

RC1: 'Comment on egusphere-2025-5789', Anonymous Referee #1, 18 Feb 2026

We thank the reviewer for the careful and constructive assessment of our manuscript. The reviewer's comments and suggestions substantially helped us improve both the clarity of the presentation and the robustness of the interpretations. In the revised version, we implemented extensive edits throughout the manuscript, including substantial improvements to the graphical representation of the Lagrangian analyses, revision of several discussion sections, implementation of Bonferroni correction in the Pearson correlation analyses, and a more cautious discussion of dust fertilisation versus mineral ballasting effects. All reviewer comments are addressed below in a point-by-point manner.

GENERAL COMMENTS

The article by Guerreiro et al. presents an interesting multidisciplinary study of the oceanographic factors driving export at two time series stations in the eastern tropical Atlantic Ocean. The authors use in situ sediment traps, satellite data and Lagrangian particle tracking modelling to examine the source of material collected in the traps and how this changes seasonally with changes in the strength of localised coastal upwelling. The article is interesting and well written, though there are some slight grammatical nuances that should be addressed, and the results presented (generally) support the conclusions drawn. The 'generally support' comment stems from the choice of graphical presentation of the linkages between satellite sources and trap material, specifically Figures 4, 5a-5c, and 6a-6d. These figures are difficult to interpret and figure panels in some cases go across 3 or 4 journal pages, making the interpretation even more challenging. The authors are strongly encouraged to consider how these results can be presented differently and/or the key patterns made more obvious. In terms of grammatical nuances, there is an abundance of 'dashes' in the text rather than a use of commas, colons, semi-colons, parenthesis or shorter sentence structure. This may be a result from the use of ChatGPT (as indicated in the acknowledgements) and show where this tool was used to assist in the language editing. This is most likely an editorial decision, but this reviewer found the abundant dashes broke up the narrative and at times confused the point(s) being made.

SPECIFIC COMMENTS

Ln 20, what is M1? Is this an abbreviation?

M1 refers to one of the two studied sediment trap moorings. For clarity, we have changed this part to:

"Here we combine Lagrangian backtracking of satellite-derived chlorophyll-a (Chl-a), particulate inorganic carbon (PIC), and primary production (PP) with one year of sediment trap fluxes of coccolith species, biogenic particles and lithogenic material (proxy for aeolian dust fluxes) from moorings CB (21°N, 20°W) and M1 (12°N, 23°W), representing distinct open-ocean settings offshore of NW Africa. These fluxes are further integrated with data from satellite-derived upwelling indices, sea surface height (SSH), aerosol optical depth (AOD), and in situ water-column observations collected at the trap locations."

Ln 29, both trap sites rather than both traps?

Done

Lns 31-33, consider rephrasing or explaining what is meant by 'productivity indicators in terms of species floral groups (see also Ln 37 and coccolith UPZ/LPZ).

For clarity, these lines have been slightly edited to:

"Multivariate statistical analyses show strong negative correlations between dust and all upper photic zone (UPZ) productivity indicators, including Chl-a, the ratio of surface-dwelling species to lower photic zone taxa (UPZ/LPZ), and carbonate fluxes associated with the placolith-forming species *Emiliania huxleyi* and *Calcidiscus leptoporus*. In contrast, dust showed positive associations with warm, stratified conditions dominated by

tropical, non-blooming LPZ species (*Florisphaera profunda* and *Gladiolithus flabellatus*), suggesting that mineral ballasting was the dominant seasonal dust effect."

Ln 58, consider replacing '-' with a comma, colon, semi-colon, or simply spitting the long lines into two. Overall, the use of dashes throughout the article is confusing and at times breaks the flow of text. Consider replacing all the dashes with either commas, parentheses or restructuring the sentences to avoid this. (See also dashes on Lns 68, 69, 88, 90, 113, 306, 530, 535, 536, 542, 556, 557, 559, 566, 567, 573, 574, 583, 584, 616, 616, 619, 620, 621, 641, 642, 655, 663, 666, 668, 686, 715, 722, 729, 770, 780, 800, 808, and 817).

All dashes have been removed from the manuscript as suggested by the reviewer. Whenever possible, they were simply replaced with a comma but, in some cases, it was necessary to slightly adjust the phrasing.

Lns 70-71, conditional phrase at the end needs rephrasing.

This has been rephrased to:

"Whether the higher productivity reported along the Mauritanian and Senegalese coasts compared to the northern sectors of the CCS (Arístegui et al., 2009) partly reflects the fertilizing influence of Saharan dust has yet to be investigated thoroughly."

Ln 87, remove extra 'in'.

Done

Ln 92, define CbPM.

CbPM stands for "carbon-based production model (CbPm), and this information is now included in the ms.

Ln 95, is 'CBeu' an abbreviation?

Yes, it stands for "Cape Blanc eutrophic"; This sentence has been updated to:

"In terms of export production, Fischer et al. (2019) documented a multi-year decline in organic carbon fluxes across all seasons from 2003 to 2016 at Cape Blanc coastal (eutrophic) upwelling site CBeu (NW Africa), which they interpreted as evidence of a long-term weakening of coastal upwelling off Cape Blanc."

Ln 101, replace 'mean' with 'method: 'sediment traps remain the dominant <method> of ...'

Done

Ln 103, 'organic carbon matter'? Suggest organic carbon or organic matter.

We have rectified this to "organic matter".

Ln 104, 'ground-truthing data' rather than 'ground-truth'.

Done

Lns 106-110, long sentence, consider splitting into two.

We agree that the sentence had too much information/wording and thus we have changed it to:

“Because coccolithophores enclose their cells in exoskeletons composed of calcite plates (coccoliths), they serve as valuable proxies for reconstructing recent and past open-ocean to coastal-neritic conditions (Baumann and Freitag, 2004; Guerreiro et al., 2015a,b), and are widely analysed in sediment-trap time series to resolve the seasonal to interannual dynamics of marine phytoplankton communities (e.g., Milliman, 1993; Sprengel et al., 2002; Baumann et al., 2005; Köbrich et al., 2015).”

Figure 1: text on this plot is very small, consider making bigger so that it is readable when published.

We have rectified this issue and have now submitted a more readable version of Figure 1.

Ln 130, what is the SACW nutrient-enriched relative to?

For clarity, this sentence has been edited to:

“The environmental setting of the studied tropical NE Atlantic region has been previously presented in Guerreiro et al. (2019). Ocean conditions at sediment trap mooring sites CB and M1 are mostly influenced by South Atlantic Central Waters (SACW) at depths down to ~500 m (Temperature–T: 6.0–18°C, Salinity–S: 34.3–35.8) with substantial contributions of North Atlantic Central Waters (NACW) below 300 m. These waters originate from the North Atlantic subtropical gyre and are relatively nutrient-poor compared to SACW.”

Ln 213, consider providing the sinking speed assumed when stating that ‘vertical flux of material is even and relatively fast’.

For clarity, we have improved the sentence with particle sinking rate information from Waniek et al. (2000):

“We only include surface drifters and assume that the vertical flux of material was even and relatively fast (e.g., up to 40–150 m d⁻¹ for algal aggregates, and 1–368 m d⁻¹ for marine snow aggregates; Waniek et al., 2000 and refs. therein), thereby implying limited lateral displacement during export to the trap depth.”

Ln 216, consider rephrasing to ‘from the coast to each trap location’ rather than ‘traps’ locations’.

Done

Fig 2: On (b) primary production should be blue? On (d) are the coccolith fluxes and satellite PIC values correct (i.e., 200 x10⁶ = 200,000,000 mol C m⁻³ or should it be 200 x 10⁻⁶ = 0.0002 or 0.2 mmol C m⁻³)? On (e) is it worth highlighting that the ratios are molar?

We thank the reviewer for his/her/their sharp eyes! Regarding (b) the PP YY axis is now in blue; (d) the units for PIC are now expressed in mmol/m³ in all figures throughout the ms.; and (e) we have now included this information in the figure. Overall, Figure 2 has been slightly improved for more efficiently representing our dataset.

Ln 320, where the p-values for the multiple pairwise Pearson correlations Bonferroni Corrected to account for the high number of tests?

We thank the reviewer for this important remark. Indeed, in the original version of the manuscript, the p-values associated with the multiple pairwise Pearson correlations had not been corrected for multiple testing. Following the reviewer’s suggestion, we have now applied a Bonferroni correction to account for the high number of comparisons performed, and updated Table 1 (and respective caption) accordingly:

Table 1. Pearson correlation coefficient matrix showing the relationships among the variables included in the data matrix used in the PCA. Correlation coefficients are shown as Pearson’s *r* values, with statistically significant correlations ($p < 0.05$) after Bonferroni correction for multiple comparisons highlighted in green (light green for negative correlations; dark green for positive

correlations). Non-significant correlations with $|r| \geq 0.36$ are shown in black, whereas weaker correlations are shown in grey. The full names of the coccolithophore taxa and environmental parameters are indicated in Table 2.

	Ehux	Gephy	Clep	Helico	Rhab & Umbell	Fp & Gflab	Umbilli	UPZ/LPZ	Coccolith-CaCO ₃	Chl- <i>a</i>	SST	AOD	DPP	MLD	CaCO ₃	bSiO ₂	OM	Lithogenic	PC
Ehux	1	0.16	0.91	-0.09	0.43	0.13	0.72	0.37	0.83	0.44	-0.47	-0.17	-0.20	0.41	0.51	-0.45	-0.40	-0.35	0.53
Gephy	0.16	1	0.27	0.42	-0.04	0.42	0.46	-0.30	0.30	0.29	0.06	-0.39	-0.04	0.29	-0.15	0.10	-0.08		
Clep	0.91	0.27	1	-0.15	0.30	0.04	0.72	0.35	0.81	0.54	-0.51	-0.12	-0.26	0.44	0.50	-0.52	-0.32	-0.35	0.49
Helico	-0.09	0.42	-0.15	1	0.24	0.87	0.29	-0.73	0.16	-0.67	0.60	0.39	0.39	-0.59	-0.49	0.72	-0.13	0.52	-0.22
Rhab & Umbell	0.43	-0.04	0.30	0.24	1	0.34	0.29	-0.06	0.49	0.00	0.03	0.02	0.26	-0.12	0.08	-0.21	-0.20	0.07	0.25
Fp & Gflab	0.13	0.42	0.04	0.87	0.34	1	0.49	-0.76	0.25	-0.60	0.57	0.46	0.36	-0.55	-0.40	0.64	-0.23	0.49	-0.17
Umbilli	0.72	0.46	0.72	0.29	0.29	0.49	1	-0.08	0.70	0.13	-0.10	0.16	-0.02	0.06	0.23	-0.03	-0.37	-0.10	0.31
UPZ/LPZ	0.37	-0.30	0.35	-0.73	-0.06	-0.76	-0.08	1	0.13	0.70	-0.75	-0.48	-0.39	0.70	0.55	-0.76	-0.12	-0.62	0.43
Coccolith-CaCO ₃	0.83	0.30	0.81	0.16	0.49	0.25	0.70	0.13	1	0.25	-0.23	-0.08	-0.04	0.11	0.34	-0.31	-0.41	-0.15	0.41
Chl- <i>a</i>	0.44	-0.31	0.54	-0.67	0.00	-0.60	0.13	0.70	0.25	1	-0.81	-0.19	-0.36	0.70	0.69	-0.81	-0.18	-0.64	0.36
SST	-0.47	0.30	-0.51	0.60	0.03	0.57	-0.10	-0.75	-0.23	-0.81	1	0.34	0.62	-0.90	-0.66	0.69	0.04	0.70	-0.38
AOD	-0.17	0.29	-0.12	0.39	0.02	0.46	0.16	-0.48	-0.08	-0.19	0.34	1	0.07	-0.45	-0.16	0.31	-0.13	0.23	-0.53
DPP	-0.20	0.06	-0.26	0.39	0.26	0.36	-0.02	-0.39	-0.04	-0.36	0.62	0.07	1	-0.58	-0.46	0.24	-0.06	0.56	-0.12
MLD	0.41	-0.39	0.44	-0.59	-0.12	-0.55	0.06	0.70	0.11	0.70	-0.90	-0.45	-0.58	1	0.49	-0.58	0.11	-0.54	0.40
CaCO ₃	0.51	-0.04	0.50	-0.49	0.08	-0.40	0.23	0.55	0.34	0.69	-0.66	-0.16	-0.46	0.49	1	-0.64	-0.30	-0.90	0.42
bSiO ₂	-0.45	0.29	-0.52	0.72	-0.21	0.64	-0.03	-0.76	-0.31	-0.81	0.69	0.31	0.24	-0.58	-0.64	1	0.07	0.54	-0.46
OM	-0.40	-0.15	-0.32	-0.13	-0.20	-0.23	-0.37	-0.12	-0.41	-0.18	0.04	-0.13	-0.06	0.11	-0.30	0.07	1	0.14	-0.33
Lithogenic	-0.35	0.10	-0.35	0.52	0.07	0.49	-0.10	-0.62	-0.15	-0.64	0.70	0.23	0.56	-0.54	-0.90	0.54	0.14	1	-0.35
PC	0.53	-0.08	0.49	-0.22	0.25	-0.17	0.31	0.43	0.41	0.36	-0.38	-0.53	-0.12	0.40	0.42	-0.46	-0.33	-0.35	1

Overall, the correction reduced the number of statistically significant correlations, as expected from the conservative nature of the Bonferroni approach. However, the main significant relationships identified in the original analysis remain robust after correction, particularly the strongest patterns highlighted by the PC1 results. This confirms that the principal environmental gradients and variable associations discussed in the manuscript are not artefacts of multiple testing.

The main difference concerns the PC2 negative relationship between Coccolith-CaCO₃, *Umbilicosphaera* spp., *E. huxleyi*, *C. leptoporus* and *Rhabdosphaera* spp. & *Umbellosphaera* spp. versus organic matter, which, although still negative in the corrected Pearson correlation matrix, is no longer statistically significant after correction. We have revised the text accordingly to avoid overinterpretation of these relationships.

We must however note that, in ecological datasets — particularly those involving complex and interdependent environmental variables — correlation patterns may still carry relevant ecological information even when they do not reach formal statistical significance after conservative multiple-test corrections. As evidenced in our dataset, such patterns still provide useful insight into the direction and structure of environmental gradients and ecosystem responses, especially when interpreted in combination with multivariate analyses such as PCA and Lagrangian Analysis outputs, rather than as isolated statistical relationships. Nevertheless, we have taken care in the revised manuscript to distinguish clearly between statistically significant and non-significant relationships.

Fig. 3: The text below the PC score axis is confusing and contains too many abbreviations to have much value. It also replicates the information in Table 2.

We understand the reviewer's perspective but we strongly believe that including the abbreviations in the figure provides a more immediate interpretation of the spatiotemporal variability represented by PC1 and PC2. Therefore, we would like to request keeping the figure in its original version.

Fig. 4: Could these be increased in size by removing the identical scale bars and limiting the eastwards extent of the plots? Quite difficult to see at this resolution. Same comment for Figs. 5a-5c. Also, should these be separate figures (5, 6 and 7) rather than sub-figures?

We appreciate the feedback of the reviewer and we agree that the submitted figures could be improved. In this new version, we have reduced figures 4 and former Figures 5a-c from each including 36 panels of two-week duration to only 20 panels of 1 month duration, and slightly extending the monitored period until May 2014 (thus improving our discussion on seasonal/interannual variability). As requested, we also reduced their

eastward extend and have now included former Figures 5a-c as Figures 5, 6 and 7. We believe the results are now efficiently shown in our paper.

Fig. 6a-d: Bar charts far too small to see. Difficult to understand these plots due to the multiple information and small labelling of the axis. It is difficult to determine clearly the patterns and trends in the results as given in the text when referencing to these plots (e.g., Ln 535, 'much steeper offshore declines along trajectories toward M1 compared to persistently higher productivity in coastal and trap proximal waters at CB (Figs. 6a-c)'). Consider a different way to plot this data, e.g., Hovmöller plots with signal intensity rather than histograms?

We appreciate the feedback of the reviewer and we agree that former Figures 6a-d (now referred to as Figures 8a-d) were not entirely effective at representing the complex and seasonally variable water mass connectivity between the coast and the location of the traps. We decided to follow the suggestion of using Hovmöller plots to represent the Lagrangian analysis trajectories as exemplified below. Although the overall interpretation of the results remains generally consistent, the description and discussion sections had to be slightly revised to reflect the new perspective provided by the Hovmöller plots. In contrast to the former Fig. 6, which displayed the "raw" Chl-a values associated with specific Lagrangian trajectories, the interpolated Hovmöller representation emphasises broader spatiotemporal variability patterns during the sediment trap sampling period.

Ln 540 and elsewhere, the '-a' in chlorophyll-a should be italicised throughout. At present it is variable whether it is (Ln 530) or is not (Ln 540).

This has been corrected along the entire manuscript.

Ln 548, why the use of bold for 'windy, dry months of boreal winter and spring'? Also, on Ln 586 the use of bold is not clear why.

This has been rectified and is no longer in bold.

Ln 569, rephrase 'this typically occur'.

This has been corrected to "this typically occurs".

Ln 598, 'worth noting' or 'worth noticing'?

We replaced "noticing" by "noting"

Ln 618, suggest rephrase 'negative side groups indicators of warm ..'

This sentence has been edited to:

"In contrast, the negative loadings are associated with indicators of warm, stratified waters, including *Helicosphaera* spp. and SST with further contributions from deep-dwelling taxa and precipitation (Tables 1–2; Fig. 3)."

Ln 686-387, reference needed to support the dominance of small photo-adapted eukaryotes in deep DCM.

As requested, we have now included the reference:

Cullen, J.J., 2015. Subsurface Chlorophyll Maximum Layers: Enduring Enigma or Mystery Solved? Annual Review of Marine Science 7, 207–39, DOI: 10.1146/annurev-marine-010213-135111

Ln 751, correct spelling 'co-occurring'.

Done