RC2

Review Commons:

The study investigates the impact of physical processes on partical distribution in the northern South China Sea based on two cruises conducted along the Guangdong coast in the summer of 2018 and 2020. The authors identified that in 2018, heavy rainfall induced by a tropical cyclone resulted in strong stratification. In 2020, the Zhujiang River plume played a dominant role in stablizing the water column under southwesterly winds, leading to the accumulation of large particles due to the formation of pycnocline.

Overall, the paper is well-written in clear and understandable English. The figures are clear and easy to read. However, I found the scientfic questions to be unclear and lacking significance. The analysis and interpreation of the results were shallow and lacked logical conherence. Some explainations regarding the implications of the results seemed disconnected from the the results themselves. I believe the paper requires substaination revision to reach the standards expected for publication in Biogeosciences. Below are my specific suggestions on how to improve part-by-part

We sincerely thank the reviewer for the constructive and detailed comments. We appreciate the recognition of the manuscript's clarity and figures, and we carefully considered the concerns regarding the scientific questions, interpretation, and logical coherence. We have thoroughly revised the manuscript to address these issues to the best of our ability, and our point-by-point responses are provided below.

Abstract

At the end of the abstract, the broader significance of the research should be addressed. Consider highlighting what new results and findings contribute to our understanding of particulate organic matter (POM) transport in coastal regions, not just limited to the northern South China Sea (NSCS) itself.

Reply: We thank the reviewer for this valuable suggestion and have revised the final part of the abstract to emphasize the broader significance of our findings as follows.

Revised Abstract:

Line 28-33: "…Although the ZRP and the subsurface chlorophyll maximum shared similar biogeochemical signatures, the ZRP exhibited higher POC-to-Chl-a ratios and greater particle bulk densities, indicating more advanced POM degradation within the river plume. Nevertheless, the significantly negative correlation between $\delta^{13}C_{POC}$ and salinity demonstrates that $\delta^{13}C_{POC}$ remains a reliable tracer of riverine influence, even under conditions of biodegradation, and outperforms conventional tracers such as the N/P ratio. The negative $\delta^{13}C_{POC}$-salinity relationship occurs when river plumes are dominated by newly produced marine-derived particles rather than terrestrial inputs. This distinction emphasizes the need to account for POM origin when applying isotopic tracers and highlights the broader utility of $\delta^{13}C_{POC}$ for studying POM transport in river-dominated coastal systems worldwide."

1. Introduction

The first paragraph (L38-L46). You should focus to introduce the object you want to study instead of general hydrological and biogeochemical environment of NSCS. What you want to study here is the POM. You should give some introduction about why study POM is important. This was partially mentioned in L70-L75, which should be placed in front

Reply: We concurred with the reviewer that the introduction should more directly emphasize the importance of POM in this study. Accordingly, we revised the opening of the introduction to highlight POM. Afterwards, because the complex hydrological setting of the northern South China Sea strongly regulates particle transport and transformation, we retained a concise description of the regional hydrography to provide necessary context for interpreting POM variability. We believe this revised structure better emphasizes POM.

Revised Introduction:

Line 38-111:

"The signatures of particulate organic matter (POM) generally serve as valuable proxies for understanding biogeochemical cycles in the global ocean system (SCOR Working Group, 2007; Weaver, 1991) and the source-to-sink (S2S) transport mechanisms of riverine materials (Fischer, 1991; Gu, 2009; Meyers et al., 1993; Sun et al., 2021). However, POM could undergo substantial transformations during transport, diminishing the reliability of indicators including stable isotopes and C/N ratios that are commonly applied to trace particle provenance (Allen, 2017; Lee et al., 2023; Miller et al., 2008; Turner et al., 2002; Yin et al., 2001).

For example, flocculation modifies particle size distributions and its bulk densities, which in turn influences the removal of substances from the water column (Hill et al., 2000). Riverine nutrient inputs stimulate phytoplankton growth, reshaping biological communities (Jiang et al., 2015; Li et al., 2018; Lu et al., 2009; Tong et al., 2024; Zhong et al., 2021). Such bio-blooms can also lead to $\delta^{13}C$ enrichment in POM due to the progressive depletion of ^{12}C in the inorganic carbon pool of the surrounding seawater

(Deuser, 1970; Nakatsuka et al., 1992). Microbial degradation further alters POM composition, resulting in residual POM with a relatively $\delta^{13}C$-depleted signature (Close et al., 2020; Huang et al., 2021). In addition, coastal hydrodynamics can alter the physicochemical properties of suspended particles (Eisma, 1986; Manning et al., 2010). Turbulence induced by waves and currents enhances the exchange of materials with surrounding waters by promoting aggregation and deflocculation of suspended particles. (Cross et al., 2014; Jago et al., 2006; Petersen et al., 1998). Therefore, the original characteristics of POM are difficult to preserve along the transport pathway.

As one of the world's largest river-dominated ocean margins (RiOMar; Xie et al., 2020), the northern South China Sea (NSCS) receives substantial inputs of particulate matter and terrestrial nutrients from major rivers, most notably the Zhujiang (Pearl) River (Cai et al., 2004; Lee et al., 2006; Liu et al., 2012; Ou et al., 2019; Xu et al., 2008). These riverine effluents enhance the diversity of water masses and suspended particle assemblages, resulting in complex hydrographic structures in nearshore regions (Lan et al., 2009; Yin et al., 2004; Zhou et al., 2012). The hydrodynamics and biogeochemical processes governing the dispersal of these effluents play a pivotal role in shaping coastal ecosystems, contributing to phenomena such as benthic hypoxia along the river plume pathway (Luo et al., 2023; Qian et al., 2018).

The distribution of the Zhujiang River plume (ZRP) on the continental shelf is shaped by factors, including river discharge, wind patterns, upwelling, and coastal flow fields (Chen et al., 2016; Dong et al., 2004; Lee et al., 2021; Ou et al., 2009; Xu et al., 2019; Zu et al., 2014; Zu et al., 2015). Satellite-based turbidity imagery has identified eight distinct spreading patterns of the ZRP (Chen et al., 2017a). During the summer monsoon, southwesterly winds drive a northeastward surface flow, facilitating the propagation of the ZRP along the Guangdong coast (Chen et al., 2017a, b; Lee et al., 2021; Pan et al., 2014; Zu et al., 2014). Monsoon-driven coastal upwelling further enhances this transport by generating baroclinic jet currents at the interface between the freshwater plume and the underlying saltwater (Chen et al., 2017b; Zu et al., 2015). Underway salinity measurements and satellite imagery have observed the broad extent of the ZRP into the southern Taiwan Strait (Bai et al., 2015)

The ZRP is critical in regulating nutrient availability and supporting primary production in the NSCS. (Liu et al., 2019; Tong et al., 2024; Yang et al., 2021; Yin et al., 2001, 2004). Strong water stratification inhibits vertical mixing along the plume pathway, allowing the riverine substances to be transported over long distances (Chen et al., 2017b; Harrison et al., 2008; Horner-Devine et al., 2015; Lee et al., 2021; Shu et al., 2014). Building on such observations, various methods have been used to investigate hydrographic, hydrodynamic, and biogeochemical responses associated with the ZRP (Gu et al., 2017; Harrison et al., 2008; Lan et al., 2009; Yin et al., 2004; Zu et al., 2015). A distinctive biogeochemical characteristic of the Zhujiang River is its high nitrogen-to-phosphorus (N/P) ratio, which contrasts with that of the surrounding seawater in the NSCS (Lee et al., 2023; Xu et al., 2008; Yin et al., 2001). The influx of nitrogen-rich riverine water into the nitrogen-limited NSCS significantly enhances coastal biomass, as observed by ocean color satellite sensors (Chen et al., 2004; Xu et al., 2008).

Our previous study near the Zhujiang River estuary (Lee et al., 2023) revealed distinct characteristics in the particulate and dissolved matter between the proximal ZRP and surrounding marine waters.

However, it remains unclear whether the biogeochemical distinctions associated with the ZRP are preserved as it spreads across the NSCS shelf under strong physical processes, including basin-wide circulation, upwelling, and nonlinear internal waves (Alford et al., 2015; Feng et al., 2021; Gan et al., 2022; Guo et al., 2014; Jing et al., 2009; Lee et al., 2021; Su, 2004). To improve our understanding of particle transport on the NSCS shelf, this study addresses three key questions:

1. How do hydrodynamic processes influence the distribution of particulate matter in a river-dominated shelf system?
2. What biogeochemical signatures of suspended particles are preserved within the ZRP along its dispersal pathway, and to what extent can these signatures be traced downstream toward the distal end?
3. Since dissolved tracers (e.g., N/P) are widely used but often diluted or biologically consumed over long transport distances, can particulate-based properties (e.g., $\delta^{13}C_{POC}$) provide alternative indicators of river plume influence and associated biogeochemical processes on the NSCS shelf?"

L88-L90: I found the statement to be unclear and vague. What exactly do you mean by "complexity"? There are several statements in the text that are similarly ambigous and require more specific

Reply: We thank the reviewer for pointing this out. Accordingly, we revised the text with a more specific description, as noted in our previous response.

"…In addition, coastal hydrodynamics can modify the physicochemical properties of suspended particles (Eisma, 1986; Manning et al., 2010). Turbulence induced by waves and currents enhances the exchange of materials with surrounding waters by promoting aggregation and deflocculation of suspended particles. (Cross et al., 2014; Jago et al., 2006; Petersen et al., 1998). Therefore, the original characteristics of POM are difficult to preserve throughout the routing system…."

L90: from -> induced by

Reply: We revised the text accordingly.

"…Turbulence induced by waves and currents enhances the exchange of materials…"

L96-L98: It is repetive of first paragraph

Reply: We revised the text to remove repetition and improved clarity. As noted in our previous response, the revised Introduction now eliminates overlap with the first paragraph (please see Revised Introduction above).

L102-L111: Regarding the three questions. I felt they need to be further clarify. For example, in question 2, which asks, "which particles are transported to downstream regions, such as the Taiwan Strait?" It appears that there is no data provided to support claims of POM transport downstream. Question 3: "Can particulate matter … processes?" The questions seems somewhat lacking in significance. It is a well-known fact that POM is impacted by water mass transport and biogeochemical processes. Therefore, please clarify what you specifically intend to ask.

Reply: Our intention was not to claim direct observational evidence of POM transport into the Taiwan Strait. Rather, by integrating results from previous upstream studies (Lee et al., 2021; Lee et al., 2023) with the present dataset, we aim to examine the upstream-downstream linkage of particle transport along the ZRP pathway. Based on these comparative analyses, we can infer whether certain particle signatures are likely to persist and potentially be transported further downstream toward the Taiwan Strait.

For Question 3, we acknowledge that it is well established that POM is influenced by both water mass transport and biogeochemical processes. The specific point we intend to raise is whether POM can serve as an alternative tracer of riverine water mass during long-distance transport, given that commonly used dissolved indicators (e.g., N/P ratio) are progressively diluted or biologically consumed along the dispersal pathway.

To clarify our research framework, we have revised the questions as follows:

Line 102-111:

1. How do hydrodynamic processes influence the distribution of particulate matter in a river-dominated shelf system?
2. What biogeochemical signatures of suspended particles are preserved within the ZRP along its dispersal pathway, and to what extent can these signatures be traced downstream toward the distal end?
3. Since dissolved tracers (e.g., N/P) are widely used but often diluted or biologically consumed over long transport distances, can particulate-based properties (e.g., $\delta^{13}C_{POC}$) provide alternative indicators of river plume influence and associated biogeochemical processes on the NSCS shelf?"

2. Materias and methods

Figure 1. Observation period - > Observational period. Figure 1c illustrates the 2018 typhoon case; however, the shape of the plume typically changes significantly before, during and after a typhoon. It appears that Figure 1c represents the conditions prior to the typhoon. To clarify this distinction, it would be beneficial to include wind vectors in the figure.

Reply: We thank the reviewer for this helpful comment and concur that the dispersal of the river plume is highly sensitive to wind forcing. As noted, wind vectors are already shown in Fig. 1c and Fig. 1f in the original manuscript. To avoid potential misunderstanding, we have revised these panels to display the average wind field during our observation period and updated the figure caption accordingly.

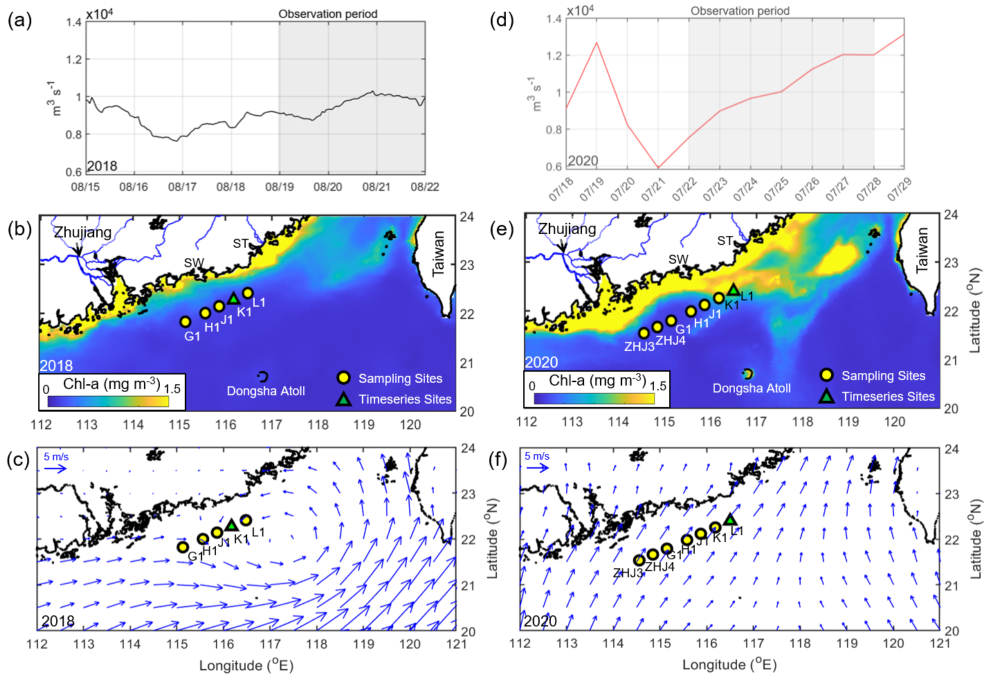

Figure 1. Environmental conditions during the observational periods. Panels (a, d) show Zhujiang River discharge, (b, e) MODIS ocean color images, and (c, f) average 10-m wind fields. Data from 2018 are shown on the left and from 2020 on the right. Gray shading in the river discharge panels indicates the cruise observation periods. The color scale in the MODIS images represents Chl-a concentration; values were averaged over the cruise to represent mean distributions in the NSCS during the observation. "SW" and "ST" mark Shanwei and Shantou, respectively. Arrows in the wind field panels indicate wind speed and direction, averaged over the cruise periods. Yellow circles and green triangles denote hydrographic stations, with the latter representing time-series stations. River discharge data were obtained from the Pearl River Water Resources Commission, satellite data from NASA Worldview (https://worldview.earthdata.nasa.gov/), and wind field data from ECMWF ERA5 reanalysis (https://www.ecmwf.int/en/forecasts/dataset/ecmwf-reanalysis-v5).

2.2 Water stratification

E represents the brunt vasala frequency, a commonly known factor used to measure the strength of stratification. It would be more appropriate to refer to it as BVF for clarity

Reply: We concur with the reviewer that the Brunt-Väisälä frequency (BVF) is a widely recognized measure of stratification strength. The E-value used in our study is mathematically equivalent to the BVF normalized by gravitational acceleration (g). To avoid confusion while maintaining consistency with previous studies that adopted the E-value, we now provide its formal definition at its first occurrence. The revised text is as follows:

Line 159-160: "…Water column stability was quantified using a static stability index, E (equivalent to the Brunt-Väisälä frequency normalized by gravitational acceleration), a widely used metric for assessing stratification influenced by freshwater input in nearshore environments…"

L177: There should be a space between the notation ± and the number that follows it

Reply: We revised the text accordingly. (e.g., ± 0.02 μmol L^{-1})

L237: The interval of the ECMWF wind data should be specific. Is it provided hourly or every 3hr?

Reply: The ECMWF wind data were provided at hourly intervals. We have added further information in the revised manuscript.

Line 236-238: "…Wind field data at 10 m above the surface were sourced from the ECMWF ERA5 reanalysis product with a spatial resolution of 0.25° × 0.25° and an hourly temporal resolution…"

3. Results

3.1 River runoff and hydrographic changes on the NSCS shelf

L250-L253: I do not understand why mention "the additional mechiansms" here. It was quite obvious the distribution of the river plume was the determined by the wind conditions, especially for your observational period. It was determined by

the episodic wind. The mentioning of dam and climate oscillation make the satements very diverge and lack of logic conherence.

Reply: We consent with the reviewer's comment. Further discussion of artificial regulation by dams and climate variability could distract from the main interpretation. We have therefore removed this part from this description.

L256: I am curious about the precipitation mechanism. While a typhoon can indeed bring heavy rainfall, it moves through the region quickly. Therefore episodic rainfall may not have a significant impact on the upper layer sea surface salinity.

Reply: We appreciate the reviewer's insightful question regarding the precipitation mechanism. While tropical cyclones move rapidly through the region, recent studies indicate that weaker and faster-moving storms can still produce detectable freshening signals in sea surface salinity (SSS) due to rainfall (Reul et al., 2021). In contrast, stronger and more slowly moving tropical storms tend to cause salinification as a result of vertical mixing and upwelling. We have added the supporting reference (Reul et al., 2021) to the revised manuscript.

Line 255-257: "…Salinity profiles in 2018 indicated the presence of fresh water (salinity 33-34) in the upper water column, primarily due to heavy precipitation induced by a tropical depression (Fig. 1c, Fig. 2a, and Appendix Fig. A2; Reul et al., 2021)…"

Reference:

Reul, N., Chapron, B., Grodsky, S. A., Guimbard, S., Kudryavtsev, V., Foltz, G. R., & Balaguru, K. (2021). Satellite observations of the sea surface salinity response to tropical cyclones. Geophysical Research Letters, 48, e2020GL091478. https://doi.org/10.1029/2020GL091478

L282: Potential regions for the high N/P ratio at stations ZHJ4 and J1 should be provided.

Reply: At station J1, the P concentration was below the detection limit, and therefore the N/P ratio should also be marked as uncertain (has been marked in gray color as the following revised table). At station ZHJ4, the P concentration was similarly low and close to the detection limit, which explains the unusually high N/P ratio observed in the surface waters. However, the salinity at these sites (~34.18) was comparable to that of ambient seawater, suggesting that the direct influence of the Pearl River was unlikely the main driver. Instead, such high N/P ratios may reflect local processes such as preferential biological uptake of phosphate, particle adsorption of P, or additional nitrogen inputs from atmospheric deposition. As our dataset does not allow these mechanisms to be distinguished, we have added a brief clarification but avoided further speculation in order to maintain focus on the main objectives of this study.

Line 281-282: "…Exceptionally high N/P values were observed in 2020 (e.g., 89.47 at Station J1), which could be attribute to preferential biological uptake of phosphate, particle adsorption. Conversely…"

N/P Ratio	ZHJ4	J1	L1(ZRP)
Surface	88.43	89.47	14.01
Middle	23.18	15.10	13.99
Bottom	14.64	11.43	38.02
N (μM)			
Surface	0.60	0.37	5.11
Middle	4.05	2.39	3.48
Bottom	5.56	4.18	2.13
P (μM)			
Surface	0.01	0.00	0.37
Middle	0.17	0.16	0.25
Bottom	0.38	0.37	0.06
Sal			
Surface	34.180	34.182	31.628
Middle	34.498	34.232	34.389
Bottom	34.538	34.552	34.501

Table 1. N and P concentrations, derived N/P ratios, and water salinity at Stations ZHJ4, J1, and L1.

3.2 Contrasting POM feathers in the shelf system.

L303-L305: Once again, I feel that the stament regarding the ECS is distracting in the context of the NSCS. Again, I felt the stament about the ECSF was distractive with the facts of NSCS. Although it was important to compare what you found with previous studies, but are they sharing the same mechanisms or not, why they are similar. You should be more clearly to describe the linkage.

Reply: We appreciate the reviewer's comment and agree that the previous description about the East China Sea (ECS) was not sufficiently linked to the NSCS case, which may have been distracting. In the revised manuscript, we have clarified the connection by emphasizing that both regions exhibited depleted $\delta^{13}C_{POC}$ values in the SCM primarily due to phytoplankton growth dynamics and isotopic fractionation, even though the physical settings differ. This revision makes the ECS comparison more directly relevant, highlighting the shared mechanism while maintaining the NSCS as the main focus.

Line 303-305: "…Similar $\delta^{13}C_{POC}$ depletion has also been reported on the East China Sea shelf (ECS), where it has been attributed to changes in phytoplankton size composition and the intrusion of offshore water (Liu et al., 2018c). Although the physical setting differs between the ECS and the NSCS, the resemblance in $\delta^{13}C_{POC}$ results highlights that phytoplankton dynamics and isotopic fractionation can produce comparable signals across marginal seas (Close et al., 2020; Liu et al., 2022). This suggests that the depleted $\delta^{13}C_{POC}$ observed in the SCM of the NSCS is likewise driven by *in-situ* phytoplankton processes rather than by direct terrestrial inputs."

References

Close, H. G., & Henderson, G. M. (2020). Open-Ocean Minima in $\delta^{13}C$ Values of Particulate Organic Carbon in the Lower Euphotic Zone. Frontiers in Marine Science, 7, Article 604165. https://doi.org/10.3389/fmars.2020.604165

Liu, Q., Kandasamy, S., Zhai, W., Wang, H., Veeran, Y., Aiguo Gao, et al. (2022). Temperature is a better predictor of stable carbon isotopic compositions in marine particulates than dissolved CO_2 concentration. Communications Earth & Environment, 3, Article 303. https://doi.org/10.1038/s43247-022-00627-y

4. Discussion

I do not think the results were organized appropriately. Some of the materials should belong in the methods section, while others are more suited for the results section. The discussion section should have deeper analysis of the mechainsms and a comparison with previous work, highlighting what is new in your findings. However, based on the descirptions provided, it feels like all the findings have been previously reported, which raises concerns about what is new.

Reply: In response to the reviewer's constructive comment, we reorganized the structure accordingly to improve clarity. For example, Lines 355-372 have been moved to the Methods section and Lines 373-430 to the Results section.

We emphasize the following contributions of our work:

1. We demonstrate that episodic rainfall and plume dispersal distinctly modulate particle distributions in the NSCS, as reflected in the variability of particle size, bulk density, and biogeochemical characteristics.
2. We report exceptionally low $\delta^{13}C_{POC}$ values in the SCM of the NSCS, which has rarely been characterized in this region.
3. While the N/P ratio is commonly used to trace the ZRP in its proximal region, we

show that $\delta^{13}C_{POC}$ provides a more reliable indicator during long-distance transport. Importantly, the $\delta^{13}C_{POC}$-salinity relationship is negative, rather than the commonly reported positive trend.

These points are emphasized in the Results and Discussion sections, clearly distinguishing our study from previous work and highlighting its contributions to understanding particle dynamics in the NSCS. The relevant descriptions in the main text are provided below:

Line 433-443: "Salinity and temperature are key factors influencing water stability in coastal environments, with salinity serving as a primary driver of stratification (Maes et al., 2014). In 2018, stratification was notably enhanced due to the formation of a low-salinity surface layer across the shelf (Fig. 2a, c). Satellite data indicated that increased rainfall led to lower surface salinity in the region (Appendix Fig. A2). In contrast, stratification along the transect in 2020 was relatively weak ($E < 5 \times 10^{-3}$), despite the presence of warm surface water (Fig. 2f, g). Nevertheless, the ZRP transported low-salinity water along its pathway, enhancing stability at the surface of Station L1 (Fig. 2e, g) and causing the halocline to shoal to depths shallower than 25 m."

Line 473-480: "…The lower PC ratio and particle bulk density in the SCM suggest the presence of relatively fresher bio-particles compared to those in the ZRP (Appendix Fig. A6). The depleted $\delta^{13}C_{POC}$ in the SCM may result from factors such as phytoplankton size composition and biological metabolism under conditions of low dissolved CO2 concentration (Close et al., 2020; Law et al., 1995; Liu et al., 2018c; Miller et al., 2008). Although low $\delta^{13}C_{POC}$ values are traditionally considered indicative of terrestrial input (Cai et al., 1988), misidentification of POM sources can occur without multivariable constraints (Lee et al., 2023)…"

Line 280-281: "The N/P ratio, a conventional indicator of the water mass, generally remained below 15 along the transect for both years (Table 1). " and Line 589-591: "In contrast, the N/P ratio exhibited minimal variability, limiting its effectiveness as a conventional tracer of the ZRP spreading. "

4.1 Co-variability among properties of water masses and particles:

L355-L372: I think this should belong to the method part.

Reply: We concurred and relocated this part to the Methods section for clarity.

L373-L430: Should belong to the result part

Reply: We concurred and relocated this part to the Results section for clarity.

L370: "below 0.1 were considered insignificant". Statistical rational for excluding values below 0.1 threshold should be given.

Reply: We thank the reviewer for pointing out the need for clarification. Our intent was not to apply a strict statistical test but rather to provide a practical reference threshold to indicate when a variable is negligible in a given EOF mode. In EOF analysis, eigenvector values close to zero represent minimal contributions of that variable to the corresponding mode, indicating weak similarity with the overall eigenweighting pattern (see Figure. 2 for an example). In our results, no more than one variable per mode showed such near-zero values, while all others contributed substantially. To avoid over-interpretation of these negligible values, we adopted a reporting threshold of 0.1 for clarity. We have revised the text to clarify this point and avoid potential misunderstanding.

Line 369-370: "…Variables with eigenvectors close to zero were regarded as negligible in this study to avoid over-interpretation of negligible contributions (e.g., fluorescence)…"

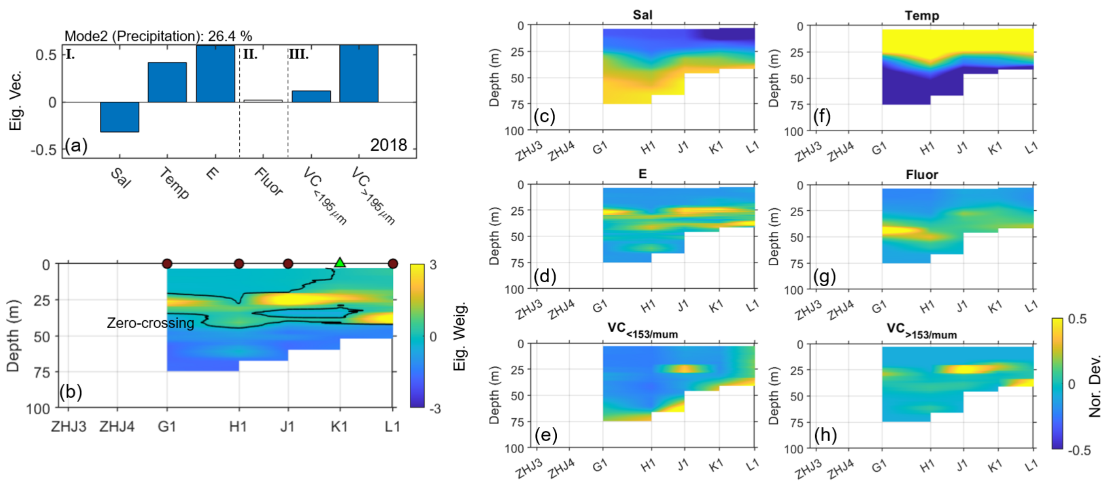

Figure 2: Results of the 2nd mode in the EOF analysis for the 2018 measurements. (a) Eigenvectors of salinity (Sal), temperature (Temp), static stability index (E), fluorescence (Fluor), and volume concentrations of particles smaller than 153 μm ($VC_{<153\mu m}$) and larger than 153 μm ($VC_{>153\mu m}$). (b) Vertical structure of the corresponding eigenweightings, with the zero-crossing marked with a black line. (c-h) Normalized deviations of each variable used in the EOF analysis, highlighting the contributions of salinity, temperature, E, fluorescence, and VCs in different size classes to this mode.

4.2 Partical distribution assoicate with water stratification

L424-L445. I do not understand the logic behind mentioning your finding that "the highest concentrations of coarse particles were observed within strongly stratified layers" in conjuction with the previous work of Tian et al. (2022). Are these findings the same, only documented in a different coastal region? If so, it would be helpful to clearly articulate the connections or similarities between the studies and explains how they contributed to the broader understanding of this phenomenon. Clarifying the relevance and implications of these findings would greatly enhance their significance.

Reply: We appreciate the reviewer's insightful comment. We agree that citing Tian et al. (2022) was not appropriate in this context, as our observed INL was primarily associated with density stratification rather than internal wave processes. To avoid confusion, we have removed this citation from the revised manuscript. The mechanism relevant to our findings is clarified in the original main text.

Line 450-451"… Material accumulates at the pycnocline in our work due to strong vertical density gradients …."

Section 4.2 and 4.3: I don't think the mechanisms were fully explored in these two sections. For example, the title of the paper is "Tracing Water Mass and Particle Dispersion on the Northern South China Sea Shelf Using POM Signatures under Contrasting Wind Conditions: A New Perspective" While the 2018 case focused on typhoon-induced rainfall changing stratification, the mechanisms mentioned primarly was about typhoon-induced rainfall. However, there is little discussion regarding the impact of winds? Typhoons can induce on-offshore winds in the region you studied, as well as stong vertical mixing. It is important to explore how these wind conditions might affect the distribution of particles and POM. A more comprehensive discussion of these factors would provide a clearer understanding of the overall dynamics.

Reply: We agree that the current title using "Contrasting Wind Conditions" may not accurately reflect our findings. In the 2018 case, our hydrographic and particle datasets did not reveal a significant response to wind forcing. Instead, the dominant signal was rainfall-induced stratification associated with the tropical depression, which controlled particle aggregation and the formation of the INL. The wind field in our analysis was considered primarily in terms of its direction, which influenced whether the ZRP could be transported northeastward, and we did not observe clear evidence of wind-induced vertical mixing in the hydrographic profiles. To avoid misleading readers, we have revised the title to "Contrasting Weather Conditions," which we believe more appropriately represents our observations.

L456: vertical transport of particulate matter, is it associated with typhoon induced strong vertical mixing?

Reply: We appreciate the reviewer's question. The results at Station K1 correspond to the observations in 2020, when prevailing southwesterly winds dominated and no tropical depression or typhoon events were present. Therefore, the observed vertical redistribution of coarse particles is not attributable to wind-induced mixing. Instead, it reflects the contrasting hydrographic setting between K1 (located off the main dispersal pathway of the ZRP) and L1 (situated along the core of the ZRP). At K1, water stratification contributed by the river plume was weaker, which facilitated vertical exchange of particulate matter. We have added further description to clarify this point.

Line 454-458: "…In areas adjacent to the ZRP, such as Station K1, coarse particles were vertically redistributed throughout the water column (Fig. 6d and 10c, d). This redistribution is attributed to the weaker freshwater-induced stratification at K1, which is located off the main dispersal pathway of the river plume and thereby allowed enhanced vertical transport of particulate matter. This interpretation is consistent with the findings that the strength and spatial distribution of plume-induced stratification are key factors in regulating the vertical exchange of marine substances…"

L459-L463: The discussion may have diverged from the central theme of your study, particularly regarding the "Contrasting Wind conditions." If your research focuses on how different wind conditons impact mechanisms such as particulate dispersion and water mass dynamics, then bringing in topics like dam impacts and climate variability may seem off-topic or overly broad.

Reply: We appreciate the reviewer's constructive comment and agree that the original discussion of dam regulation and climate variability was too broad in the context of our study. Our analysis focuses on wind direction and its role in regulating water stratification, rather than on wind intensity-driven mixing. Accordingly, we have revised the title from "Contrasting Wind Conditions" to "Contrasting Weather Conditions," which more accurately reflects the emphasis of this study.

In the revised text, we have streamlined the discussion by removing details on dam regulation, while retaining the reference to ENSO-related variability to emphasize that increased river discharge under climate variability may enhance nearshore stratification and thereby influence particulate dispersion. For example:

Line 459-463: "…Beyond this local setting, increased river runoff associated with climate variability (e.g., ENSO) may further intensify stratification in nearshore regions, which in turn alters the balance between vertical exchange of particulate matter."

We also revised description at L547-548 in the original manuscript

Line 547-548: "Climatic variability could further alter particle distribution and biogeochemical responses on the NSCS shelf by inducing rapid fluctuations in Zhujiang River discharge and sediment load, which in turn affect freshwater dispersal, nutrient delivery, and suspended particle dynamics."

L482-L487: Again, the discussions may have strayed from a direct connection to your study's results, specifically regarding the comparisons made with Xu et al.(2022). If their study focused on offshore dynamics while your research is centered on inshore conditions, it is important to clearify the implications of this distinction. For example, provide specific mechianms or observations that differ between the two studies. Discuss any varing hydrodynamic conditions, stratification patterns, or particle types that might lead to different outcomes.

Reply: We thank the reviewer for this valuable suggestion. In the original version, the comparison with Xu et al. (2022) was too general. We have revised the text to clarify the distinction between our shelf-based observations and their offshore findings. Specifically, our results show the SCM located below the pycnocline and dominated by fine particles. By contrast, Xu et al. (2022) reported SCMs above the pycnocline in offshore waters, likely influenced by mesoscale dynamics (e.g., eddy-induced isopycnal displacement) and stronger nutrient limitation. We now emphasize that inshore SCMs are strongly coupled to local water stratification, whereas offshore SCMs are more sensitive to mesoscale and open-ocean nutrient constraints. The revised text highlights this distinction of SCM formation across the SCS.

Line 481-487: "…The SCM is typically found near the pycnocline, where nutrient enrichment and optimal light conditions favor phytoplankton growth (Lu et al., 2010). The VC profile (Fig. 10a, b and Appendix Fig. A5) revealed that the SCM was located below the pycnocline and primarily consisted of fine particles (<10 μm), consistent with previous reports (Chen et al., 2021; Liu et al., 2016; Ning et al., 2004; Williams et al., 2013). By contrast, Xu et al. (2022) observed SCMs above the pycnocline in offshore waters, where physical processes such as eddy-induced isopycnal displacement and stronger nutrient limitation are thought to shape the vertical distribution of the SCM. This contrast highlights that inshore SCMs are strongly coupled to local water stratification, whereas offshore SCMs are more sensitive to mesoscale dynamics and open-ocean nutrient constraints, underscoring the spatial heterogeneity of SCM formation across the SCS."

5. Concusions:

L579-L581: It seems your results do not specifically address or demonstrate transport to the Taiwan Strait

Reply: Our intention was not to claim direct observational evidence of particle transport into the Taiwan Strait. Rather, by integrating results from previous upstream studies (Lee et al., 2021; Lee et al., 2023) with the present dataset, we aim to examine the upstream-downstream linkage of particle transport within the northeastward ZRP pathway. Based on these comparative analyses, we infer that certain particle signatures are likely to persist and potentially be transported further downstream toward the Taiwan Strait. To avoid any misunderstanding, we have revised the statement as follows to clarify this point.

Line 579-580: "…Our findings indicate that the ZRP plays a key role in transporting riverine nutrients and marine-sourced biogenic particles down the pathway, where their signatures may persist and contribute to sediment composition and coastal biogeochemistry, with the potential to extend toward the Taiwan Strait…."