

Reply to Referees' Comments

## 1 Referee 1 comments (RC1)

### General Comments

This manuscript provides a unique assessment of phytoplankton responses to different disturbances, here classified as storm events that induce changes in aerial, fluvial, and pluvial regimes, to directly identify the consequences of physical perturbations on the underlying biology of marine systems. Another positive point is the inclusion of different marine areas (coastal vs. open waters) and, in part, the chemical bases (nutrients). I personally find that the efforts reported in this work could be an elegant way to conceptualize the challenging dynamics of blooms. In this regard, I see the authors' work as a potentially very interesting paper worthy of publication, but at this stage it still requires some polishing, given the number of typos and the need to better structure the methodology section.

We thank the reviewer for the positive remarks and for recognizing the effort invested in this work. We are grateful for the time spent to provide detailed and constructive comments that have improved the manuscript. We have addressed all comments, and the manuscript has been modified accordingly.

To facilitate the review process, all the references to Lines below correspond to the revised non-annotated version.

### 1 Specific Comments

Abstract

"We focussed in summer because it is a low nutrient season where phytoplankton major shifts and blooms are not expected."

This sounds counterintuitive. Why would you study plankton shifts when they are not expected to happen?

This sentence was modified into:

"Our study targeted the summer season, which is typically characterised by low nutrient availability, yet transient phytoplankton blooms often occur." Lines 10–11.

"...phytoplankton abundance were combined with high-frequency meteorological data (precipitation and wind) and hydrological records from 2012 to 2022."

Hydrological records include several parameters, and as I understand it, you consider only water levels? If that is so, adjust it accordingly.

The sentence is corrected and now reads :“From 2012–2022, low-frequency (weekly to fortnightly) flow cytometry measurements of phytoplankton abundance were combined with high-frequency meteorological data (precipitation and wind) and river flow rates as a proxy for riverine influence.”  
Lines 11–13

“... nano-sized phytoplankton (nanophytoplankton and cryptophytes).” Why are cryptophytes not included in nanophytoplankton? And why do you make this distinction: nano-sized vs nanophytoplankton?

Apologies for the confusion. The parenthetical phrase has been removed in the revised manuscript (Line 17). To avoid confusion, we now use the term *nanophytoplankton* consistently throughout the text, and cryptophytes are explicitly treated as part of the nanophytoplankton group.

“High inflow storms, whether accompanied by weak or strong winds, promote coastal advection of riverine plumes enriched in nutrients, sustaining diatom dominance and, under high wind stress, favouring nano-sized phytoplankton (nanophytoplankton and cryptophytes). In contrast, low inflow conditions limit riverine nutrient supply, shifting reliance to regenerated nutrients from vertical mixing. When combined with strong winds, these conditions support nanophytoplankton growth,....” High-inflow-strong-wind has the same effect as low-inflow-strong-wind? Please clearly identify the differences and similarities among storms.

The sentence is corrected as follows:

“Regardless of wind conditions, high inflow storms favoured diatoms, as nutrient-rich river plumes supported their growth. In contrast, low inflow events paired with strong winds enhanced vertical mixing and nutrient availability, favouring nanophytoplankton. Finally, weak winds and relatively low-nutrient conditions favoured picophytoplankton (*Synechococcus* and picoeukaryotes).” Lines 15-18

We hope it is clearer now.

“These findings highlight storms as recurrent structuring forces in the EEC, mediating nutrient availability and driving shifts in phytoplankton composition across the summer months.” Could you say something about the use of your findings in, e.g., prediction models? Storm prognoses might be an important input to prediction models for phytoplankton.

Your suggestion is now added it reads:

“These findings highlight storms as recurrent structuring forces in the EEC, mediating nutrient availability and driving shifts in phytoplankton composition; as such, storm-driven dynamics might be an important input to prediction models for phytoplankton.” Lines 20–22.

## Introduction

“The coastal marine ecosystems are vulnerable to changes in weather patterns and various extreme events, such as storms and heatwaves.” Extreme events are also changes in weather patterns. Please, modify your statement.

Corrected. It reads now. “Coastal marine ecosystems are vulnerable to changes in weather patterns, particularly extreme events such as storms and heatwaves.” Lines 24–25.

“At higher latitudes, storm forcing has been associated with enhanced primary productivity; for example, Pozdnyakov et al., (2014) observed appreciable Chl-a increase in oligotrophic Arctic waters within days of a cyclone, while Crawford et al., (2020) reported elevated net primary production in inflow regions such as the Barents and southern Chukchi Seas. Despite these insights, the responses of rapidly changing temperate and high-latitude coastal seas to extreme events remain poorly resolved...” Why do you say that, if the research you cite is tackling polar regions and not temperate regions?

Our intention was to highlight that extratropical storm influence both polar and temperate regions; however, most existing research has examined their effects on primary production and chlorophyll-a in polar environments. This text was modified, we hope it is clear now.

“While studies in polar environments have observed appreciable Chl-a increases in oligotrophic Arctic waters (Pozdnyakov et al., 2014) and elevated primary production in regions like the Barents and southern Chukchi Seas (Crawford et al., 2020) following cyclones, the influence of such storms in coastal temperate waters remains poorly documented.” Lines 30–34

“The English Channel is a temperate coastal sea generally characterized by strong atmospheric frontal activity and frequent extratropical storms, occasionally accompanied by thunderstorms. These systems typically originate in the North Atlantic and track towards north-western Europe...” This is a new paragraph, and it lacks the smooth transition to the study area. You could start with something like: Here we focus on the English Channel etc. State clearly which systems you refer to? Coastal seas? Modify the sentence to represent more clearly what you want to communicate.

Replaced by:

“In this context, we focus on the eastern English Channel (EEC), a temperate coastal sea characterized by strong atmospheric frontal activity and frequent extratropical storms. Extratropical storms typically originate in the North Atlantic and track toward north-western Europe, exerting significant physical forcing on the region's coastal waters.” Lines 37–40

“...eastern English Channel (EEC) is characterized by a nutrient-rich regime, particularly with an excess.” Provide a reference demonstrating that. So far, you have only assumed that the nutrients are present and have used other parameters (e.g., a phytoplankton bloom) as indicators to support that claim. Cite the reference that claims this is a nutrient-rich area.

We have added supporting references (Dulière et al., 2019; Loquet et al., 2000) to substantiate this statement. Revised sentence is now “Within the English Channel, the EEC is characterized by a nutrient-rich regime (Dulière et al., 2019; Lefebvre et al., 2011), particularly with an excess of nitrogen originating mainly from local rivers (e.g., the Somme; Loquet et al., 2000).” Lines 43–45

“The phytoplankton community was characterized using size-based functional groups derived from flow cytometry along a coastal–offshore gradient in the Strait of Dover, known as the DYPHYRAD (Dynamics of PHYtoplankton on RADiale) transect (Hubert et al., 2025b) by the Strait of Dover. The dataset comprises 1835 samples collected on 268 dates during a ten-year survey (2012–2022). Storm characterization was based on Météo-France meteorological data (wind and precipitation) from the Boulogne-Sur-Mer station (<https://meteo.data.gouv.fr/>) and river discharge records from Eaufrance (<https://www.eaufrance.fr/>) near the DYPHYRAD transect.” Reduce the text and move parts to M&M.

We have reduced the description of the dataset in the introduction and moved methodological details (sampling frequency, number of samples, data sources, and URLs) to the Methods section Lines 106, 137 and 151.

The end of the introduction now reads:

“A 10-year dataset (2012–2022) was used to evaluate biological responses alongside local meteorological forcing and riverine inputs. The phytoplankton community was characterized using functional groups derived from flow cytometry along a coastal-offshore gradient in the Strait of Dover, known as the DYPHYRAD (Dynamics of PHYtoplankton on RADiale) transect (Hubert et al., 2026).” Lines 66–70.

## Materials and Methods

“... receives substantial nutrient inputs from multiple estuaries...”. You can claim that if you provide evidence for it, e.g., a citation, whereas a figure (map) you cite only shows that there are lots of rivers, but not what they carry.

Thank you for your remark. We added citation and fixed the sentence and deleted reference to the figure 1: “and receives substantial nutrient inputs from multiple estuaries along the Picardy and Opale coasts, most notably the Seine and Somme rivers (Huguet et al., 2024).” Lines 75–76

“Chl-a concentrations were measured...” At which depth?

“2.3 Phytoplankton abundance” Sampling depth was not indicated.

The information is now found in one sentence:

“Subsurface water samples (1–2 m depth) were collected along the DYPHYRAD transect to measure Chl-a, nutrients and phytoplankton abundance.” Lines 94–95.

“PhytoBS stations located .... Additional datasets from SOMLIT stations C and L were used to compare pico- and nano-phytoplankton abundances with DYPHYRAD observations. These complementary observations were not included in the statistical analysis.” This part talks about microscopy? Where is the protocol for sampling, sample fixation, and analysis? You mentioned that you do not use this data (likely microscopy counts) for statistics, but what did you use it for? Maybe you have stated that, but it is not clearly written. Thus, adjust the text accordingly and add all the details: which net was deployed, at which depth, fixatives...

The reviewer is right, this is now clarified in the revised text: “PHYTOBS microscopy data (<https://www.phytoBS.fr/en>) were used only to check for the species related to the observed phytoplankton blooms, while SOMLIT flow-cytometry data (<https://www.somlit.fr/>) provided complementary estimates of Chl-a and pico- and nano -phytoplankton for comparison with the DYPHYRAD transect (see Fig.1 for the locations). All samples from both networks were collected at sub-surface (1–2 m).” Lines 120–125

“Table 1. Sampling stations and associated spatial, temporal, and sampling characteristics.” For what did you sample? Just flow cytometry or microscopy, too?

New legend:

Sampling station characteristics.-

We agree that it was confusing, we removed from the table 1 SOMLIT and PHYTOBS since the data that were downloaded from the relative databases were only used in the discussion section as described in M+M. Lines 125–127

Table 2. “Coccolithophores, and some autotrophs and armoured dinoflagellates”, what do you mean by some autotrophs? Then you also write: “Diatoms, and other microphytoplankton”, which other microphytoplankton are you referring to?

We apologise for the incomplete information, we recognise that haptophytes are nano-neukaryotes and “some autotrophs” does not make sense; We corrected Table 2 according to Hubert et al. (2026), as follows:

The RedNano cluster is now described as “nanoeukaryotes including haptophytes”, which in the English Channel and North Sea predominantly represent different life stages of *Phaeocystis globosa*. The HsNano cluster is defined as “coccolithophorids”. Finally, the microphytoplankton group is described as diatoms, with the possibility of including some dinoflagellates and *Phaeocystis globosa*.

“Storm events in this study were identified as periods when wind speeds exceeded the 90th percentile (Fig. A1) ( $11.3 \text{ m s}^{-1}$ ). Storm length was initially identified as the  $\pm 3$ -day period surrounding the peak wind speed day, with day 3 designated as the storm day.” This should be the initial statement in this paragraph. First, introduce what storms are, then explain the rest. In addition, Fig. A1 shows the results and thus cannot be cited as such. Throughout the following methodology, you refer to numerous figures from the results, e.g., Figs. 3-7 and A1-C. These must be changed, and in addition, every figure/table should be cited in a numerical order; now, you cite Fig. 3 before Fig. 2.

We have revised the paragraph so that it begins with the definition of how storm events were identified. We now introduce the storm criteria first, followed by the description of the  $\pm 3$ -day window used to characterize storm length. Lines 133–135.

In addition, we removed all references to figures that present results (e.g., Fig. A1 and Figs. 3–7) from the Methods section, as these should not be cited in methodological descriptions. Finally, we corrected the order of figure citations throughout the manuscript to ensure numerical consistency.

“We expect phytoplankton to respond rapidly to changes in nutrient availability.” Why? Elaborate. The summer composition of phytoplankton inevitably includes many mixotrophs and heterotrophs that are already adapted to acquire nutrients in organic form. Why would you expect that such a community would have a rapid response to an inorganic surplus?

The sentence has been removed from the revised manuscript, as it was not appropriate for the Materials and Methods section. The mechanisms linking nutrient pathways to phytoplankton community responses are now addressed in the Discussion, where we examine these processes in the context of our results.

“In the study area, river plumes are transported under the influence of prevailing south–westerly winds.” Is there a reference supporting this claim?

The references are now added. (Brylinski et al., 1991, 1996). Lines 153-154

“Consequently, the River Slack and the Wimerieux estuary affect water chemistry along the transect earlier than other estuaries in the region (Fig. 1), thereby initiating changes in community structure.” Slack is located north of the transect. If you apply what you explain here: SW winds, it means that their direction will be NE. How can the River Slack then be important or affect the transect? Moreover, why do you say that the River Slack is affecting the chemistry and the Wimerieux estuary? Does that include more rivers? Why not just Wimerieux River?

We have clarified the rationale for including both the River Slack and the Wimerieux estuary when describing local riverine influence. Although the Slack lies north of the transect, its close proximity means that its freshwater signal can occasionally reach the study area under specific hydrodynamic conditions, such as strong tidal mixing, southward tidal flow during the ebb phase (NE–SW; Brylinski et al., 1991), or short-lived wind reversals. For this reason, we used the Slack and Wimerieux rivers as practical indicators of immediate local riverine inputs affecting water chemistry near the transect. The text has been revised to make this reasoning explicit and to avoid over-interpreting the role of individual rivers.

Revised sentence: “Because of their close proximity to the transect, the Wimerieux and Slack rivers were used as indicators of local riverine influence on water chemistry. Although the Slack lies north of the transect, strong tidal mixing, wind reversals, and the NE–SW ebb-directed tidal flow (Brylinski et al., 1991) can transport its freshwater signal into the study area.” Lines 154–157

“...number of windy days (wind speed  $> 8 \text{ m s}^{-1}$ ) and average river inflow ( $\text{m}^3 \text{ s}^{-1}$ )...” Unless this is stating the methods/protocols applied, the M&M should be devoid of any results. Please explain why these numbers were chosen.

We agree that these values should not appear in the Materials and Methods, as they represent part of the results rather than the methodological protocol, and we have therefore removed them. To clarify their purpose, the number of windy days (defined as days with wind speed  $> 8 \text{ m s}^{-1}$ ) was used as a proxy for periods when wind forcing is strong enough to enhance vertical mixing and entrain subsurface waters into the surface layer. Similarly, the monthly average river discharge from the Slack and Wimerieux rivers was used to indicate whether summer conditions were relatively wet or dry, thereby providing a simple metric of how storminess and catchment runoff varied between years. Together, these proxies help characterize interannual variability in summer hydrometeorological conditions and are now presented exclusively in the Results section. Lines 232–234

“Phytoplankton abundances from the pre-storm (–10 days) and post-storm (up to 14 days) periods were compared with this baseline...” Why this asymmetry? Why not 10 before and after?

DYPHYRAD sampling is conducted weekly, with additional observations only when weather and logistics permit. Using a 10-day pre-storm window ensured that at least one observation per station was available before each storm event, while avoiding overlap with the post-storm period. In contrast, the post-storm window was extended to 14 days to account for the time required for storm-driven changes to propagate through the system. We have added the following text to make this reasoning explicit: “The pre-storm window was limited to 10 days to ensure at least one available observation per station given the weekly sampling frequency, whereas the post-storm window was extended to 14 days to capture the propagation of storm-driven freshwater and nutrient inputs into the Strait of Dover.” Lines 175–178

## Results

First of all, what I find distracting in this paragraph are the different ways of annotating dates. Consider unifying them in the whole manuscript.

We fixed the date format to YYYY-MM-DD on lines 311, 340, 372, and 390, and throughout the manuscript.

“Several storms persisted for multiple days (e.g., 2016-07-02; Fig. A1), with the 2016-07-02 event representing the most intense episode, during which wind stress frequently surpassed  $0.1 \text{ N m}^{-2}$  (Fig. 2). Storm associated wind stress varied considerably among events (Fig. 2).” How much did the most severe event differ from others? For clarity, it would be best to address when the figure or table is in the appendix.

We agree that the severity of the storms was not clearly described. Among the events considered, the storm on 2016-07-02 had the longest duration (86 h; Fig.A1 in Appendix A) and the strongest wind-stress forcing (mean =  $0.12$ ; SD =  $0.09 \text{ N m}^{-2}$ ; Fig. 2). We added this information in Lines 194–195.

Fig. 2 The dashed line should be called Mean or similar, and not numerically 0.1.

We agree that labelling the dashed line as “0.1” may cause confusion. This line represents the “wind stress threshold ( $0.1 \text{ N m}^{-2}$ )”, not a mean value. We have updated the figure 2 legend to label it clearly as ‘Wind stress threshold’ rather than using the numerical value alone.

“Wind stress ( $\tau$ ;  $\text{N m}^{-2}$ ) across 10 storms, derived from wind speed over  $\pm 3$  days around each storm. The red dashed 220 line marks the  $0.1 \text{ N m}^{-2}$  threshold used to categorize storms as high or low wind stress.” To categorize which part of the data? The mean, the medium? Later, you display low and high precipitation and inflow rates, clearly coloring them blue (low) and red (high). The consistency would

make the figures more structured and make it clear that you are telling a single story rather than patching data from different sources.

We clarified in the legend of Figure 2 that the storms were classified as high (pink) or low (blue) wind stress. High wind stress storms are those for which the upper quartile (Q3) exceeds the  $0.1 \text{ N m}^{-2}$  threshold (dashed line). We also improved visual consistency across figures by applying the same colour scheme used for inflow and precipitation (blue for low, pink for high) and by clearly labelling the wind-stress threshold.

We now consistently refer to blue and pink as low and high class in all the figures 2, 3, 5 and E1.

...“High” precipitation was defined as  $\geq 16.12 \text{ mm}$ , and “High” inflow as  $\geq 0.45 \text{ m}^3 \text{ s}^{-1}$  (Fig. B1).” Exact numbers are less important if they are properly cited than the fact that they refer to the 80<sup>th</sup> percentile.

We revised the text to clarify that the thresholds for high precipitation and high inflow are based on the 80<sup>th</sup> percentile of their respective June–July distributions. Lines 203–204.

The corresponding numerical values ( $16.12 \text{ mm}$  and  $0.45 \text{ m}^3 \text{ s}^{-1}$ ) are now presented as percentile-derived thresholds rather than standalone cut-offs. We also revised it in the caption of figure 3.

“Other events also alleviated nutrient limitation, including the 2012-07-12 and 2015-07-13 storms (Table 3).” Refer to the concrete limitations, e.g., 2012-07-12 was a P-limitation. For 2015-07-13, I do not see a limitation. Please state which nutrient/s you are referring to.

We agree that the 2012-07-12 storm did not alleviate nutrient limitation, and that P-limitation persisted after this event. Post-storm conditions for 2015-07-13 also do not indicate nutrient-limiting conditions. We have therefore removed the original statement from the manuscript to avoid over-interpretation.

Figure 3. “Precipitation classes (“High” and “Low”) were defined from June–July rainfall distribution, with the high threshold set at  $16.12 \text{ mm}$  (80<sup>th</sup> percentile); inflow classes were defined from June–July river-flow distribution, with the high threshold set at  $0.45 \text{ m}^3 \text{ s}^{-1}$  (80<sup>th</sup> percentile).” Use the terminology consistently; here, you say rainfall, and on the figure, precipitation is written. The same goes for inflow/discharge in the text. If the threshold is  $16.12 \text{ mm}$ , why do you classify 2016-07-02 as high precipitation? In addition, it would be useful to display the threshold lines too.

We have ensured consistent terminology throughout the manuscript and figures by replacing “rainfall” with “precipitation” and “discharge” with “inflow”. We also added the threshold lines for both precipitation and inflow in Fig. 3, as suggested. In addition, we corrected the classification of the

2016-07-02 event, which is now shown as a low-precipitation storm because its precipitation total falls below the 80<sup>th</sup> percentile (16.12 mm) threshold.

Table 3. Use terms consistently, e.g., you use “after storm” interchangeably with “post-storm”. “Rainiest events were defined as those with total precipitation > 16.12 mm,...” By total, do you mean average or maximum? Why is it relevant how high the nutrients were after the storm if we do not have an idea whether they were higher or lower than before the storm? Revise and argument.

We replaced “after storm” with “post-storm” in Table 3. We clarified that ‘total precipitation’ refers to the accumulated precipitation over the  $\pm 3$ -day storm window, not an average or maximum value. The text has been revised accordingly. Lines 157–158.

Available pre-storm samples are limited (1 sample within the 10-day pre-storm window) and thus, do not consistently capture the nutrient conditions immediately preceding each storm. Because of this limited temporal resolution, pre-storm values cannot be used as a reliable baseline for quantifying storm-driven changes. We therefore compared post-storm nutrient concentrations to the seasonal means, which provide a robust representation of expected summer nutrient levels under warm and nutrient-depleted conditions. Post-storm concentrations that exceed these climatological baselines indicate anomalous nutrient inputs relative to typical seasonal conditions.

This is now added in the revised version:

“Because pre-storm nutrient samples were limited (1 sample per station within the 10-day pre-storm window) and did not consistently capture conditions immediately before each event, we used climatological means as the reference baseline (Fig. C1d–f in Appendix C).” Lines 216–219

Figure 4. I find it a bit confusing to read these multi-coloured bars. Could you keep the same colour for the same parameters and change the hue, e.g., blue for wind that is of a lighter hue for June, and a darker hue for July? This could improve the readability. In the same way, you can also colour the axes/titles in blue for wind and another colour of choice for the inflow. In the legend, the dashed line title should be changed, as it is unnecessary to repeat what is already stated in the figure description.

We have updated the colour scheme to improve readability and now coloured the axes according to windy days and river inflow. We also revised the dashed-line label in the legend to the shorter and non-redundant term “Mean inflow”. Therefore, we also updated the caption explaining the blue and green colour gradient in the figure 4.

Figure 5. Why are the vertical dashed lines of different colours from each other? Please indicate that those dashed lines represent the day of the storm event. Adjust the title in the legend for the Chl-a

mean as it is redundant, and those details are already stated in the caption. Are the whiskers standard deviations or errors? Are the points outside the boxes outliers?

We standardized the vertical dashed lines so they now share a single colour and explicitly indicate the day of the storm event. We also simplified the legend title for the mean Chl-a to avoid repeating information already provided in the caption. In addition, we updated the figure/caption by replacing the green colour with pink and blue to represent “High” and “Low” inflow storms, respectively. The whiskers represent the 1.5×IQR range, and points outside this range are plotted as outliers; we do not mention this since it is inherent to box-plot calculation.

Revised caption: “Boxplots of pre- and post-storm Chl-a distributions (compiled from DYPHYRAD and SOMLIT) for the 10 storms. Vertical dashed lines indicate the day of each storm event. Pre-storm Chl-a distributions are shown together with mean inflow over a ±3-day storm period (grey bars). The green dashed line marks the June–July climatological mean of Chl-a concentration ( $3.20 \mu\text{g L}^{-1}$ ) in the EEC. Pink and blue colouring indicate “High” and “Low” inflow storms, respectively.”

Figure 6. Why climatological mean and not just mean? If it is climatological, both coastal and offshore would need that adjective too.

Sorry for this; it is corrected as follows:

“Climatological means and standard errors of phytoplankton abundances in the Coastal (R0–R2) and Offshore (R2’–R4) regions along the DYPHYRAD transect, based on 15-day means from February 2012 to December 2022. The black line represents the mean value across all stations. (a) RedMicro (diatoms), (b) RedNano (nanoeukaryotes), (c) HsNano (coccolithophorids), (d) OraNano (cryptophytes), (e) OraPicoProk (*Synechococcus*), and (f) RedPico (picoeukaryotes), respectively (see also Table 2).”

“Coccolithophorids peaked at  $1.2 \times 10^5$  cells  $\text{L}^{-1}$  at the R0’ station (Fig. 7C(c)), while cryptophytes showed a strong increase (Fig. 7C(d)) at stations R1–R3 (mean:  $3.6 \times 10^5$  cells  $\text{L}^{-1}$ ; max:  $7.6 \times 10^5$  cells  $\text{L}^{-1}$ ), exceeding their climatological mean of  $3.0 \times 10^5$  cells  $\text{L}^{-1}$  (Fig. 6).” I suggest commenting the results connected to spatial distribution too, e.g., what is closer to shore and what is in the open waters.

We have revised the sentence to explicitly indicate the spatial context by adding “coastal” and “offshore” next to the corresponding stations. This clarifies that R0–R2 are coastal stations and R2’–R4 represent offshore waters. The revised sentence is now “Coccolithophorids peaked at  $1.2 \times 10^5$  cells  $\text{L}^{-1}$  at the nearest to the coast R0’ station (Fig. 7C(c)), while cryptophytes showed a strong increase (Fig.

7Cd) moving offshore from R1 to R3 stations (mean:  $3.6 \times 10^5$  cells L<sup>-1</sup>; max:  $7.6 \times 10^5$  cells L<sup>-1</sup>), exceeding their climatological mean of  $3.0 \times 10^5$  cells L<sup>-1</sup>". Lines 381-384

"Rather than stimulating diatoms, the storm amplified pico-sized phytoplankton under the prevailing warm conditions, while diatoms were further suppressed (Fig. 7D)." Isn't this expected, as the smaller organisms will reproduce faster? So, why do you say rather than stimulating diatoms? Why did you expect that?

To clarify this point, the revised sentence reads: "Under the prevailing warm conditions, the storm amplified picophytoplankton (Fig. 7D)." Lines 392–393

#### Discussion

"Summer storm impacts in the EEC were highly variable between years, arising from different combinations of river inflows and wind events that were in turn modulated by large-scale atmospheric circulation." Cite papers showing that variability.

The following references were added: (Alvarez et al., 2024; Crawford et al., 2023; Turki et al., 2023); Lines 407–408

"These patterns directly support our initial hypothesis that different storm types exert distinct ecological impacts." You did not hypothesize this; your hypothesis was that storms would induce disturbance in the phytoplankton community, but you did not hypothesize the heterogeneous responses to different storms.

We corrected the sentence now as "These patterns support our hypothesis that variations in river inflow and wind forcing drive changes in phytoplankton abundance and community composition." Lines 408-409

"Specifically, our findings confirm that high inflow storms favoured diatoms, wind driven mixing, low inflow summers promoted nanophytoplankton, cryptophytes and pico-sized phytoplankton (Table 4)." What are you confirming? Something that was shown in other papers? Modify the statement and cite papers if needed.

The word "confirm" is now replaced by "indicate". Line 410

Table 4. Rationalize the caption, keep the necessary information, and reduce the redundant information from the table. Elsewhere in the text, you specify *P. globosa*, so what is it: sp., spp., or *globosa*? Change the heading "Storm" to "Date". All the storms under the header "Dominant physical mechanism" have a listed horizontal advection; it is redundant to repeat it. This can go into the caption.

In the same way, under the header “Physical description” there is repetitive: “South-westerly wind driven coastal flow transports river plume northward” for every storm.

We agree. This table is now entirely reconsidered, please see new Table 4.

The taxonomic label has been corrected to *Phaeocystis globosa* to ensure consistency throughout the manuscript.

“Distinct and contrasting patterns emerged between coastal and offshore waters: diatoms were consistently more abundant in coastal zones (Fig. 6a), while *Synechococcus* dominated offshore waters (Fig. 6e). Seasonal dynamics revealed a June–July mean increase in diatom abundance in early July, following the spring bloom (Fig. 6a). *Synechococcus* rose in late May but dipped in early July despite warming temperatures, then recovered by late July as diatoms declined. This crossover suggests that transient meteorological disturbances, including storm related reductions in light or shifts in nutrient dynamics, temporarily favoured diatoms over *Synechococcus*. The subsequent reversal toward late July reflects a return to more stable summer conditions (Fig 6e). Similarly, high standard errors in diatom, pico-sized phytoplankton, and cryptophyte abundances point to greater fluctuations during June–July (Fig. 6) due to storm driven disturbances.” Could you discuss this part in the context of what the literature says? Is that something others observe, that offshore is dominated by smaller cyanobacteria and close to shore, larger phytoplankton?

This discussion has been expanded by adding:

“Previous studies have shown that large phytoplankton often dominate nutrient-rich upwelling regions of the ocean, whereas open-ocean waters are typically dominated by picophytoplankton (James et al., 2022; Ribalet et al., 2010). A similar pattern was observed in the English Channel, where riverine input represents the dominant mechanism of nutrient supply. This nutrient enrichment supports the abundance of larger phytoplankton, such as diatoms and *Phaeocystis globosa*, in nearshore waters (Bonato et al., 2015; Napoléon et al., 2014).” Lines 460–464

“Post-storm peaks in microphytoplankton abundances were often driven by specific diatom taxa such as *Leptocylindrus danicus* and *Chaetoceros socialis*, whose abundances exceeded climatological records by more than 3-fold. *Leptocylindrus danicus* dominated June diatom blooms between 2016 and 2020 (Houliez et al., 2023; Skouroliahou et al., 2022), except in 2018 when *Pseudonitzschia* prevailed, reaching  $\sim 10^6$  cells L<sup>-1</sup> and contributing 90% of total diatom abundance at SOMLIT C and PHYTOBS 1-Boulogne stations (Fig. 1).” Cite the part demonstrating the 3-fold increase and the abundance of *Pseudo-nitzschia*.

We cited the table showing a 3-fold increase on post-storm dates relative to the climatological mean (Table H1 in Appendix H) and added the citation to Skouroliaou et al. (2024), which reported that *Pseudo-nitzschia* reached  $\sim 10^6$  cells L<sup>-1</sup> (lines 484 and 360, respectively).

“The recurrence of these post-storm diatom blooms across multiple years (Table 4; 2012, 2013, 2016–2020) indicates that they are not isolated anomalies but rather a consistent feature of coastal phytoplankton dynamics.” OK, is there something like this described in the literature? What kind of post-storm blooms does the literature tell us about? Is the closeness to the shore something that determined a preference for a diatom bloom (e.g., silica availability aside from other nutrients, etc.)?

We have added literature showing that post-storm diatom blooms have been previously documented in the English Channel. “In a previous study, Rees et al. (2009) reported a monospecific post-storm bloom of *Chaetoceros debilis* associated with increased Chl-a following enhanced river inflow, supporting our observation that such blooms are recurrent in the region. Higher summer silicate concentrations ( $\sim 1.8 \mu\text{mol L}^{-1}$ ) at the coastal station R0 (Hubert et al., 2025a) likely favour diatom growth in coastal waters.” Lines 488–492

“By contrast, the 2022-06-06 storm produced a different outcome. With only a brief one-hour windy period, the post-storm community was dominated by pico-sized phytoplankton (Table 4), with only marginal increases in nanophytoplankton (Fig. 7D).” How low can your resolution go? Wasn't it day-based? I find it hard to switch to the per h resolution, given that the whole manuscript was written using days, or even a 3-day level. Rephrase! Also, where are the h-to-h data? If they are not shown, please show them as such.

We agree our analysis is based on daily and 3-day resolutions. We now provide the hourly wind record for each event in Appendix A1 and clarified this in the caption. Accordingly, we removed the reference to a “one-hour” windy period and rephrased the sentence to remain consistent with the daily scale: “This short-lived event generated only weak wind forcing,…….” Lines 529–530

## 5 Concluding remarks

This reads as a continuation of the discussion rather than a conclusion. Rename and add to the discussion. If you think that the article is calling out for a conclusion chapter, then keep it distilled to the key findings and remarks without a broad discussion.

The text now reads as a continuation of the discussion, and some concluding remarks have been added in the last four lines of the discussion:

“In conclusion, interannual variability in storm impacts (wind and riverine forcing) was reflected in phytoplankton community composition. Higher riverine inputs favoured diatoms through enhanced silicate availability, leading to increased Chl-a concentrations in coastal waters. In contrast, in the absence of strong riverine inputs, wind-driven mixing events favoured nanophytoplankton, whereas strong wind-driven mixing suppressed picophytoplankton.” Lines 553–557

## Appendix

All descriptions above the figures can be rationalized and joined into the captions.

Figure A1 Cite it in the Result section. Why is the date on the x-axis in reverse order compared to the one inside the figure? “Wind speed time series during storm events ( $\pm 4$  days). The red dashed line indicates the selected central storm day, with analyses conducted over a  $\pm 3$ -day window around this reference point.” Why during storm events  $\pm 4$  days, in a  $\pm 3$ -day window? Explain.

All the appendices are now mentioned in the main text. All descriptions above the figures have been incorporated into the figure captions and removed from the main text.

The legend is corrected as follows: The x-axis spans  $\pm 4$  days to provide visual context around each storm, whereas the analytical window used in the study is  $\pm 3$  days. We have corrected the figure and caption accordingly and now cite Fig. A1 (Line 416) in the Results section. In addition, the description above the figures has been incorporated into the figure itself.

Figure B1: Rationalize the caption and add the above description and cite it in the results section.

We modified the caption to include a description of Fig. B1 and now cite it in the Results section. Line 204

Figure D1. Shading or otherwise indicating the months used earlier for summer analysis would be useful? Which years were taken for this analysis? And please indicate locations rather than saying just “study site”.

We now shade the June–July period in Figure D1 to indicate the months used for the summer analysis. We also clarified that the climatology is based on hourly wind data from Boulogne-sur-Mer (Meteo-France station) for the period 2010–2025.

Figure E1 Comments similar to Fig. 5.

We simplified the legend title for the mean Chl-a to avoid repeating information already provided in the caption. In addition, we updated the figure/caption by replacing the green colour with pink and blue to represent “High” and “Low” inflow storms, respectively. Added the description to the caption,

noting that precipitation does not exhibit a linear relationship with Chl-a. Revised caption is now “Boxplots of pre- and post-storm Chl-a distributions (compiled from DYPHYRAD and SOMLIT) for the 10 storms. Vertical dashed lines indicate the timing of each storm event. Pink and blue boxplots denote “high” and “low” inflow storms, respectively, corresponding to increased and decreased Chl-a responses. Pre-storm Chl-a distributions are shown together with total accumulated precipitation over a  $\pm 3$ -day storm period (dark grey bars). Total precipitation and post-storm Chl-a did not exhibit a linear relationship for the storms on 2013-06-15, 2020-07-27 and 2022-06-06. The green dashed line indicates the June–July climatological mean Chl-a concentration ( $3.20 \mu\text{g L}^{-1}$ ) in the EEC.”

Figures 6 Captions can be rationalized.

The revised caption is now “Climatological means and standard errors of phytoplankton abundances in the Coastal (R0–R2) and Offshore (R2’–R4) regions along the DYPHYRAD transect, based on 15-day means from February 2012 to December 2022. The black line represents the mean value across all stations. (a) RedMicro (diatoms), (b) RedNano (nanoeukaryotes), (c) HsNano (coccolithophorids), (d) OraNano (cryptophytes), (e) OraPicoProk (*Synechococcus*), and (f) RedPico (picoeukaryotes), respectively (see also Table 2).”

Similarly, we rationalized Figure C1 caption.

Table G1 Formatting can be edited, including the thickness of lines, merging cells, and indicating when  $p < 0.05$

Table G1 has been updated by removing extra borders, merging cells, and highlighting  $p < 0.05$  in bold.

Tables H1&2 Edit table formatting, including the thickness of lines, merging cells, position of text in cells. Header “Date”, indicate the format y-m-d because you are interchangeably using different formats throughout your manuscript. Use station names consistently, preferably as they are indicated on the map. **In continuation, is it *Phaeocystis* sp./spp./globosa? Revise: *Chaetoceros socialis* f. *radians* <https://marinespecies.org/aphia.php?p=taxdetails&id=163126> Status: uncertain > unassessed; *Chaetoceros* sp./spp.; *Leptocylindrus (autres)*, you mean other, on which other are you referring to; *Asterionellopsis* sp./spp.; *Chaetoceros (autres)*, do you mean other than mentioned earlier?**

Table H1 & H2 has been updated by removing extra borders, merging cells. Dates formats are mentioned in table H1 and H2. The header “Date” now indicates the format (YYYY–MM–DD) for clarity. Station names are consistent now.

Because the species and genera are reported directly from the PHYTOBS database, we cannot alter or revise them.

## References

Add more and reduce the level of self-citation.

The following new citations have been added: Rees et al. (2009), James et al. (2022), Ribalet et al. (2010), and Levasseur et al. (2025) (Lines 442, 461 and 533).

The 'self citations' of Houliez et al., 2023 (line 484); Skouroliakou et al., 2022 (line 484), and Hubert et al., 2026 (line 493) were removed where possible.

Technical corrections and typing errors

## Abstract

"focussed in"/ focused on, "well identified" / well-identified, "under high wind stress, favouring nano-sized phytoplankton" / under high wind stress, favour nano-sized phytoplankton

"Focussed" has been replaced with "targeted" in line 10, and a hyphen has been added to "well-identified" (line 8). "Favouring" has been retained to maintain the correct verb form (line 17).

## Introduction

Redundancy: "Existing studies in lakes and oligotrophic seas in tropical..." / Studies in lakes and oligotrophic seas in tropical.

Removed "Existing" Line 27

"increase in the Chl-a (chlorophyll-a)" / increase in the chlorophyll-a (Chl-a)

Fixed to "increase in the chlorophyll-a (Chl-a)" Lines 27-28

"for example, Pozdnyakov et al., (2014)" / for example, Pozdnyakov et al. (2014)

We revised the sentence as "...increases in oligotrophic Arctic waters (Pozdnyakov et al., 2014) and elevated primary....." Line 31

"while Crawford et al., (2020)" / while Crawford et al. (2020)

We revised the sentence as "Barents and southern Chukchi Seas following cyclones (Crawford et al., 2020)...." Line 32

“Over recent decades, the summer season in the EEC” / Over recent decades, summer seasons in the EEC

Removed “the” Line 52

“...occurrence of the summer phytoplankton blooms and in particular to investigate the possible effect of summer storm events on the magnitude of the blooms and also the phytoplankton community. We were particularly interested to examine how...” / ...occurrence of the summer phytoplankton blooms and to investigate the possible effect of summer storm events on the magnitude of the blooms and the phytoplankton community. We were particularly interested to examine how...

Removed “in particular” and “also” from the sentences. Line 63

“...coastal–offshore gradient in the Strait of Dover, known as the DYPHYRAD (Dynamics of PHYtoplankton on RADiale) transect (Hubert et al., 2025b) by the Strait of Dover.” / ...coastal–offshore gradient in the Strait of Dover, known as the DYPHYRAD (Dynamics of PHYtoplankton on RADiale) transect (Hubert et al., 2025b).

Corrected to “(Hubert et al., 2026)” and replaced “in the Strait of Dover”. Line 69

Obvious, redundant: “...events, assess the various impacts of storms on the marine environment and phytoplankton structure, and conclude with a synthesis of our findings.” / ...events, assess the various impacts of storms on the marine environment and phytoplankton structure.

Removed the sentence. Line 70

Materials and Method

“Materials and Method Section” / Materials and Methods

Deleted “Section”. Line 71

“The The eastern English Channel” / The eastern English Channel

Deleted “The”. Line 73

“...we incorporated datasets from two French National Observation Systems (Systèmes Nationaux d’Observation, SNO): SNO SOMLIT and SNO Phytobs.” / ...we incorporated datasets from two French National Observation Systems (Systèmes Nationaux d’Observation, SNO): SOMLIT and Phytobs.

Removed “SNO”. Line 88

Using PSU is discouraged in oceanography and especially in scientific papers, e.g. <https://www.coastalwiki.org/wiki/Salinity#:~:text=After%20receiving%20the%20latest%20issue,of%20the%20practical%20salinity%20scale>

“...and salinity (S, PSU)...” / salinity (S)

Deleted “PSU”. Line 93

Subsurface water samples were collected for dissolved inorganic nutrients (NO<sub>3</sub><sup>-</sup>, NO<sub>2</sub><sup>-</sup>, PO<sub>4</sub><sup>3-</sup> and Si(OH)<sub>4</sub>.” / Subsurface water samples were collected for dissolved inorganic nutrients, i.e. nitrate(NO<sub>3</sub><sup>-</sup>), nitrite (NO<sub>2</sub><sup>-</sup>), orthophosphate (PO<sub>4</sub><sup>3-</sup>), and orthosilicic acid (Si(OH)<sub>4</sub>).

We agree that, for consistency, only the terms “DIN, DIP, and DISi” are now used throughout the manuscript, figures, and tables. This has been added in line 96 of the Materials and methods section and in Fig. C1.

“...Aminot and K rouel, (2004).” / Aminot and K rouel (2004).

Deleted “comma”. Line 98

“SOMLIT SNO measurements used in this study include temperature, salinity, nutrients (nitrate, nitrite, phosphate, and silicate),...” / SOMLIT SNO measurements used in this study include temperature, salinity, nutrients (NO<sub>3</sub><sup>-</sup>, NO<sub>2</sub><sup>-</sup>, PO<sub>4</sub><sup>3-</sup> and Si(OH)<sub>4</sub>),....

This sentence has been deleted. We mentioned SOMLIT datasets in revised sentence at line 125–127.

“...transect, chlorophyll-a concentrations from...” / ...transect, chl-a concentrations from...

Revised the sentence as: “DYPHYRAD transect to measure Chl-a, nutrients and phytoplankton abundance”. Line 95

Unify the names of the stations and locations, is it: Wimereux SOMLIT-C / SOMLIT C / SOMLIT Point C, Boulogne-1 / Boulogne 1 / Point 1 Boulogne / Point 1-B, Boulogne-Sur-Mer/ Boulogne sur mer / Boulogne-sur-Mer.... ? Those also appear differently in Fig. 1, tables, and text.

We regret the previous inconsistency. The stations are now consistently referred to as SOMLIT C, SOMLIT L, PHYTOBS Boulogne, and PHYTOBS C, following the naming used by the data provider. This has been updated in Figure 1. Lines 89–91

“10mV...” / 10 mV, “...5 L s<sup>-1</sup>...” / 5  L s<sup>-1</sup>, “...25mV...” / 25 mV

Added the space between quantity and unit. Line 113 and 115

“time (8–10min).” / time (8–10 min).

Added the space between quantity and unit. Line 116

“...(CytoBuoy b.v., Netherlands)...” / “...(CytoBuoy b.v., the Netherlands)...

Added “the”. Line 118–119

“... vocabulary of (Thyssen et al., 2022).” / “... vocabulary of Thyssen et al. (2022).

We removed the citation from the revised manuscript.

“Phytobs stations located south of the DYPHYRAD transect (50.8° N, Fig. 1)...” / Phytobs stations located south of the transect (Fig. 1)...

The sentence was removed following revision; therefore, “50.8° N” is no longer mentioned.

Table 1 Edit table formatting. Correct parts of the table. If all have the same time span for sampling, i.e., 2012-22, you can remove it from the table and add it to the table description. Also, the tables contour-lines are varying in thickness, which is something to adjust. You write “Once/twice a week” with capital letters, but “fortnightly” with small letters. SOMLIT C appears twice, with different sample counts (168 SOMLIT C vs 160 Phytobs Wimereux (SOMLIT C). Explain why?

The sampling period (2012–2022) was removed from each row, and the contour-line thickness was standardized. SOMLIT and PHYTOBS were also removed from table 1, as they were not part of the analysis. Line 128

“90th...” / 90<sup>th</sup> Throughout the whole text, you miss the superscript for “th”, please correct it in the text, figure, and table captions, and in figures.

Corrected the superscript: 90th to 90<sup>th</sup> throughout the manuscript. E.g., line 133, 175

“Table 2. Flow cytometry (FCM) phytoplankton...” You have introduced this abbreviation but have never used it elsewhere; remove it if it is unnecessary.

Deleted “FCM” from the table 2 caption. Line 130

The header in Table 2, “Phytoplankton description,” can be shortened to Phytoplankton.

Deleted “description” from Table 2

“Larger cyanobacteria (e.g., large-size Crocosphaera, Richelia)” / Larger cyanobacteria (e.g., Crocosphaera, Richelia)

Deleted “large-size” from Table 2

“...armoured dinoflagellates” / ...armored dinoflagellates

We have removed “and some autotrophs and armoured dinoflagellates” and only kept the “Coccolithophores” in Table 2.

“...(assumed here as constant  $\rho_{\text{air}} = 1.225 \text{ kg m}^{-3}$ )...” / ... (assumed to be  $\rho_{\text{air}} = 1.225 \text{ kg m}^{-3}$ )... because the sign “=” implies a constant.

Deleted “constant” from the sentence. Line 144

“...on the wind speed as (Wu, 1982):” / ...on the wind speed as:, because Wu, 1982 was already cited in the same sentence.

Removed repeated citation “(Wu, 1982)”. Line 145

“...(Eaufrance; <https://www.eaufrance.fr>).” and similar can be shortened by, for instance, hyperlinking the name Eaufrance.

Shortened by hyperlinking “<https://www.eaufrance.fr>”. Line 151

“...(Derot et al., 2015), (Fig. 7).” / ... (Derot et al., 2015).

Removed the “Fig.7” sentence. Line 169

“...(Derot et al; 2015).” / (Derot et al., 2015).

Fixed “;” to “.” inside the citation. Line 181

Results

“Storm associated wind stress...” / Storm-associated wind stress...

Fixed to “Storm-associated” Line 188

Redundant sentence, remove: “Figure 3 presents total precipitation and average flow rate during each storm event.”

Removed “Figure 3 presents total precipitation and average flow rate during each storm event.”

Rephrase and remove PSU: “...produced marked salinity reductions (33.4–34.0 PSU; Table 3).”.

New sentence is now: “a corresponding reduction in salinity (33.4–34.0; Table 3)” Line 212

Introduce the abbreviation ahead: “ For example, the 2016-06-20 storm exhibited DIN and ...”

Added the abbreviations ahead at line 99: “the 2016-06-20 storm exhibited DIN and DiSi concentrations of...”

Why do you start a new paragraph that starts with thus: “ ...river flow below  $0.35 \text{ m}^3 \text{ s}^{-1}$  (Fig. 4).

We have removed the paragraph break. The sentence beginning with “Thus” now remains within the same paragraph, as it synthesizes the preceding observations rather than introducing a new topic. Line 242

Table 3. The “DIP” abbreviation was not introduced. Add horizontal lines or spacing between dates because it is very hard to follow the nutrient content in the current version. The column of nutrients can be split into two columns: the nutrient name in one, and the values in the other.

We have now introduced the “DIP” abbreviation at its first occurrence in the manuscript (Line 99). In Table 3, we added horizontal lines to visually separate each storm event, improving readability. Additionally, the nutrient column has been revised in table 3. Line 255

There is only one green in Fig. 5: “...(depicted in green shades, Fig. 5)...” / ...(depicted in green, Fig. 5)...

Removed “shades” from the sentences and revised as “(depicted in pink, Fig. 5)”. Line 265

“...six storms are presented in the appendix...” / ...six storms are presented in the appendices...

Replaced “appendix” with “appendices”. Lines 308–309

Figure 7. “Exceedance probability (CCDF) distributions of six phytoplankton groups along the DYPHYRAD...” / Exceedance probability (CCDF) distributions of six phytoplankton groups (a-f) along the DYPHYRAD...

Added “(a-f)” in the caption. Line 332

Discussion

“...wind driven mixing...” / wind-driven mixing

Replaced with “wind-driven” in line 410 and 412

“...Seine estuary...” / ...Seine Estuary...

Replaced “estuary” with “Estuary”. Line 423

“...Somme estuary...” / ...Somme Estuary...

Replaced “estuary” with “Estuary”. Line 429

Table 4.” South-westerly wind driven coastal flow transports river plume northward” / South-westerly wind-driven coastal flow transports river plume northwards

The caption of Table 4 has been changed to: “Summary of storm impacts and their associated nutrient and phytoplankton responses. See Table 2 for phytoplankton group description.” Line 432

“High Inflow, Low wind” / High inflow, low wind

The phrase “High Inflow, Low wind” has been updated to “High inflow, low wind” in the table 4.

“...phytoplankton blooms can persist for weeks (e.g., (Rees et al., 2009; Skouroliakou et al., 2022) .” /  
...phytoplankton blooms can persist for weeks (e.g., Rees et al., 2009; Skouroliakou et al., 2022).

Revised and corrected as “(Rees et al., 2009)”. Line 442

“...(number of days > 8 m s<sup>-1</sup>)...” / ...(number of days > 8 m s<sup>-1</sup>)...

Removed space between “s” and “-1”. Line 448

“...due to storm driven disturbances.” / ...due to storm-driven disturbances.

Replaced with “storm-driven” in line 472.

“...when *Pseudonitzschia* prevailed...” / ...when *Pseudo-nitzschia* prevailed...

Replaced with “*Pseudo-nitzschia*” in line 360.

Appendix

Keep the consistent annotation, e.g., is it Fig. C1b or C1 (b)?

We have retained the format of “Fig.C1b” and removed the parentheses “(b)” to ensure consistency.  
E.g., line 427

Table H1&2 “Abundance (Cells L<sup>-1</sup>)” / Abundance (Cells L<sup>-1</sup>)

Changed “(cells L<sup>-1</sup>)” to “(Cells L<sup>-1</sup>)” in line 664 and line 683 respectively.

Data availability

Doi can be mentioned in the reference list if you mention the standard citation with the surname.

We have updated the citation and references for the respective datasets used in the manuscript. Lines  
685–689