in the dataset (Pielou's J' = 0.69, n = 11 combinations), with carbon distributed across opportunist–predator–scavengers (43.0 %), filter/suspension feeders (31.6 %) and deposit-based modalities, and across burrowing (24.1 %), mixed burrower–crawler (37.8 %) and sessile (33.6 %) strategies. Neither station held carbon in the mixed deposit–opportunist–predator–scavenger modality. Low standing carbon at these two stations therefore does not correspond to a single functional configuration."

Proposed new text (Sect. 3.4.2 — Intermediate LV1: infaunal, deposit-dominated assemblages)

"Stations with intermediate LV1 scores (ACF4, DB2, KOF3) held between 0.19 and 0.86 g C m^{-2} of benthic invertebrate carbon, with KOF3 holding the least of any station in the study. These were the most strongly infaunal stations in the dataset, with epifauna contributing 2.5 % or less at each and filter/suspension feeding effectively absent (0.4–3.8 %). ACF4 and KOF3 again showed convergent composition despite occupying different coastal systems, both dominated by deposit feeding (95.3 % and 75.2 %) and by burrowing and mixed burrower–crawler movement (86.1 % and 89.2 % combined). DB2 differed in holding the majority of its carbon in opportunist–predator–scavengers (78.7 %), the highest proportion at any station, expressed almost entirely by burrowing infauna (93.6 %). Resource use across this group is therefore predominantly sediment-associated rather than suspension-based, and the intermediate position of these stations on LV1 does not correspond to an intermediate functional composition between the low- and high-LV1 ends."

Proposed new text (Sect. 3.4.3 — High LV1: epifaunal assemblages with mixed feeding strategies)

"Stations with high LV1 scores (KOF2, DB1, ACF2, ACF3) spanned the widest range of benthic trait carbon in the study (0.43 to 4.95 g C m^{-2}), including both the highest value recorded (KOF2) and one of the lowest (ACF2). The group is distinguished by composition rather than by standing carbon. Epifaunal contribution was highest here (mean 66.0 %, against 1.2 % at intermediate and 16.9 % at low-LV1 stations), as was the contribution of taxa capable of mixed deposit–opportunist–predator–scavenger feeding (mean 29.4 %, against ≤0.5 % elsewhere). KOF2 held both the highest total benthic trait carbon and the largest proportional contribution of filter/suspension feeders (68.8 %), expressed almost entirely by sessile epifauna (68.8 %). ACF3 held the highest proportional representation of mixed feeding of any station (86.3 %), expressed by crawling epifauna (88.1 %), and consequently had the most concentrated functional composition in the dataset (J' = 0.22). ACF2 was the most evenly distributed (J' = 0.70), with carbon split between filter/suspension (45.2 %) and deposit feeding (37.6 %). DB1 departed from the group pattern, being predominantly infaunal (66.7 %) and dominated by mixed deposit–filter/suspension feeders (69.1 %). High LV1 scores therefore correspond to a shift in feeding mode and environmental position, and not to a consistent increase in either standing carbon or functional evenness."

Discussion

Proposed new text (Sect. 4.3 — replaces L462–477**) – NB:** This forms the third paragraph of the revised Sect. 4.3. The two preceding paragraphs, on the responses of filter/suspension feeders and infaunal groups to the carbon predictors, are given in AC1.24 (RC1) / AC2.22 (RC2).

"Mixed feeding strategies, by contrast, provide the clearest insight into how carbon is redistributed along the latent gradient. The proportion of carbon held by taxa that are jointly deposit feeders, predators and scavengers increased along LV1 (r_s = 0.91, $p < 0.001$), the strongest association with LV1 of any compositional measure examined, although it was substantial only at KOF2 (28.1 %) and ACF3 (86.3 %), the two stations that also held the highest benthic invertebrate carbon. A recent isotope study of feeding types in epibenthos from Northeast Greenland characterised most fauna as generalists (Nordström et al. 2026), suggesting that access to multiple carbon sources may be particularly important for benthic consumers in this region. Our trait framework captures this generalism by retaining combined trait modalities where taxa express multiple feeding strategies. Two such modalities were retained under the 95 % biomass criterion, and one of them (combined deposit, opportunist, predator and scavenger feeding) proved to be the compositional measure most strongly associated with the latent gradient. Finer mixed strategies beyond these two contributed proportionally little carbon and were excluded by the retention rule. Rather than reflecting reliance on a single prey source, the prominence of this modality suggests exploitation of advected particulate matter, sedimentary detritus and benthic secondary production together, and in such carbon-rich settings trophic flexibility may allow organisms to exploit spatially and temporally variable resources across co-occurring energy pathways (McMeans et al. 2015; Mavraki et al. 2020).*

We emphasise that this represents a change in which strategies hold the carbon, not an increase in the range of strategies present. Functional evenness, Shannon diversity and the number of trait combinations expressed were all unrelated to LV1 (Spearman's ρ = −0.15 to +0.47, all $p > 0.20$),

and at ACF3, the majority of benthic invertebrate carbon was held within a single mixed-feeding modality, producing the most concentrated functional composition in the study. Where mixed feeding was prominent, it was therefore concentrated in a small number of dominant taxa rather than distributed across the assemblage. Together, these contrasting responses between epifaunal and infaunal strategies indicate that benthic invertebrate carbon is governed not simply by carbon quantity, but by the interaction between carbon supply pathways and resource characteristics, with different trait strategies potentially exploiting distinct components of the carbon pool that are not equally captured by bulk POC flux or sedimentary carbon measures."

Proposed new text (Sect. 4.4 — replaces L498–502)

"We hypothesise that a comparable configuration emerged in our coastal systems, with high latent-variable scores situated on steep sills supporting epifaunal assemblages in which mixed deposit–opportunist–predator–scavenger feeding was prominent, and, at two of the four stations, the highest benthic invertebrate carbon was recorded, even in the absence of elevated POC export or SOC. The gradient captured by LV1 is compositional rather than one of diversity: functional evenness and richness were unrelated to LV1, and the two most carbon-rich stations were among the most functionally concentrated in the dataset. We therefore interpret LV1 as an axis along which particular epifaunal and mixed-feeding strategies come to hold an increasing share of the carbon, rather than as a gradient of increasing functional complexity. We note that the low- and intermediate-LV1 ends are not characterised by a single alternative strategy: deposit feeding, mixed deposit–filter feeding and burrowing showed no significant association with LV1 in either direction, and the two low-LV1 stations differed markedly from one another. As LV1 is also moderately associated with seabed slope and terrain ruggedness ($r^2 \approx 0.26–0.33$), we hypothesise this compositional shift could be consistent with an influence of near-bed hydrodynamic conditions on which species trait strategies may capture carbon, though our data cannot establish that relationship directly."

Proposed new text (Sect. 4.4 — add after the ACF1 passage (L508–512))

"The intermediate-LV1 stations are worth noting in this context. Rather than representing a transitional state between the two ends of the gradient, they were the most strongly infaunal and deposit-dominated stations in the study, with epifaunal contributions below those of the low-LV1 stations. This suggests that the latent gradient does not represent a simple continuum of increasing exposure, but instead distinguishes different configurations of resource use, from communities dominated by sediment-associated strategies to those where epifaunal strategies become more prominent. The intermediate LV1 group is therefore not simply transitional, but represents a particularly strong expression of infaunal and deposit-dominated resource use."

B. Taxonomic resolution and trait retrieval

We have also clarified the taxonomic resolution of the benthic identifications and the completeness of trait information, as requested by RC2.9. Taxa were identified to the lowest practical taxonomic level, ranging from species to phyla. Trait information was retrieved from the

Arctic Trait Database using the available taxonomic information and the fuzzy coding approach described in Sect. 2.3. Environmental position and mobility were available for all 206 taxa, while feeding habit was available for 205 taxa (99.5%). The single taxon without feeding information, *Katianira bilobata*, contributed <0.001% of total benthic carbon biomass and was therefore not material to the carbon-based analyses. We have clarified these details in Sections 2.2 and 2.3 and now use "taxon level" rather than "species level" where appropriate.

Proposed new text (Sect. 2.2, identification level):

"Taxa were identified to the lowest practical taxonomic level, ranging from species to phylum; 55.8 % of taxa were resolved to species and a further 26.2 % to genus, together accounting for 97.3 % of total benthic carbon; the remaining taxa were assigned at family level or above and contributed 2.7 % of carbon. The distribution of identification levels and their contribution to total carbon is given in SM Table R5."

Proposed new text (Sect. 2.3, after the fuzzy-coding description**):**

"Traits were retrieved from the Arctic Trait Database at the highest taxonomic level available for each taxon, using the fuzzy-coding approach described above. Where a taxon was identified above species level, trait values were taken at the level of identification. Trait coverage was effectively complete: environmental position and mobility were available for all 206 taxa, and feeding habit for 205 (99.5 %). The single taxon lacking feeding information, Katianira bilobata, contributed less than 0.001 % of total benthic carbon biomass and was therefore immaterial to the carbon-based analyses (SM Fig. S2; SM Table R5). We use "taxon level" rather than "species level" throughout to reflect this variation in identification."*

Table R5. Taxonomic level of identification and completeness of trait assignment for the 206 taxa in the dataset. Carbon percentages are given under the taxon-specific conversion. A taxon was considered complete when data were available for all three trait families (environmental position, feeding habit, mobility).

Identification level	Taxa	% of taxa	Carbon (g C m^{-2})	% of carbon	Complete	% complete
Species	115	55.8	8.163	71.1	114	99.1
Genus	54	26.2	3.010	26.2	54	100
Family	18	8.7	0.104	0.9	18	100
Class	8	3.9	0.022	0.2	8	100
Phylum	5	2.4	0.142	1.2	5	100
Order	4	1.9	0.043	0.4	4	100
Subclass	1	0.5	<0.001	<0.1	1	100
Suborder	1	0.5	<0.001	<0.1	1	100
Total	**206**	**100**	**11.48**	**100**	**205**	**99.5**

RC2.10: Line 131: remove "additional"

AC2.10: Thank you for noting this. We will remove "additional" from the sentence.

RC2.11: Section 2.4.1: It is assumed samples were homogenized and the results then represent grain size of the upper 10 cm of sediment at each site. Clarify in the text. The grain size

data refers to clay which is showin in Figure S3 but the caption states "mud" which appears throughout the rest of the manuscript and figures. Authors should change to either clay or mud for consistency throughout.

AC2.11: Thank you for highlighting this clarification. The sediment subsamples represented the upper 10 cm of each box core and were homogenised prior to analysis. We will clarify this in Section 2.4.1 by adding "The subsamples were homogenised prior to analysis". We also recognise that "mud" was used incorrectly in the main manuscript, but sediment characteristics were correct in the supplementary material. We will revise the terminology to distinguish between clay and silt, while using "mud" only when referring to their combined fraction, "...consisting of approximately 50% clay, 40% silt, and 0–10% sand, with gravel...".

New proposed text:

"For each box core replicate, two additional sediment subsamples were collected ... using 50 mL Falcon tubes inserted vertically ~10 cm into the sediment to capture both surface and subsurface layers. The subsamples were homogenised prior to analysis."

RC2.12: Lines 157-160 describe the process of estimating POC flux at the seafloor from attenuation coefficients and deepest trap depths. It is unclear from this description what the deepest trap depth represents because in Table S11ii all deepest trap depths are shallower than the seafloor depth or deepest seafloor depth except at station DB1. In addition, Figure S11i shows the attenuation coefficient regressions where there are trap measurements existing below the "deepest trap depth" line. It is unclear what the "ratio between seafloor depth and deepest trap depth" means.

AC2.12: Thank you for highlighting this ambiguity. Here, "deepest trap depth" refers to the depth of the deepest sediment trap cylinder at each station (maximum 400 m, as described in the Methods), rather than the seafloor (box core) depth. The differences between trap and benthic sampling depths reflect the practical requirements of the respective sampling methods, which cannot be deployed at precisely the same location without potentially disturbing the material collected by the sediment trap. As the deepest sediment traps generally did not reach the seafloor, the seafloor flux was estimated from the flux measured in the deepest trap using the station-specific attenuation exponent *b* from the log-log regression of POC flux against depth:

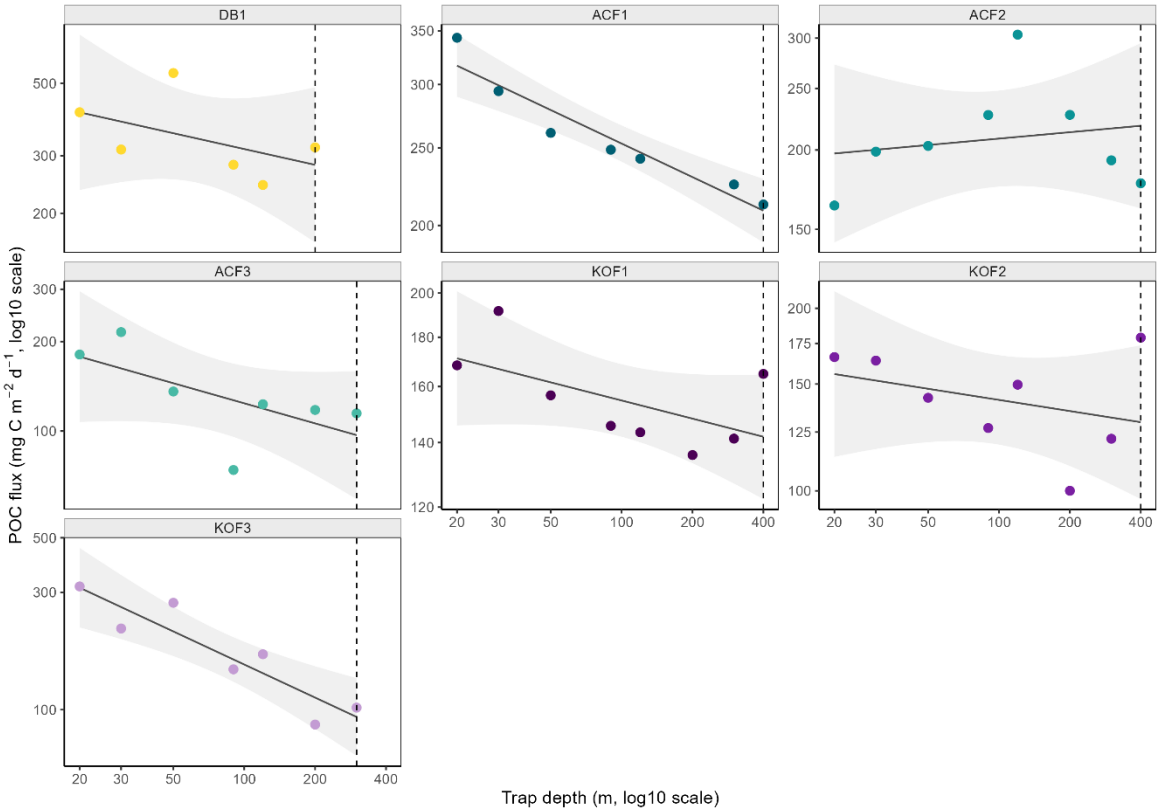
$$F_{seafloor} = F_{trap} \times (Z_{seafloor} / Z_{trap})^{b}$$

Specifically, the ratio of seafloor (box core) depth to the deepest trap depth was used to estimate how POC flux changed from the deepest trap to the seafloor. For all stations except one, the seafloor was deeper than the deepest measured trap, enabling POC extrapolation from the deepest measured trap to the seafloor. As the fitted attenuation exponent is negative at these stations, the estimated seafloor flux is lower than the flux at the deepest trap. At DB1, the trap was deployed at 200 m whereas the corresponding box core was collected at 163 m, so the calculation represents interpolation rather than extrapolation and results in a slightly higher estimated flux of 329.3 mg C m^{-2} d^{-1} compared with 318.3 mg C m^{-2} d^{-1} at the deepest trap, a difference of 3.3%. We will clarify this distinction and the calculation in Section 2.4.3.

Proposed new text (Sect. 2.4.3):

"To estimate POC flux at the seafloor, station-specific attenuation coefficients were derived from log-log regressions of sediment trap POC flux against trap depth. Sediment traps and box cores were deployed separately, and their sampling depths therefore did not always coincide. Consequently, seafloor POC flux was calculated as $F_{seafloor} = F_{trap} \times (Z_{seafloor} / Z_{trap})^b$, where b is the fitted attenuation exponent, $Z_{seafloor}$ is the water depth at the corresponding box coring sampling, and Z_{trap} is the depth of the deepest trap. For all stations except DB1, the box core depth was greater than the deepest trap depth, and the equation therefore extrapolated POC flux from the deepest measured trap to the seafloor. At DB1, the deepest trap was below the box core depth, so the equation instead interpolated to the shallower sampling depth. This approach minimises extrapolation and provides conservative estimates of carbon delivery to the benthos. The fitted attenuation exponent, standard error, r^2 and p value for each station are provided in (Updated) Table S11ii."

In the preprint, the dashed lines in Figure S11i marked an approximate rather than exact depth, which is why traps appeared below it. The figure has been redrawn: axes are now in measured units (trap depth in m, POC flux in mg C m^{-2} d^{-1}, both log_{10}), the dashed line marks the exact depth of the deepest trap, and the fitted slope is shown with its 95 % confidence band. Amended figure below.



"(Updated) Figure S11i. *Depth attenuation of particulate organic carbon (POC) export at each sediment-trap station in Northeast Greenland coastal systems (DB1, ACF1–3, KOF1–3). Points represent POC export measured in individual trap cylinders, plotted against trap deployment depth; both axes are on a log_{10} scale in measured units. Note that the flux axis is scaled independently in each panel, so vertical positions are not comparable between stations. Solid lines are station-specific log–log linear fits to log_{10}(POC flux) against log_{10}(depth); the fitted slope is the attenuation exponent b, reported with its standard error, r^2 and p value in Table S11ii. Grey*

bands show the 95 % confidence interval of the fit and indicate where a single power law describes the profile poorly, most clearly at ACF2, where the slope is positive (b = +0.034, r^2 = 0.04), and at DB1. Black dashed vertical lines mark the depth of the deepest trap at each station, which is the reference point from which POC flux at the seafloor was extrapolated (Sect. 2.4.3); seafloor depths lie beyond the plotted depth range and are given in Table S11ii."

Table S11ii. Station-specific POC flux attenuation and seafloor flux estimates. Attenuation exponent *b* is the slope of an ordinary least-squares regression of $\log_{10}$(POC flux) on $\log_{10}$(trap depth). Box-core depth is the water depth at the benthic sampling station. Depth distance is the interval between the deepest trap and the box-core depth over which flux was estimated. *DB1 was interpolated, given there was a depth difference between the sediment trap and box locations, despite being at the same ship station.

Station	n	b	SE	r^2	p	Deepest trap (m)	POC deepest trap (mg C m^{-2} d^{-1})	Box-core depth (m)	Depth difference (m)	Seafloor POC (mg C m^{-2} d^{-1})
DB1	6	−0.16	0.14	0.25	0.317	200	318.3	163	37	329.3*
ACF1	7	−0.14	0.02	0.91	<0.001	400	212.4	547	147	203.4
ACF2	8	+0.03	0.07	0.04	0.650	400	177.3	402	2	177.3
ACF3	7	−0.23	0.12	0.42	0.118	300	114.7	390	90	108.1
KOF1	8	−0.06	0.04	0.35	0.124	400	164.9	604	204	160.7
KOF2	8	−0.06	0.07	0.12	0.407	400	178.9	498	98	176.5
KOF3	7	−0.45	0.09	0.84	0.004	300	102.0	358	58	94.2

*DB1 was interpolated, given there was an inverse depth difference between the sediment trap and box locations (e.g., box core depth was shallower than deepest sediment trap).

RC2.13: The calculation of attenuation coefficients seems straightforward but I suggest the authors comment on the clear non-linearity of POC flux profiles particularly at AFC2 which results in the only location with a positive coefficient. I suggest this because the coefficient (much like the choice of wwt-carbon conversion factor) could greatly impact the POC flux estimates used in all subsequent analyses - thus, a brief discussion of potential sources and magnitudes of error is warranted.

AC2.13: Thank you for highlighting this important point. We agree that the nonlinearity of some POC flux profiles, particularly at ACF2, warrants explicit discussion, given that the attenuation coefficients are subsequently used to estimate seafloor POC flux. The ACF2 profile is non-monotonic and is poorly described by a single log-log relationship (r^2 = 0.04). The fitted coefficient is also not significantly different from zero (b = 0.034, SE = 0.070, p = 0.65), and therefore, we do not interpret this as evidence of increasing POC flux with depth. Rather, the positive coefficient reflects the limitations of applying a single power law to a short and variable depth profile. We will clarify this in the revised manuscript (new proposed text below).

The reviewer's comment also prompted us to report the fit quality across all stations, which was not done in the original manuscript. Only two of the seven profiles have $r^2 > 0.8$ (ACF1, r^2 = 0.91, $p < 0.001$; KOF3, r^2 = 0.84, p = 0.004), while the remaining profiles have $r^2 < 0.5$. We will therefore report the attenuation coefficient together with its standard error, r^2 and p value for each station in Table S11ii, rather than reporting the coefficient alone. Importantly, the effect of these

coefficients on the estimated seafloor POC flux is small because the deepest traps were relatively close to the corresponding box core depths. For the six stations where the seafloor was deeper than the deepest trap, the estimated seafloor POC flux was 92–100% of the measured flux at the deepest trap, with the largest reduction occurring at KOF3 (7.6%), where the steepest and best constrained attenuation coefficient was observed. Propagating the standard error of the fitted exponent through the same depth ratios results in an additional uncertainty of approximately 1.5–3.0% in the estimated seafloor flux. At ACF2, the box core was only 2 m deeper than the deepest trap, so the positive coefficient changes the estimated flux by approximately 0.02% (177.30 to 177.33 mg C m^{-2} d^{-1}) and therefore has a negligible influence on subsequent analyses. We will describe these limitations and their magnitude in Section 3.2.

We have also added a brief discussion of the potential sources and magnitude of error associated with the choice of attenuation model, noting that globally averaged exponents such as the Martin curve are known to poorly represent any individual system, and that the direction of this mismatch is itself region-dependent. We highlight that our use of station-specific coefficients avoids importing this bias, while acknowledging it as an additional, unquantified source of uncertainty alongside the extrapolation uncertainty already discussed above.

Proposed new text 3.2:
"The log-log attenuation relationships varied considerably among stations, with r^2 values ranging from 0.04 to 0.91 (Figure S11i & Table S11ii). The ACF2 profile was particularly poorly described by a single power law and produced a small positive, non-significant exponent ($b = 0.034$, $p = 0.65$). This coefficient is therefore not interpreted as indicating an increase in POC flux with depth, but rather reflects variability in the observed profile. Because the deepest traps were relatively close to the corresponding box core depths, the resulting seafloor flux estimates were only modestly affected by the fitted attenuation relationships (e.g., an additional uncertainty of approximately 1.5–3.0% in the estimated seafloor flux). We also note that a single, globally averaged exponent, such as the widely used Martin curve ($b \approx 0.86$; Martin et al., 1987), is known to poorly represent attenuation in any individual region or system (Reigstad et al., 2008; Marsay et al., 2015), and the direction and magnitude of that mismatch is itself system-dependent (Lam et al., 2011; Marsay et al., 2015). Fitting station-specific coefficients, as done here, avoids importing that bias, though the poorly constrained fits at several stations (Table S11ii) remain an independent source of uncertainty."

RC2.14: Lines 214-215 state that bottom-water conditions are similar across stations. This is true at this point in time - no seasonal dynamics can be explored from the data presented in this study. This statement should be amended to reflect this.

AC2.14: Thank you. We will revise the statement to acknowledge that these observations reflect conditions at the time of sampling and update the result to reflect our new water-mass findings (AC2.19 & RC1.2). The sentence will be changed to:

"We therefore conclude that the seven stations within Kong Oscar Fjord and Ardencaple Fjord experienced closely comparable seafloor physical conditions at the time of sampling, in terms of both bottom-water properties and sediment composition, while the Dove Bugt stations differed in bottom-water mass but not in sediment composition."

RC2.15: Line 265 states that the patterns observed from GLLVM analyses provide context for interpreting spatial differences in carbon sources but very limited data in this study relate to carbon sources and nothing definitive (e.g., biomarkers, in-depth chemical composition or lability). This should be changed to "carbon stocks" or something more appropriate for the data collected and presented in this study.

AC2.15: Thank you. We agree that "carbon sources" was too strong, given the data collected in this study. We have replaced this with "carbon stocks" to more accurately reflect the measurements and analyses presented.

RC2.16: Figure 3: add a color scale or state what the ends of the scale indicate in the caption.

AC2.16: Thank you. We have clarified the figure caption to explain that colours represent feeding habit, the central trait category in the alluvial diagram, allowing each feeding strategy to be traced between environmental position and mobility.

New figure caption:
"Figure 3 \| Trait based composition of benthic carbon biomass and trait specific responses to carbon variables. *(i) The distribution of benthic carbon biomass (g C* m^{-2}*) across major trait groups. Colours represent feeding habit, the central trait category in the alluvial diagram, allowing each feeding strategy to be traced between environmental position and mobility. Flow widths represent the proportional contribution of each trait combination to the total benthic invertebrate carbon pool. (ii) Trait-specific coefficients from the GLLVM models for three carbon predictors: vertical POC flux (export) (mg C* m^{-2} d^{-1}*) at the deepest sediment trap depth, the interaction between vertical POC flux and SOC, and surface SOC. Points represent estimated coefficients (β), with horizontal lines indicating 95% confidence intervals. Black points denote statistically significant effects at* $P < 0.05$ *("true"), whereas grey points indicate non significant effects at* $P \geq 0.05$ *("false"). Panels are grouped by trait categories of environmental position, feeding habit and mobility."*

RC2.17: Section 3.4.1 highlights a difference between stations AFC1 and KOF1 in terms of functional trait composition but little attention was focused on the taxonomic compositional differences between stations. Since this is only presented very coarsely at phylum level in the supplement, not much can be said and this is not the focus of the study. However, even at phylum level it is clear that there is a taxonomic compositional difference between these stations which does not seem reflected in the trait composition which is interesting in the context of the overall study.

AC2.17: Thank you for highlighting this interesting pattern. We agree that the taxonomic differences between stations are interesting in the context of the trait patterns presented here, even though exploring taxonomic turnover is deliberately outside the main focus of this study. Our aim was instead to use a trait-based approach to move beyond describing which taxa are present and towards understanding how different organisms may contribute to carbon processing and storage through their functional characteristics.

Our interest here, however, is in what this species-level information can reveal when translated into functional characteristics (55.8% at species-level trait resolution). Organisms rarely express

a single functional characteristic in isolation, and combinations of environmental position, feeding habit and mobility may provide more mechanistic insight into how carbon is captured, processed, transferred and stored. This is why we consider the alluvial representation particularly useful: rather than treating traits as independent variables, it allows combinations of traits expressed by organisms to be considered together and linked to benthic carbon biomass. This raises questions that are difficult to address from taxonomic composition alone, such as whether different taxa contribute to similar carbon pathways through shared functional strategies, whether particular combinations of traits are repeatedly associated with high carbon biomass, and whether these strategies are shared across the community or concentrated within particular taxa. This perspective is also supported by our previous work in Greenland, where we have found that substantial taxonomic turnover does not necessarily translate into equivalent functional turnover, while in other cases, taxonomic differences are accompanied by divergence in functional traits (Armitage et al. 2025, https://doi.org/10.1016/j.ecss.2024.109086; Armitage et al. 2026, https://doi.org/10.1111/ddi.70195). These contrasting patterns highlight the value of considering taxonomic and functional composition as complementary dimensions of community structure.

We have therefore retained the coarse taxonomic information in the Supplementary Material rather than expanding the taxonomic analysis in the present study. The underlying species-level data are also publicly available, allowing further exploration of taxonomic composition and its relationship with the trait patterns presented here. We appreciate the reviewer highlighting this distinction, as it reinforces the value of considering taxonomic and functional composition together, while keeping the present study focused on the mechanistic relationships between benthic traits and carbon pathways.

RC2.18: Lines 370, 374, and 422: use "carbon accumulation" but this study measured POC flux and sedimentary carbon stocks not true accumulation rates. Change terminology for clarity.

AC2.18: Thank you. We agree that “carbon accumulation” could imply a measured accumulation rate, which was not quantified in this study. We have therefore revised the terminology throughout the manuscript to refer to “sedimentary carbon stocks” where we are describing our measurements, and have replaced “carbon accumulation” in the highlighted sections.

RC2.19: Lines 380-383: The novel observation of Atlantic Water in this fjord system should be confirmed with more information regarding the water mass structure and temporal variability of it including the potential for water mass transformations. Description of processes which could lead to this were well explained in the subsequent lines of the manuscript.

AC2.19: Thank you for this important comment. We agree that the presence of Atlantic Water at the inner stations of Ardencaple Fjord warrants cautious interpretation, particularly because the hydrographic observations represent a single sampling period and cannot resolve temporal variability or water mass transformations. As Reviewer #1 also commented on the water mass characteristics, in response, we have substantially revised the water mass classification and its presentation throughout the manuscript (RC1.2). This included a detailed reassessment of the hydrographic profiles and the criteria for identifying Atlantic Water, with particular attention to the regional context of Northeast Greenland.

We now define Atlantic Water using regionally appropriate temperature and salinity criteria based on several references (Straneo & Heimbach, 2013; Sejr et al., 2017; Boone et al., 2018; Gjelstrup et al., 2022; Rysgaard et al., 2024), rather than relying on broader definitions from across the Arctic. A full response for this can be found in RC/AC1.2, where we provide the classification criteria and bottom-water properties for each station in a new supplementary table, and the revised T–S diagram explicitly shows the classification boundaries and bottom-water observations (AC1.2, Table R1). This reassessment confirmed Atlantic Water at the seven stations in Kong Oscar Fjord and Ardencaple Fjord, whereas the two Dove Bugt stations do not meet the criteria for Atlantic Water: DB1 is classified as Polar Water and DB2 as transitional. The revised classification is also consistent with the regional influence of bathymetry on water mass exchange, including Gjelstrup et al. (2022), who describe shallow fjords as more Polar Water-driven. We have therefore revised the manuscript to describe Dove Bugt as Polar and transitional water.

We have also revised the Discussion to clarify that the observed Atlantic Water represents modified Atlantic origin water in Northeast Greenland, rather than the warmer Atlantic Water core characteristic of other Arctic regions. Potential mechanisms for its presence, including episodic deep-water renewal and mixing, are presented as explanations rather than demonstrated processes. The temporal persistence and seasonal variability of Atlantic Water cannot be established from our observations alone; this limitation, together with relevant regional evidence from previous studies, is addressed in our response to RC2.20 below.

We thank the reviewer again and believe these revisions provide a more transparent and regionally appropriate basis for identifying Atlantic Water while retaining the observation that water of Atlantic origin reaches the deep basins of Kong Oscar Fjord and Ardencaple Fjord.

Proposed new text (Replaces preprint Sect. 2.4.3, L146–149**):**

"Temperature–salinity diagrams were used to identify water masses. Definitions of Atlantic Water vary across the Arctic, and because Atlantic-origin water reaching the Northeast Greenland shelf is cooled and modified during transit through Fram Strait (Wekerle et al., 2024; Rysgaard et al., 2024*), we applied criteria established for this region rather than broader pan-Arctic definitions. Following Gjelstrup et al. (2022), Atlantic Water (AW; water of Atlantic origin) was defined as* $\theta > 0$ *°C and* $S_p > 34.4$*, and Polar Water (PW) as* $\theta < 0$ *°C and* $S_p < 34.4$*. Surface Water (SW) denotes the relatively fresh surface layer overlying PW, identified from its position in the hydrographic profile rather than by fixed thresholds, also following Gjelstrup et al. (2022). This characterisation is also consistent with previous descriptions of these water masses in Northeast Greenland (Straneo & Heimbach, 2013; Sejr et al., 2017; Boone et al., 2018; Rysgaard et al., 2024). Water meeting neither the AW nor the PW definition is described as transitional. Bottom-water* θ*,* S_p*,* $\sigma\theta$*, water-mass assignment, and the distance of each sample from the classification thresholds are reported for all nine stations in SM Table R1. The classification boundaries and the bottom-water observations are shown explicitly in the T–S panels of Fig. 1(iii)."*

RC2.20: Given the limited temporal coverage of this study, it seems inappropriate to conclude here and on like 535 that AW is a consistent background condition of this region without exploring seasonality in hydrography here. If this has been studied previously to inform this statement, literature should be referenced. Otherwise the statement seems to overreach the data in the present study.

AC2.20: Thank you for highlighting this point. We agree that our August 2022 observations alone cannot establish year-round persistence or fully characterise seasonal variability in Atlantic Water at the sampled stations. However, we do not consider the presence of Atlantic Water in these systems to be supported solely by our single sampling period. Gjelstrup et al. (2022) compiled multi-decadal hydrographic observations across the Northeast Greenland shelf, coast and fjords and documented a long-term shoaling of Atlantic Water, including an increasingly persistent presence of Atlantic Water in the bottom waters of Northeast Greenland fjords; Schaffer et al. (2017) document sustained AW pathways on the shelf; and Boone et al. (2018) and Sejr et al. (2017) provide multi-year mooring and monitoring records of subsurface conditions in these coastal waters. We will therefore retain the regional interpretation of increasing and persistent Atlantic Water influence, but will revise the wording to distinguish this established regional pattern from the temporal coverage of our own observations. Specifically, statements referring to Atlantic Water as a "consistent background condition" will be revised to indicate that Atlantic Water was present at the sampled bottom depths in August 2022 and that this observation is consistent with the documented long-term increase in Atlantic Water influence across the Northeast Greenland region.

Proposed new text (Replacing L396**)**:

"Atlantic Water was present at the sampled bottom depths of the two fjord systems in August 2022, and bottom-water properties there were closely comparable among stations. Our observations cover a single period and cannot establish year-round persistence; however, they are consistent with multi-decadal records documenting a long-term shoaling and increasingly persistent presence of Atlantic Water in Northeast Greenland shelf and fjord bottom waters (Schaffer et al., 2017; Sejr et al., 2017; Boone et al., 2018; Gjelstrup et al., 2022). Against this comparatively uniform hydrographic setting, vertical carbon flux, sedimentary carbon stocks and trait-based benthic composition varied markedly among the same stations, which is the contrast this study is built on."

RC2.21: Line 421: The statement about processes weakening the link between pelagic and benthic realms is a bit confusing since fecal pellet production can enhance carbon flux to the seabed whereas remineralisation in the water column decreases it. Consider changing "weaken" to "alter" or more clearly explain these linkages.

AC2.21: Thank you for highlighting this distinction. We agree that "weaken" was too general, as the processes described can either reduce or enhance vertical carbon transfer depending on the balance between remineralisation, grazing, and repackaging into sinking particles. We will therefore change "weaken" to "alter" to more accurately reflect their potential effects on the amount of carbon reaching the benthos.

RC2.22: Line 447: This line mentions long-lived and immobile Arctic taxa - is this a statement about Arctic taxa generally or related to the traits of fauna observed in this study? If there is evidence that the sampled communities here contained long-lived and immobile taxa this statement is directly relevant to the study. Otherwise, it is commenting more generally on Arctic benthic communities and this should be clarified.

AC2.22: Thank you for highlighting this ambiguity. The original statement was intended as a general observation about Arctic benthic fauna, referring to the long-life spans often attributed to Arctic benthic species and the potential implications of seasonal variation in food availability. It was not intended to imply that the sampled communities were predominantly long-lived, as longevity was not among the traits analysed here, and we therefore agree that this statement extends beyond the scope of our study. We have removed this statement to keep the discussion focused on the results presented here. Reviewer 1 also raised a related point regarding the potential seasonal interpretation of this section (RC1.24), and we have addressed both comments through the same revision. The revised text instead focuses on the contrasting feeding-strategy responses observed in our data and on the potential importance of carbon source and resource characteristics beyond bulk carbon quantity.

Proposed new text – NB: This forms the first two paragraphs of the revised Sect. 4.3; the remainder of the section is given in AC1.3 (RC1) / AC2.9 (RC2):

"Filter and suspension feeding taxa showed the strongest and most consistent responses to the carbon predictors themselves. This was the only feeding trait significant across all latent-variable specifications, for both sedimentary organic carbon and its interaction with POC flux (SM Table R8). Their response to the interaction term suggests that neither POC flux nor SOC alone is sufficient, but that the combination of pelagic carbon supply and benthic carbon availability is important. Carbon held by this modality was concentrated at KOF2, ACF2 and KOF1 (68.8, 45.2 and 31.6 % of station carbon, respectively), with smaller contributions at ACF3 and DB1, and these stations span a wide range of carbon environments. This distribution does not follow the latent gradient: filter/suspension contribution showed no significant association with LV1 (Spearman's ρ = 0.43, p = 0.24), and the third-largest contribution occurred at the lowest-LV1 station.

In contrast to these epifaunal taxa, our GLLVM results showed that several prominent infaunal trait groups, including deposit feeders, burrowers and mixed deposit–filter feeders, showed little or no statistical response to bulk carbon predictors, with coefficients centred near zero. Rather than indicating insensitivity to organic matter, this suggests that these strategies may depend on resource characteristics not captured by bulk carbon metrics, such as particle size, lability and biochemical composition. For example, infaunal benthic consumers may preferentially assimilate sea ice-derived organic matter over pelagic sources even when total carbon availability is similar, reflecting differences in energetic value rather than quantity alone (Cautain et al. 2022; Clarke 1983; Niemi et al. 2024; Yunda-Guarin et al. 2020). This highlights a broader challenge for benthic trait-based research: functional categories such as deposit feeding encompass diverse resource acquisition strategies that are not captured by current broad trait classifications. Organisms classified as deposit feeders may therefore exploit different components of the sedimentary organic matter pool that are not distinguished by this category. Resolving these finer feeding specialisations, particularly among infaunal taxa, could substantially improve our understanding of how benthic communities acquire, transform and redistribute carbon."

RC2.23: Line 453 mentions carbon lability and although not a detailed analysis of it, this study did measure sedimentary C:N ratios. It seems that the low C:N at AFC3, AFC4, KOF3 which are open to shelf waters (or on the open shelf) may indicate advective organic carbon inputs of marine origin also supporting the higher SOC measured at these stations.

AC2.23: Thank you for this helpful observation. We agree that the spatial pattern in sediment C:N provides useful context for interpreting the differences in sedimentary organic carbon among stations. As you note, we have already included the spatial variation in C:N ratios in the Supplementary Material (Fig. S12), where the relatively low C:N ratios at ACF3, ACF4 and KOF3 are highlighted relative to the broad reference ranges for marine sediments. We will make this connection more explicit in the main Discussion, noting that the low C:N ratios at these outer, shelf-influenced stations, together with their elevated SOC concentrations, may indicate a greater contribution of relatively fresh marine organic matter. We will retain the existing caveat that C:N ratios alone cannot definitively resolve organic matter sources in the absence of isotopic or biomarker measurements.

Proposed new text:
"Differences in sedimentary C:N ratios can provide additional context for this spatial variability (SM Fig. S12). The relatively low C:N ratios observed at the outer ACF3, ACF4 and KOF3 stations, which are more directly exposed to shelf waters, occurred alongside elevated SOC concentrations. This combination could be consistent with a greater contribution of relatively fresh marine organic matter at these stations. However, C:N ratios alone cannot resolve organic matter sources, and this interpretation therefore remains tentative."

New References:

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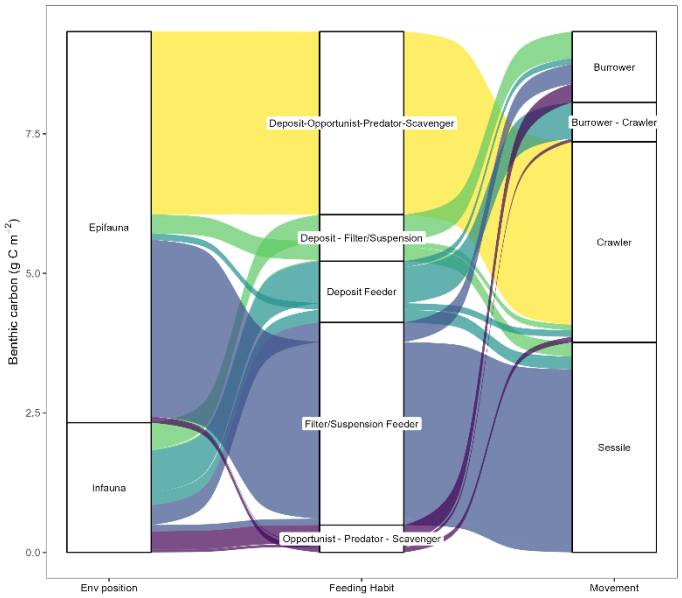
Ricciardi, A. and Bourget, E.: Weight-to-weight conversion factors for marine benthic macroinvertebrates, Mar. Ecol. Prog. Ser., 163, 245–251, doi.org, 1998.

Rysgaard, S., Mortensen, J., and Haxen, M.: Summer Hydrography Conditions at Proglacial Fjord Entrances Along East Greenland, J. Geophys. Res.-Oceans, 129, e2023JC020665, https://doi.org/10.1029/2023JC020665, 2024.

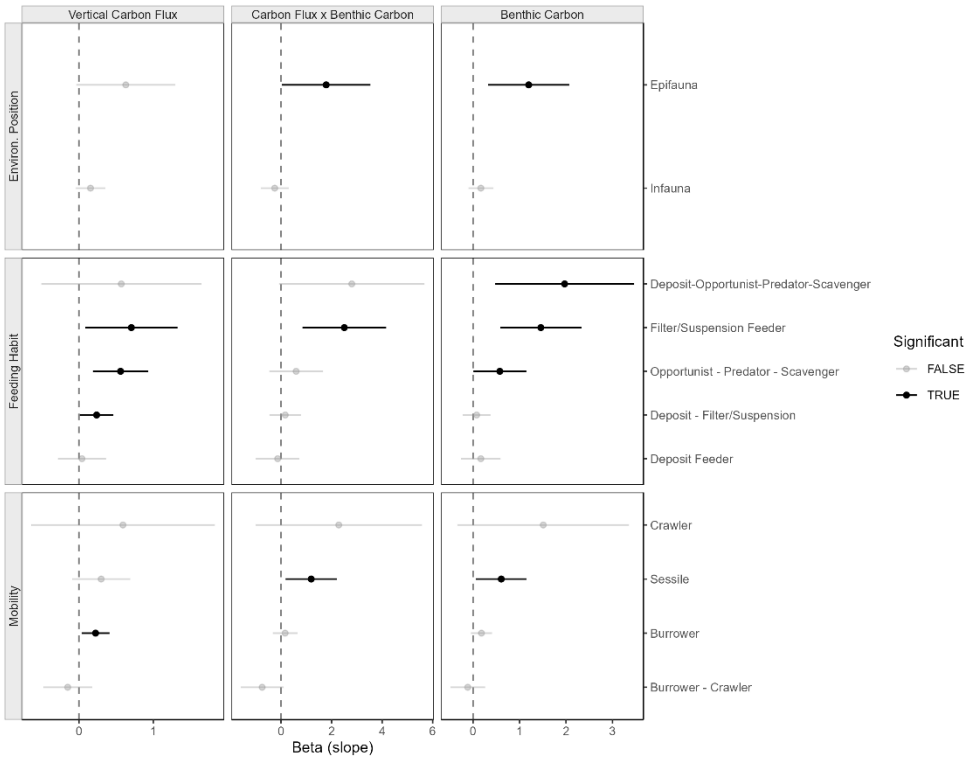
Tables and Figures not in response text

Updated Figure 3 | Trait-based composition of benthic carbon biomass and trait-specific responses to carbon variables. (i) The distribution of benthic carbon biomass (g C m^{-2}) across major trait groups. Colours represent the proportional contribution of each trait combination to the total benthic invertebrate carbon pool. **(ii)** Trait-specific coefficients from the GLLVM models for three carbon predictors: vertical POC flux (export) (mg C m^{-2} d^{-1}) at the deepest sediment trap depth, the interaction between vertical POC flux and SOC, and surface SOC. Points represent estimated coefficients (β), with horizontal lines indicating 95% confidence intervals. Black points denote statistically significant effects at $P < 0.05$ ("true"), whereas grey points indicate non-significant effects at $P \geq 0.05$ ("false"). Panels are grouped by trait categories of environmental position, feeding habit and mobility.

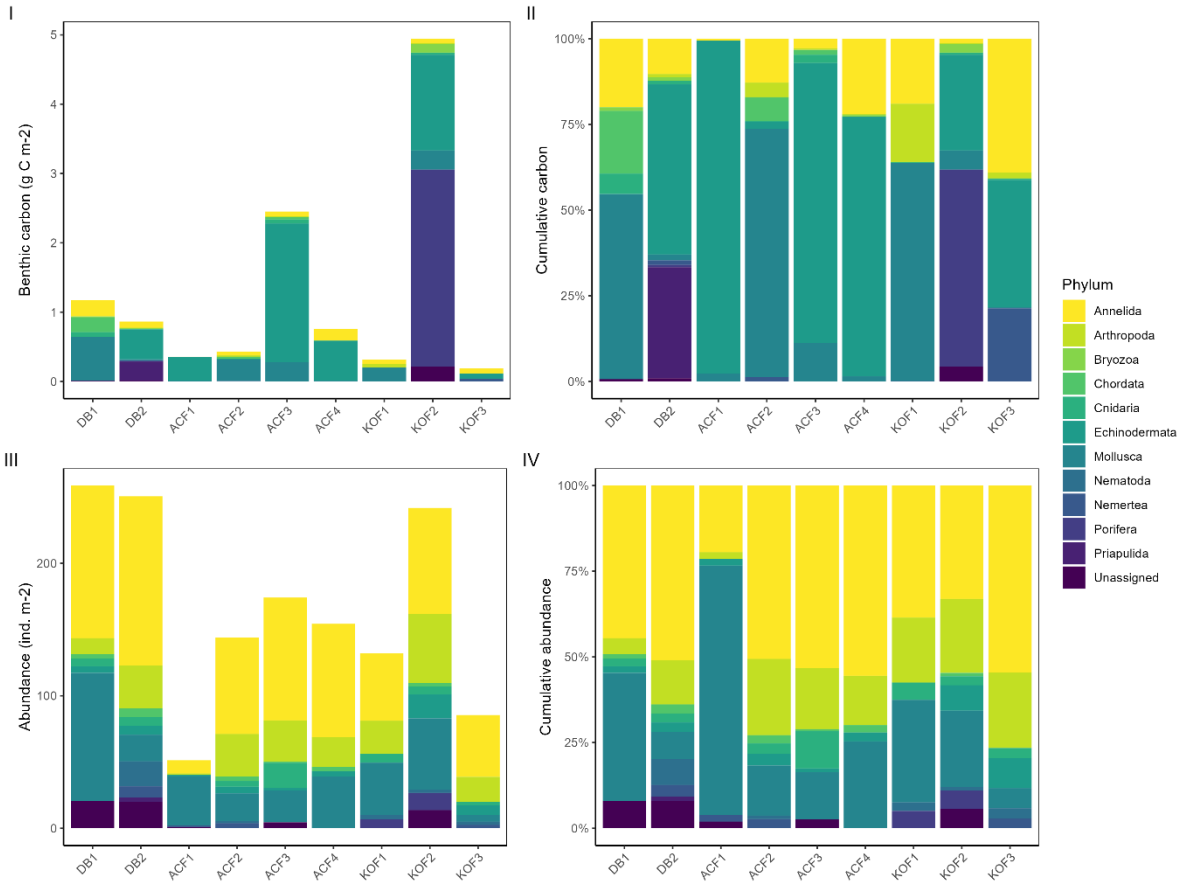
(i)



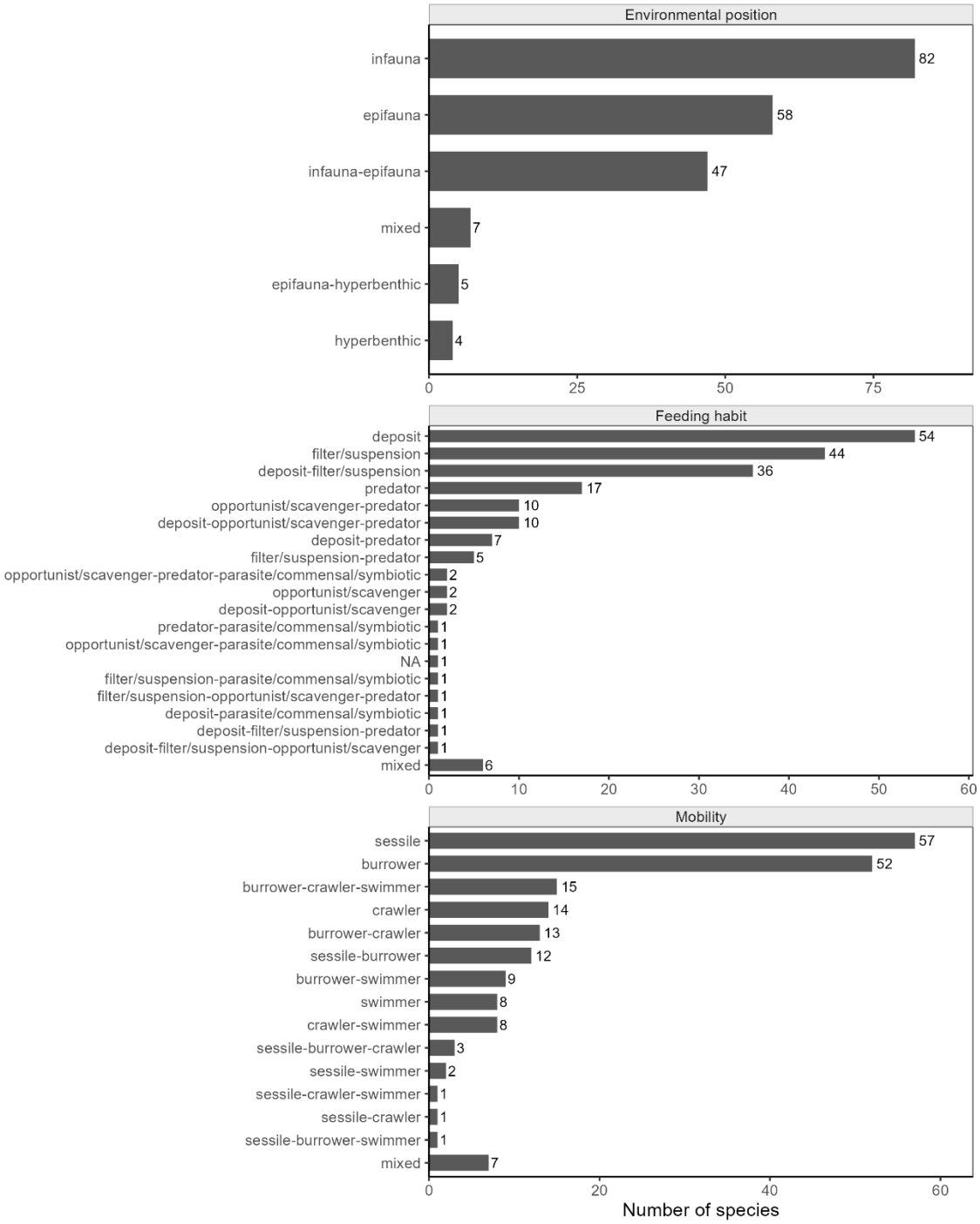
(ii)



Updated Figure S1. Taxonomic composition of benthic communities across sampling stations in Northeast Greenland coastal systems. Panels (I) and (II) show absolute and cumulative benthic carbon biomass (g C), respectively, while panels (III) and (IV) show absolute and cumulative abundance (ind. m^{-2}). Absolute values are shown as stacked bars partitioned by phylum, and cumulative panels display proportional contributions of each phylum to total community biomass or abundance. Colours indicate major benthic phyla. Stations are ordered by coastal system and inner–outer position within each system; Dove Bugt (DB), Ardencaple Fjord (ACF), and Kong Oscar Fjord (KOF).



Updated Figure S2. Distribution of categorical trait assignments across all taxa in the full benthic community prior to truncation at 95 per cent cumulative biomass. Shown are counts of species for three traits: environmental position, feeding habit, and mobility. Bars represent the number of species assigned to each trait category. Categories comprise multiple terms from fuzzy-coded trait assignments that were subsequently translated into composite text labels, such that species with any affinity to multiple modalities (*e.g.*, deposit feeder and predator) are represented as combined categories (*e.g.*, deposit-predator). NA denotes species for which trait information was unavailable.



Updated Figure S9: Diagnostic residual plots for the selected Generalised Latent Variable Model (GLLVM) with one latent variable. Panels show Dunn–Smyth residuals plotted against (i) linear predictors, (ii) theoretical quantiles (normal Q–Q plot), (iii) site index (rows), and (iv) trait biomass matrix index (columns), as well as (v) scale–location residual patterns. The final panel (vi) shows the single latent variable (LV1) ordered by sampling station (rather than LV1 score as shown in main text). Residuals show no major violations of model assumptions, with approximately constant variance, no strong trends against predictors or station/trait biomass, and acceptable normality of transformed residuals, indicating adequate model fit.

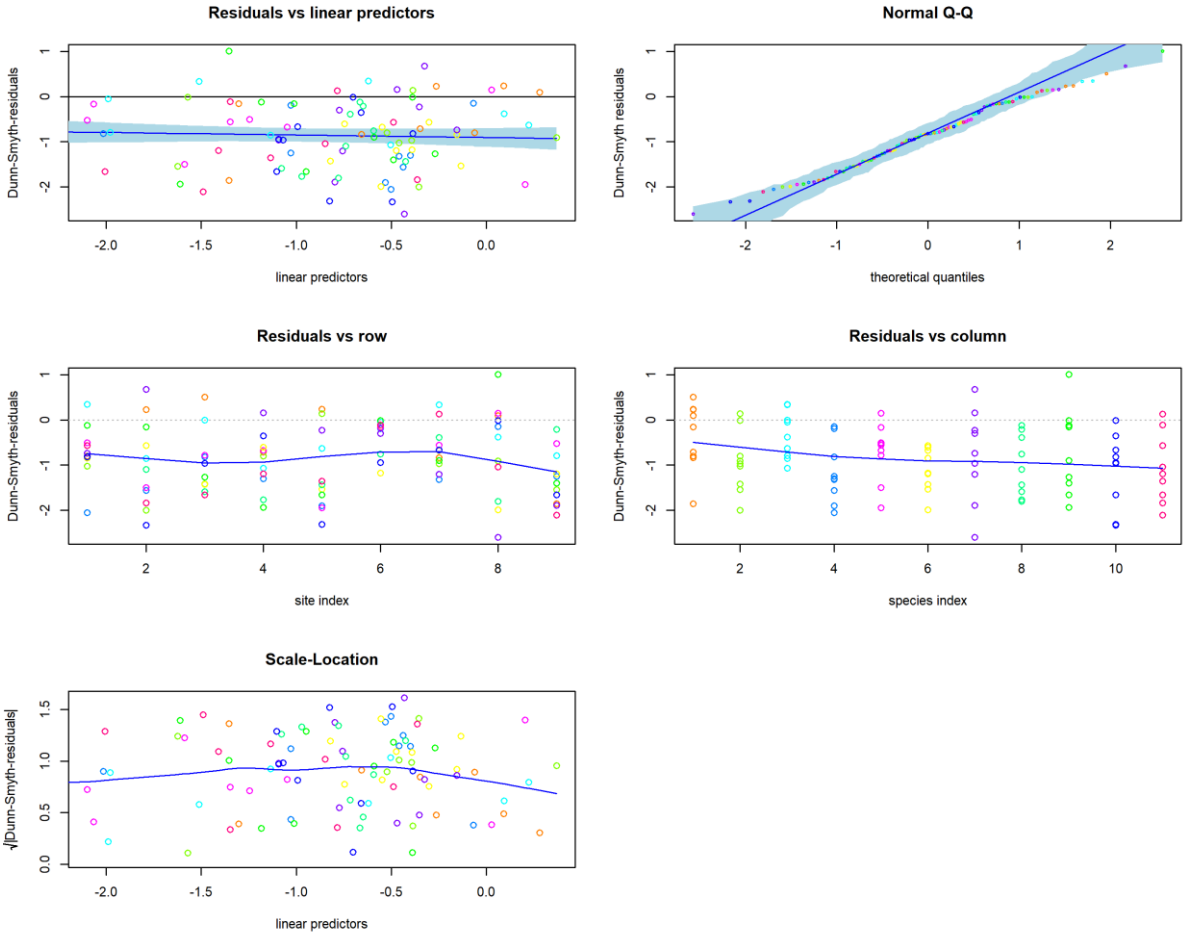


Table R6. Wet-mass to ash-free dry mass conversion factors applied to benthic taxa. Factors were assigned at the level of taxonomic group; all taxa within a group received the same factor. The primary factor was used in the reported analysis, with low and high values defining the bounding scenarios reported in Table X. Sources: B&Z, Behrisch and Zwerschke (2026); Gogina, Gogina et al. (2022); R&B, Ricciardi and Bourget (1998). Where sources disagreed, preference was given to B&Z as the most regionally appropriate, then to Gogina et al., whose measurements were made under the same convention as ours with shells and tests retained. The full per-taxon assignment is given in the archived dataset.

Group	*n* taxa	Primary	Low	High	Basis
Polychaeta	63	0.148	0.119	0.160	Gogina North Sea 0.148 (Baltic 0.119); R&B all polychaetes 0.160
Amphipoda	26	0.128	0.121	0.160	Gogina 0.121–0.128; R&B 0.160
Bivalvia	21	0.084	0.058	0.084	Gogina North Sea 0.084 (shells retained); R&B 0.058
Bryozoa	18	0.073	0.037	0.073	Gogina 0.073; B&Z Horneridae 0.045, Phidoloporidae 0.037
Isopoda	9	0.119	0.112	0.221	Gogina Baltic 0.119
Porifera	6	0.113	0.057	0.145	B&Z Polymastiidae 0.113 (high confidence, *n* = 44); Theneidae 0.071; Gogina 0.057
Gastropoda	5	0.096	0.075	0.106	Gogina 0.096–0.106; R&B prosobranch 0.075
Ophiuroidea	5	0.074	0.062	0.101	R&B 0.074; B&Z Ophiacanthidae 0.062, Ophiopholidae 0.101
Sipuncula	5	0.148	0.020	0.148	Gogina 0.148; R&B 0.112; B&Z Golfingiidae 0.020 (low confidence)
Anthozoa	4	0.130	0.089	0.151	Gogina 0.130–0.141; B&Z Hormathiidae 0.089, Liponematidae 0.151
Cumacea	4	0.120	0.076	0.130	Gogina 0.120–0.130; R&B 0.076
Asteroidea	3	0.112	0.071	0.222	R&B 0.112; B&Z Benthopectinidae 0.097, Echinasteridae 0.222
Tanaidacea	3	0.151	0.120	0.183	Gogina
Ascidiacea	2	0.045	0.012	0.048	Gogina 0.045; B&Z Didemnidae 0.048
Crinoidea	2	0.063	0.031	0.095	B&Z Antedonidae 0.063 (high confidence; direct match for *Poliometra*)
Hydrozoa	2	0.301	0.099	0.301	B&Z Sertulariidae 0.301 (high confidence; direct match for *Thuiaria*); Gogina 0.099
Caudofoveata	1	0.189	0.133	0.245	Gogina

Group	*n* taxa	Primary	Low	High	Basis
Echinoidea	1	0.035	0.011	0.077	R&B 0.035; B&Z Strongylocentrotidae 0.011 (low confidence); Gogina Echinodermata 0.077
Hirudinea	1	0.178	0.089	0.267	Gogina
Holothuroidea	1	0.109	0.020	0.109	R&B 0.109; B&Z Laetmogonidae 0.020, Molpadiidae 0.026
Nemertea	1	0.158	0.142	0.200	Gogina 0.142–0.158; R&B 0.200
Oligochaeta	1	0.129	0.129	0.256	Gogina Baltic 0.129
Polyplacophora	1	0.105	0.105	0.272	Gogina 0.105; R&B 0.272 (n = 1)
Priapulida	1	0.106	0.065	0.106	Gogina 0.106 (n = 269); R&B 0.065
Pycnogonida	1	0.107	0.092	0.260	Gogina 0.107; B&Z Nymphonidae 0.260
Nematoda	1	0.148	0.119	0.160	No published value; polychaete proxy
Ostracoda	1	0.128	0.121	0.160	No published value; amphipod proxy
Scaphopoda	1	0.096	0.075	0.106	No published value; gastropod proxy

Table R7. Information Criterions (AIC, BIC and AICc) values for Generalised Latent Variable Models (GLLVMs) fitted with zero to three latent variables.

Latent Variables	Converg-ence	df	logL	AIC	BIC	AICc	dAIC	dBIC	dAICc
0	TRUE	55	9.71	90.59	233.32	233.84	172.48	94.62	0
1	TRUE	66	53.68	24.64	195.92	301.02	106.53	57.22	67.17
2	TRUE	76	87.35	-22.71	174.52	509.29	59.18	35.82	275.45
3	TRUE	85	125.94	-81.89	138.70	1042.71	0	0	808.88

Table R8. Robustness of trait–environment coefficients across latent-variable specifications. Generalised linear latent variable models were fitted with zero to three latent variables (lv0–lv3); each row gives one covariate × trait modality term. A term was considered significant where its 95 % confidence interval excluded zero. Estimates are on the standardised predictor scale, so one unit corresponds to one standard deviation of the covariate. Terms are grouped by robustness and ordered within each group by the magnitude of the median estimate. POC flux, particulate organic carbon flux to the seafloor; SOC, sediment organic carbon; POC flux × SOC, their interaction. Conclusions in the main text are drawn only from terms in the robust category.

Covariate	Trait family	Modality	Significant under	n	Median	Range	Direction
Robust — significant under all specifications							
POC flux × SOC	Feeding habit	filter + suspension	lv0–lv3	4 of 4	2.563	1.598 to 3.100	+
SOC	Feeding habit	filter + suspension	lv0–lv3	4 of 4	1.601	0.687 to 2.033	+
POC flux × SOC	Mobility	sessile	lv0–lv3	4 of 4	1.081	0.955 to 1.197	+
POC flux	Feeding habit	opportunist + predator + scavenger	lv0–lv3	4 of 4	0.542	0.535 to 0.560	+
POC flux	Mobility	burrower	lv0–lv3	4 of 4	0.218	0.213 to 0.224	+
Mostly robust — significant under two or three specifications							
SOC	Feeding habit	deposit + opportunist + predator + scavenger	lv1, lv2, lv3	3 of 4	2.260	0.581 to 3.460	+
SOC	Environmental position	epifauna	lv1, lv2, lv3	3 of 4	1.221	0.522 to 1.392	+
SOC	Mobility	sessile	lv1, lv2, lv3	3 of 4	0.558	0.426 to 0.609	+
SOC	Mobility	crawler	lv2, lv3	2 of 4	2.256	0.382 to 3.537	+
POC flux × SOC	Environmental position	epifauna	lv1, lv3	2 of 4	1.696	0.851 to 1.838	+
POC flux	Feeding habit	filter + suspension	lv1, lv2	2 of 4	0.757	0.383 to 0.911	+
SOC	Feeding habit	opportunist + predator + scavenger	lv0, lv1	2 of 4	0.520	0.497 to 0.576	+
POC flux	Feeding habit	deposit + filter + suspension	lv0, lv1	2 of 4	0.223	0.204 to 0.239	+
Model-dependent —							

Covariate	Trait family	Modality	Significant under	n	Median	Range	Direction
significant under one specification							
POC flux × SOC	Mobility	crawler	lv3	1 of 4	2.989	0.634 to 3.975	+
POC flux × SOC	Feeding habit	deposit + opportunist + predator + scavenger	lv3	1 of 4	2.845	0.766 to 4.163	+
POC flux × SOC	Mobility	burrower + crawler	lv3	1 of 4	−0.667	−0.744 to −0.553	−
Not significant under any specification							
POC flux	Mobility	crawler	—	0 of 4	0.794	0.059 to 1.137	+
POC flux	Feeding habit	deposit + opportunist + predator + scavenger	—	0 of 4	0.636	−0.053 to 0.989	varies
POC flux	Environmental position	epifauna	—	0 of 4	0.625	0.334 to 0.664	+
POC flux × SOC	Feeding habit	opportunist + predator + scavenger	—	0 of 4	0.519	0.502 to 0.600	+
POC flux × SOC	Environmental position	infauna	—	0 of 4	−0.283	−0.334 to −0.247	−
POC flux	Mobility	sessile	—	0 of 4	0.260	0.233 to 0.299	+
SOC	Feeding habit	deposit	—	0 of 4	0.174	0.158 to 0.228	+
POC flux × SOC	Feeding habit	deposit + filter + suspension	—	0 of 4	0.164	0.156 to 0.183	+
SOC	Environmental position	infauna	—	0 of 4	0.163	0.158 to 0.168	+
SOC	Mobility	burrower	—	0 of 4	0.158	0.145 to 0.181	+
POC flux	Environmental position	infauna	—	0 of 4	0.155	0.151 to 0.156	+
POC flux	Mobility	burrower + crawler	—	0 of 4	−0.135	−0.195 to −0.112	−
POC flux × SOC	Feeding habit	deposit	—	0 of 4	−0.132	−0.155 to −0.121	−
POC flux × SOC	Mobility	burrower	—	0 of 4	0.096	0.039 to 0.164	+
SOC	Mobility	burrower + crawler	—	0 of 4	−0.080	−0.192 to −0.044	−
SOC	Feeding habit	deposit + filter + suspension	—	0 of 4	0.067	0.057 to 0.077	+
POC flux	Feeding habit	deposit	—	0 of 4	0.040	0.036 to 0.082	+