Response to Reviewer 1

RC1: 'Comment on egusphere-2024-3289', Anonymous Referee #1, 01 Dec 2024

Dear Reviewer:

We greatly appreciate the time you spent reviewing our manuscript and providing constructive comments and minor revisions. We have made revisions in response to your suggestions.

Comment:

This study investigated the wind and wave effects on the dispersal of the Pearl River-derived sediment using a coupled numerical model. The results demonstrated the crucial role of wind in the westward along-shelf transport of the riverine sediments and the formation of the mud belt along the coasts. The diagnostics of cross-shelf current and suspended sediment concentration revealed the mechanism of winds in the formation of along-shelf currents, vertical mixing, and resuspension of sediment. This work is valuable for understanding the transport processes of the Pearl River sediment and the manuscript is well written. Therefore, I recommend publication of the manuscript after minor revision.

Response:

We very appreciate your comments for our manuscript. These comments and insights are helpful for improving the quality of our paper. We address your comments point-by-point as follows. We thank you for your constructive comments.

Comment:

Were winds and waves included om the ramp simulation from Jan.1, 2016 to Apr. 1, 2017? The initial bed sediment distribution would be different for the two case simulations. Which case Figure 2 represents for?

Response:

Thank you for your comment. Yes, winds and waves were incorporated into the ramp simulation from January 1, 2016, to April 1, 2017. This period was selected to ensure that the model reached dynamic equilibrium before the main simulation phase. In total, we conducted seven cases: one Control case and six Sensitivity cases. Figure 2 presents the spatial distribution of seabed sediment fractions at the end of the spin-up phase in the Control run on April 1, 2017. This simulation accounts for winds, tides, waves, ambient shelf currents, and seasonal variations in critical erosion stress (i.e., increased critical erosion stress during winter). The same initial bed sediment distribution was applied to all seven cases. We have clarified this in the revised manuscript to ensure transparency and eliminate any ambiguity.

Comment:

The critical shear stress chosen for clay is large. Although clay is cohesive, the large critical shear stress would restrict the transport of clay on the shelf and the riverine clay actually represents riverine sand. Comparing the initial prototype of bottom sediment with that after realistic reworking, the changes in slit component is the most significant because of the low critical shear stress.

Response:

Thank you for your valuable suggestion regarding the critical shear stress for sediment. In our initial setup, the critical shear stress was determined based on previous literature and model calibration. However, we acknowledge that this approach may have limitations, particularly in capturing seasonal variations in sediment properties. Observations, laboratory experiments, and numerical sensitivity analyses from prior studies have demonstrated that the critical shear stress of sediments in the Pearl River Estuary is higher in winter than in summer.

In response to your insightful comment, we have conducted additional numerical experiments incorporating seasonal variations in critical shear stress. The results reveal that the bed sediment grain size distribution after realistic reworking is now significantly closer to the initial prototype compared to our previous simulations, which did not account for such temporal variability. This improvement underscores the importance of considering seasonal changes in sediment properties for accurately modeling sediment dynamics. Specifically, the revised results highlight that the silt component, characterized by a lower critical shear stress, undergoes the most significant changes, aligning more closely with observed patterns.

To further address this issue, we have revised our study and designed seven numerical cases. Six of these cases incorporate seasonal variations in critical erosion shear stress, while one case excludes this variation to analyze its impact on the ultimate fate of riverine sediments in the Pearl River Estuary. These updates have been integrated into the manuscript, along with a detailed discussion of their implications. Your feedback has greatly enhanced the robustness of our study, and we sincerely appreciate your contribution.

Comment:

Line 374-376. The westward extension of Peral River plume is more significant than the eastward extension. Also see the salinity distribution in Fig. 5a.

Response:

Thank you for your comment. The primary reason for this is that our previous analysis focused on the vertically averaged salinity field. In the revised manuscript, we now present both surface and bottom salinity fields. The surface salinity field more clearly highlights the significant eastward expansion of the plume. We have made the necessary modifications to the manuscript accordingly.

Comment:

Figure 3. The source and location of wind, air temperature and wave measurements need to be presented.

Response:

Thank you for your suggestion. The wind and air temperature data are sourced from NCEP, while the wave measurements are not based on observations but are derived from model results. We have clarified this in the manuscript.

Comment:

Line 614-618 and Figure 8. The eastward transport of sediment is significant when winds and waves were not imposed in the model. It should be aware that the wind-driven northeastward shelf currents can be introduced from the open boundaries that were extracted from HYCOM that contains winds. Because the riverine sediment input is large in wet season and there is no wind/wave induced resuspension in dry season, the yearly averaged sediment flux has a strong northeastward component.

Response:

Thank you for your invaluable feedback, which has significantly strengthened our study. In response to your comments, we have conducted seven additional numerical simulations to systematically evaluate the relative contributions of tides, waves, ambient shelf currents, seasonal variations in critical erosion stress, settling velocity, and the initial bed grain size distribution to the transport and dispersal of Pearl River-derived sediments. These simulations include one Control case and six Sensitivity cases. In our initial simulations, we inadvertently overlooked that the HYCOM-derived flow fields already account for the influence of monsoon-driven currents, South China Sea Warm Current (SCSWC), and Kuroshio intrusions on shelf circulation. This includes the strong northeastward currents in summer and the weaker northeastward or southwestward currents in winter. To address this, we have refined our approach in the NAS case (i.e., no ambient shelf currents) by excluding HYCOM-derived water levels and velocities. This adjustment allows for a clearer assessment of the influence of South China Sea (SCS) circulation while eliminating potential inaccuracies arising from monsoon-driven currents and Kuroshio intrusions. As a result, our model now provides a more accurate representation of the underlying physical processes. We believe these revisions enhance the robustness of our findings, and we sincerely appreciate your insightful suggestions.

Response to Reviewer 2

RC2: 'Comment on egusphere-2024-3289', Anonymous Referee #2, 22 Jan 2025

Summary and General Comments:

Dear Reviewer:

We greatly appreciate the time you spent reviewing our manuscript and providing constructive comments. We have made revisions in response to your suggestions. Now we have conducted seven numerical simulations to systematically evaluate the relative contributions of tides, waves, ambient shelf currents, seasonal variations in critical erosion stress, settling velocity, and the initial bed grain size distribution to the transport and dispersal of Pearl River-derived sediments. These simulations include one Control case and six Sensitivity cases.

Comment:

I do not feel that the paper in its current form meets the standard expected for publication in Ocean Science. My general reasons are (1) some of the analysis seem poorly justified and detract from the main findings; (2) the organization should be improved to better communicate major findings; (3) the skill assessment has geographic and temporal limitations; and (3) the findings are not generalized to other systems. Despite these shortcomings, the paper has potential. The model quantifies suspended sediment dispersal on the shelf off the Pearl River Estuary (PRE) and compares dispersal during summer (wet season) and winter (energetic season). The authors explore the roles of winds and waves by comparing “Case 1” (includes winds and waves) to “Case 2” (neglects winds and waves); but the presentation of this could be improved.

Response:

We sincerely thank you for dedicating your valuable time and sharing your professional insights during the review of our manuscript. Your thoughtful comments have been instrumental in improving the quality of our paper and advancing its contribution to the academic community. Below, we provide a detailed, point-by-point response to your suggestions. We are deeply grateful for your constructive and insightful comments.

Comment:

Below are general points that if addressed would strengthen the paper.

Most sections of the Results include both “Case 1” and “Case 2”, and consideration of the wind/wave effects are interspersed with the seasonal variations and annual averages. For example, Figure 4g,h (section 4.1) has the impact of winds and waves. Then, Section 4.3 shows the annual averages for both Cases 1 and 2. The analyses would be clearer if the comparisons between Cases 1 and 2 were in one section.

Response:

Thank you for your insightful suggestion. We agree that organizing the comparisons between cases within a single section will enhance clarity and readability. In response, we have restructured the Results section to more clearly distinguish between seasonal variations, annual averages, and the Sensitivity cases.

Comment:

Discussion Section 5.1 does not seem to contribute to the main conclusions, and does not seem to yield general knowledge for river-influenced shelves. My suggestion is to remove or shorten this section unless it is better justified.

Response:

Thank you for your valuable suggestion. We have removed Section 5.1, as its content was not closely aligned with the main focus of this study and did not directly support our key findings. We agree that this section lacked significant insights for river-influenced shelves, and its removal enhances the clarity and focus of our discussion.

Comment:

Hydrodynamics: This section estimates idealized geostrophic velocities (Figure 11) and thermal wind shears (Figure 12). These analyses were unclear, and they complicate the paper and do not seem well justified. The numerical model solved the full momentum equations which would include the geostrophic and the thermal wind dynamics. What is gained from these analyses that are useful for the PRE and extendable to other locations?

Response:

Thank you for your valuable feedback. We acknowledge that the analyses of idealized geostrophic velocities and thermal wind shears may have complicated the manuscript and lacked clear justification. In response to your suggestion, we have removed this section from the revised manuscript to improve clarity and focus on the key findings. We appreciate your insightful comments, which have helped us to refine our study.

Comment:

Sediment Transport Analysis: Equation 2 provides the transport equation for suspended sediment. The annual averages of three of these terms are shown in Figure 13, but it is unclear how these were calculated. For example, HADV, units of mg/L/s, does this represent both the u- and v-component? Is it vertically averaged? Similar for the settling and resuspension terms: are these vertical averages? Near-bed values?

Response:

Thank you for your insightful comments. HADV represents the total horizontal advection of suspended sediment, incorporating both the u- and v-components. All the terms previously presented in Figure 13, including horizontal advection (HADV), settling, and resuspension, are vertically averaged values. However, we now realize that this section is not closely aligned with the main focus of our study. We have therefore removed this section to ensure that the manuscript emphasizes our primary findings more clearly.

Comment:

Lines 714 – 717 are somewhat general statements instead of building on the analyses presented in this section.

Response:

Thank you for your suggestion. We have now removed this content.

Comment:

Discussion Section 5.2 should do a better job of extending this study within the literature. The authors cite papers but often do not provide the context. For example, Line 723 states that most of the Pearl River sediment stays near the estuary. Walsh's and Hanebuth's papers are cited, but this study is not related to the conceptual frameworks in these papers. Line 741 mentions a "12 km threshold" without any context. Lines 747 – 752 make an interesting point, that Walsh' framework may not be directly suitable for monsoonal systems, particularly when the sediment delivery does not coincide with energetic conditions. This might be expanded and explained.

Response:

Thank you for your constructive feedback. We have made appropriate revisions to Section 5.2 to better contextualize our citations. We believe these modifications enhance the clarity and depth of our discussion.

Comment:

The conceptual model (Figure 14) presents schematics of dispersal dynamics under "normal" conditions (the annual-average?), and of a "no wind no waves" scenario. Figure 14 shows the idealized "no wind no waves" scenario, and the annual average that may not represent "normal conditions" because of the monsoonal nature. A conceptual model that compared the summer (high discharge, low wind/waves) to winter (low discharge, energetic winds/waves) would be interesting.

Response:

Thank you for your insightful comment. We acknowledge your point and agree that our previous conceptual model may not have adequately captured the monsoonal variability. In response, we have removed the original conceptual diagram to better align with the study's focus.

Comment:

The model grid extending from Taiwan to the Beibu Gulf. The authors demonstrate model skill in the “Near” region of the model, and no observations from the “Western” or “Beibu Gulf” regions are shown (see Figure 1 for locations). Observations are limited to two months for water level and waves (Figure S1), and one week for S/T/SSC (Figure S2). However, the paper’s most interesting findings rely on the seasonal differences in hydrodynamics and sediment dispersal, and on delivery of sediment to distal regions such as Beibu Gulf. The model results would be more definitive if stations further from PRE were included, and if annual cycles were considered for at least some values (such as water level and wave height).

Response:

Thank you for your valuable comments. We sincerely appreciate your suggestions and have taken steps to enhance the validation of our model results. First, we would like to clarify that the water level validation in the Pearl River Estuary (PRE) region we previously presented already covered a full year (12 months). In response to your suggestion, we have now included additional validation at stations farther from the PRE. Specifically, we have added water level validation (12 months) at two stations: Zhapo in the "Western" region and Qinglan in the "Distal" region. Additionally, we have incorporated a 38-day mooring-based current velocity validation in the "Southwestern" region and a one-week wave validation in the "Beibu Gulf" region. We hope these additional validations strengthen the reliability of our study’s findings and provide a more comprehensive assessment of the model’s performance. Thank you again for your insightful feedback.

Comment:

Figure S3 shows model skill for several stations that are near the PRE. These observations from August 2017 were used to justify model parameters, but sediment characteristics may vary seasonally. The paper would benefit from consideration of how uncertainties in sediment characteristics (settling velocities, critical shear stresses) propagate into uncertainties in their conclusions.

Response:

Thank you for your valuable suggestion. Now we have conducted seven numerical simulations to systematically evaluate the relative contributions of tides, waves, ambient shelf currents, seasonal variations in critical erosion stress, settling velocity, and the initial bed grain size distribution to the transport and dispersal of Pearl River-derived sediments. These simulations include one Control case and six Sensitivity cases. We have now incorporated the seasonal variation of sediment characteristics in six simulation cases, specifically by increasing the critical shear stress for sediment erosion during winter, based on findings from previous studies. Exp 5 (NVS) was identical to Control case, except that it did not account for the seasonal variation in critical erosion stress, keeping the winter and summer values the same. Exp 6 (DSV) was identical to Control case, except that it sets a double sediment settling velocity of the Control case. Additionally, we have analyzed these results and included a discussion in the main text to assess their impact on our conclusions. We appreciate your insightful feedback, which has helped improve the robustness of our study.

Comment:

In many places the text is overly vague; including Section 5.3. Some examples are given below,

Specific Comments (by line number in the preprint)

The Introduction should better motivate the study and analyses. Many of the references are cited with no summary or context, making it difficult to see how this builds on past studies. The introduction should especially provide stronger motivation for the focus on winds and waves (Lines 78 – 79); and better place the regional setting of the PRE Shelf within the context of past research of the behavior of freshwater and sediment plumes under different wind and wave conditions.

Response:

Thank you for your helpful suggestion. We have made the corresponding revisions. Below is the rewritten version of **The Introduction**:

"***Introduction***

The transport process of suspended sediment from river source to ocean sink is an important link in the global material cycle (Kuehl et al., 2016;Liu et al., 2016;Cao et al., 2019). Much of the riverine sediment is trapped on the shallow shoals in estuaries, while the rest is transported by river plume out of the estuary (Meade, 1969;Burchard et al., 2018;Zhang et al., 2019). The riverine sediment carried by the river plume has a significant impact on the water quality, ecology, and geomorphology of the estuaries and continental shelves (Wright and Coleman, 1973;Turner and Millward, 2002).

The transport and deposition of riverine sediments from river source to estuarine, coastal, and shelf environments are governed by various physical processes, including tidal forces, wave action, and shelf circulation dynamics (Gao and Collins, 2014). Tides play a critical role in estuarine sediment transport dynamics, as spring tides typically produce higher bed shear stress, enhanced sediment resuspension, and greater offshore sediment transport flux compared to neap tides (Bever and MacWilliams, 2013;Zhang et al., 2019). In nearshore regions, wave-induced bed shear stress is often an order of magnitude higher than that generated by currents (Xue et al., 2012). Furthermore, wave-driven sediment resuspension frequently exceeds, and is often several times greater than, the peak levels achieved by current-induced resuspension (Sanford, 1994;Brand et al., 2010). In shelf regions, shelf circulations significantly influence sediment transport, with the magnitude of along-shelf transport substantially exceeding the cross-shelf component in most locations (Nittrouer and Wright, 1994;Gao and Collins, 2014).

Furthermore, sediment properties, including settling velocity (Xia et al., 2004;Chen et al., 2010;Cheng et al., 2013), critical shear stress for erosion (Dong et al., 2020), and bed grain size distribution (Xue et al., 2012;Bever and MacWilliams, 2013), significantly influence sediment transport dynamics and deposition/resuspension processes. Settling velocity can influence the location of sediment depocenters, with higher settling velocities leading to more proximal entrapment and vice versa (Ralston and Geyer, 2017). Similarly, critical shear stress for erosion can affect the resuspension of deposited sediment, with higher critical *shear stress resulting in less resuspension and more deposition especially during neap tides and weak wind wave periods (Dong et al., 2020;Choi et al., 2023).*

A comprehensive understanding of sediment transport and deposition from river source to ocean sink requires the integrated consideration of both physical forcing factors and inherent sediment characteristics. Here, we present the transport and deposition of Pearl River-derived sediments on the continental shelf as a case study. The Pearl River, ranking as China's second-largest river in terms of freshwater discharge (Hu et al., 2011), forms the Pearl River Estuary (PRE) in its lower reaches (Figures 1 and S1). Its freshwater and sediment discharge are primarily delivered through eight major outlets (Figure S1b; Wu et al., 2016;Zhang et al., 2019), forming distinct plumes that extend across the northern South China Sea (SCS) shelf. The present average annual (2001-2022) freshwater and riverine sediment loads are 2.74 $\times 10^{11}$ m^3 *and 2.84* $\times 10^7$ *tons, as reported by the Ministry of Water Resources of the People's Republic of China (http://www.mwr.gov.cn/sj/#tjgb). The distribution of these inputs shows significant seasonal variability: approximately 80% of the freshwater and 95% of the sediment load are transported during the wet summer season (April to September), while the remaining portion is discharged during the dry winter season (Xia et al., 2004).*

The northern SCS, shaped by the East Asian Monsoon, displays marked seasonal contrasts, featuring winter monsoon winds averaging 7-10 $m\ s^{-1}$ *and summer winds typically below 6* $m\ s^{-1}$ *(Su, 2004;Ou et al., 2009). This seasonal shift drives coastal currents: northeastward in summer and southwestward in winter (Gan et al.,* *2009;Gan et al., 2013). Beyond the coastal zone, the consistent SCS Warm Current (SCSWC) flows northeastward along the shelf break and inner continental slope toward the Taiwan Strait, originating near Hainan Island and persisting year-round, even during the winter northeast monsoon, across a remarkable distance of 600-700 km to the southern tip of the Taiwan Strait (Su, 2004;Yang et al., 2008).*

The PRE is situated in the central part of the northern South China Sea boundary, positioned between the Taiwan Banks and Hainan Island. The PRE has a micro-tidal and mixed semi-diurnal regime, with daily inequality in the range and in the time between the high and low tides (Mao et al., 2004). The neap and spring tides alternately influence the water elevation downstream of the estuary, with tidal ranges varying from approximately 0.7 m during neap tides to over 2 m during spring tides (Chen et al., 2016;Gong et al., 2018b). The PRE and the nearby shelf exhibit strong seasonal variation in water column stability and are highly stratified during the wet summer season, while the PRE becomes partially mixed or vertically well-mixed during the dry winter season (Dong et al., 2004). Offshore of the PRE region, wave conditions display distinct seasonal patterns: the waves are mild during summer, and become stronger during winter, marked by larger southeasterly waves (Gong et al., 2018a;Gong et al., 2018b;Zhang et al., 2021).

Previous studies have focused on sediment transport within the PRE. Most Pearl River-derived sediments are deposited within the estuary, and neglecting tidal effects can lead to overestimating deposition rates while underestimating offshore sediment flux (Hu et al., 2011). The depositional dynamics of sediments from different PRE *outlets are shaped by outlet location, topography, and tidal conditions, with neap tides favoring sediment accumulation on shoals and spring tides driving erosion and enhancing offshore sediment transport (Zhang et al., 2019). Waves further intensify both lateral trapping within the PRE and offshore sediment transport (Liu and Cai, 2019;Zhang et al., 2021).*

However, numerical studies on the transport of Pearl River-derived sediments across the continental shelf remain scarce, even amidst the widespread adoption of computer modeling approaches. Previous research on the distribution of these sediments has primarily relied on analyses of seismic profiles, gravity cores, and laboratory-based radiometric dating of sediment samples (Ge et al., 2014;Liu et al., 2014;Cao et al., 2019;Lin et al., 2020;Chen et al., 2023). Outside the PRE, gravity core and seismic survey data were used to examine the Holocene sedimentary processes, revealing two distinct mud depo-centers: an eastward proximal depo-center extending southeastward and a southwestward distal mud belt (Ge et al., 2014;Liu et al., 2014;Chen et al., 2023). However, seismic and drilling data cannot confirm that the Pearl River sediment can be transported to the Beibu Gulf (Ge et al., 2014). Due to the lack of sufficient gravity core samples and seismic data, it is difficult to quantitatively attribute the sediment in the Beibu Gulf to the Pearl River-derived sediment (Cao et al., 2019). Afterward, Lin et al. (2020) used the ^{226}Ra*—*^{238}U *and* ^{232}Th*—*^{238}U *endmembers model based on measurements of radionuclides in the surface sediment samples. They found that approximately 15% of the surface sediment in the nearshore area of the Beibu Gulf originates from the PRE* *region. However, their studies only address the proportion of PRE sediment in the surface sediment of the Beibu Gulf, without directly indicating the seasonal transport pathways, flux, and annual deposition mechanisms of sediment from the Pearl River.*

A gap persists in understanding how physical processes (such as tides, waves, and ambient circulations) and sediment characteristics (such as critical shear stress for erosion, settling velocity) and sediment initial conditions influence the seasonal suspension, transport, and annual deposition of Pearl River-derived sediment on the shelf. In this study, we utilize numerical modeling, complemented by extensive collection of field observations and seabed grain size distribution data for model calibration and validation—a highly effective approach for exploring mechanisms and testing hypotheses derived from limited observational datasets. This study focused on the processes of Pearl River-derived sediment suspension, transport, and deposition over the continental shelf. Several specific questions addressed in this paper include:

(1) What are the seasonal dispersal and annual deposition patterns of the Pearl River-derived sediment over the continental shelf?

(2) How do physical processes, sediment characteristics and sediment initial conditions influence the dispersal of the Pearl River-derived sediment?"

Comment:

Sections 3.1 – 3.3: The authors describe the model implementation, but it is impossible to include all of details. Many modeling papers instead provide a complete archive of the model input files (for example see the Data Availability statement in

Moulton et al. JGR 2024 https://doi.org/10.1029/2023JC019685). Some issues that I see with the Methods description include:

Lines 142 – 144 provide model parameters theta_s and theta_b, but this is jargon of limited use even to ROMS modelers.

Response:

Thank you for your valuable suggestion. We understand that certain model parameters, such as theta_s and theta_b, may not be immediately familiar to all readers. Additionally, we recognize the difficulty of including every detail of the model implementation within the manuscript. In response to your comment, we will provide key configuration files (such as "ocean.in" and "sediment.in") as part of the supplementary materials and explicitly reference this in the Data Availability statement. This will enable readers to directly access and review the essential model parameters. We greatly appreciate your feedback and believe these additions will enhance the transparency, reproducibility, and accessibility of our study.

Comment:

Line 171: provide a citation for the wave-current interaction.

Response: Thank you for pointing that out. We have made the necessary revision and added the appropriate citation for the wave-current interaction.

Comment:

Line 176: suggest being more specific, "The freshwater and sediment discharges for the Pearl River …"

Response:

Thank you for your helpful suggestion. We have made the corresponding revisions.

Comment:

Line 180: What is the evidence that one year of spin-up is sufficient?

Response:

Thank you for your comment. In our initial setup, the critical shear stress was determined based on previous literature and model calibration. However, we acknowledge that this approach may have limitations, particularly in capturing seasonal variations in sediment properties. Observations, laboratory experiments, and numerical sensitivity analyses from prior studies have demonstrated that the critical shear stress of sediments in the Pearl River Estuary is higher in winter than in summer. In response to your insightful comment, we have conducted additional numerical experiments incorporating seasonal variations in critical shear stress. The results reveal that the bed sediment grain size distribution after realistic reworking is now significantly closer to the initial prototype compared to our previous simulations, which did not account for such temporal variability. This improvement underscores the importance of considering seasonal changes in sediment properties for accurately modeling sediment dynamics.

Comment:

Lines 188 – 190: Riverine sediment inputs was based on a rating curve and assumptions from earlier papers. The authors do not explain how they divide the total load from Zhang et al. (2012) into the distributary mouths. A 40% / 60% fraction was assumed for silt / clay based on earlier works (Table 1). Assumptions like these are necessary, but the paper does not address how uncertainties in these types of factors might impact the overall results.

Response:

Thank you for your feedback. In the revised manuscript, we have provided the calculation formula for the rating curve, which is used to estimate the riverine sediment input. Based on this relationship, the total amount of Pearl River sediment input over our 12-month study period was calculated to be 34.52 million tons. This value aligns closely with the annual load reported in 2017 by the Pearl River Water Resources Commission. The riverine sediment input, derived from the river discharge, was allocated across the eight outlets located on the northern boundary (Figure 1b) based on the distribution approach of Hu et al. (2011). Additionally, in the discussion section, we have addressed the potential impact of uncertainties associated with the 40% / 60% fraction. We acknowledge that while such assumptions are necessary, they may introduce uncertainties, and we have discussed how these uncertainties could influence the overall results.

References

Hu, J., Li, S., and Geng, B.: Modeling the mass flux budgets of water and suspended sediments for the river network and estuary in the Pearl River Delta, China, Journal of Marine Systems, 88, 252-266, 10.1016/j.jmarsys.2011.05.002, 2011.

Comment:

Lines 190 – 233. The paper could benefit from consideration of the sensitivity of the results to uncertainties in the initial bed grain size distribution, and sediment properties (settling velocity, critical shear stress). Some specific examples:

The lack of grain size distributions in part of the model domain (i.e. the Beibu Gulf especially) lead to large uncertainties in transport there.

Response:

Thank you for your valuable feedback regarding the sensitivity of the results to uncertainties in the initial bed grain size distribution and sediment properties. In response, we conducted seven different cases to systematically evaluate the influence of these factors, including variations in the initial bed grain size distribution, settling velocity, and critical shear stress. Our findings indicate that the grain size distribution has a relatively minor impact on the transport of Pearl River sediment on the continental shelf. Instead, the sediment transport dynamics are predominantly governed by physical factors such as hydrodynamic conditions, tidal forces, and regional circulation patterns. This suggests that while uncertainties in grain size distribution exist, particularly in areas like the Beibu Gulf, their effect on the overall sediment transport is limited compared to the dominant physical drivers.

Comment:

The text states that the "spin-up greatly reduced the irregularities" (line 231). But that is not evident in the figure.

Response:

Thank you for your comment. We have incorporated seasonal variations in critical erosion stress into our model and re-simulated the results. The revised findings now demonstrate a closer alignment with the initial grain size distribution, effectively addressing the discrepancy identified in the previous analysis. This refinement offers a more precise representation of sediment dynamics in the study area.

Comment:

Panels 2g-i show that spatial grain size variability develops for example at lon/lat 114E,19N. These features are also seen in the bed shear stress (Figures 4F, 4H). Are they a model artifact or instability? Are they aligned with bathymetry (bathymetric contour lines in Figure 1b might help).

Response:

The features observed at 114E,19N are located near the model boundary where water depths are relatively large and boundary effects may be significant. However, this location is quite far from our main study region of interest. Based on our analysis, these boundary features have minimal impact on the key conclusions of this study. To provide more context, we have now added bathymetric contour lines to the relevant figures (e.g. Figure 1b). The bathymetry shows that 114E,19N is in a deep area near the model boundary. While some model artifacts or instabilities may occur in this boundary region, they do not affect the primary results and interpretations for our main study area. The spatial grain size variability and bed shear stress patterns in our core study region are robust and not influenced by these distant boundary effects.

Comment:

Panel 2i shows that large parts of the grid become much sandier than the initial grain sizes.

Response:

Thank you for highlighting the observation in Panel 2i. We have incorporated seasonal variations in critical erosion stress into our model and re-simulated the results. The revised findings now demonstrate a closer alignment with the initial grain size distribution, effectively addressing the discrepancy identified in the previous analysis. This refinement offers a more precise representation of sediment dynamics in the study area.

Comment:

Figures 9 and 10: The important points could be made with fewer figure panels.

Response: Thank you for your suggestion. We have now removed the original Figures 9 and 10, as we have significantly revised the paper by conducting seven cases. We found that the original Figures 9 and 10 were not closely related to the content of the revised manuscript and appeared redundant.

Comment:

Lines 564 – 566 and elsewhere. The paper mentions thermal winds, upwelling behavior, and a strong jet. The introduction does not provide the context for these processes. The paper does not identify these features within the model results. This adds complexity without reinforcing the main conclusions. I suggest removing these remarks here and elsewhere to focus on the main findings.

Response: Thank you for your comment. We agree with your suggestion and have removed this context, as it was not directly related to our main findings. This revision streamlines the paper and ensures a clearer focus on the key conclusions.

Comment:

Conclusions should be strengthened to better emphasize novel findings of your paper. For example, lines 878 – 883 discuss the overall sediment dispersal patterns modeled, but do not emphasize the disconnect between sediment delivery (summer high discharge) and redistribution (winter high energy). Paragraph lines 884 – 890 also do not provide very much that is novel.

Response:

Thank you for your valuable feedback. In response to your suggestion, we have revised the conclusion to more clearly highlight the novel findings of our paper, particularly the disconnect between sediment delivery during the summer high-discharge period and redistribution during the winter high-energy period. Additionally, we have removed paragraph lines 884–890, as they did not provide significant new insights. We hope these revisions enhance the clarity and focus of our conclusions.

Comment:

Technical Corrections (by line number in the preprint)

Figure 1: Bathymetry unclear. It is hard to see Taiwan Banks and offshore bathymetry that may impact shear stress (Figure 4f) and grain size (Figure 2g-i).

Response:

Thank you for your feedback regarding Figure 1. We have taken your comments into consideration and have revised the figure to improve the clarity of the bathymetry.

Comment:

Lines 132 – 134 (etc.). Cite sources for component numerical models (ROMS, SWAN, CSTM etc). Provide citation for GEBCO and all similarly used data products.

Response:

Thank you for your feedback. We have made the necessary revisions as per your suggestions.

Comment:

In some places the text uses “Case 1” and “Case 2”, and in other places it uses “WW” and “NWW”. Use either “Case 1 and 2” OR “WW and NWW” in all places.

Response:

Thank you for your feedback. We have made the necessary revisions as per your suggestions.

Comment:

Perhaps add “Boundary Forcing” to Table 2 for ROMS (i.e. for Case 2: do you still use the same open boundaries for water levels, ubar/vbar, T/S, etc.?).

Response:

Thank you for your invaluable feedback, which has significantly strengthened our study. In response to your comments, we have conducted seven additional numerical simulations to systematically evaluate the relative contributions of tides, waves, ambient shelf currents, seasonal variations in critical erosion stress, settling velocity, and the initial bed grain size distribution to the transport and dispersal of Pearl River-derived sediments. These simulations include one Control case and six Sensitivity cases. In our initial simulations, we inadvertently overlooked that the HYCOM-derived flow fields already account for the influence of monsoon-driven currents, South China Sea Warm Current (SCSWC), and Kuroshio intrusions on shelf circulation. This includes the strong northeastward currents in summer and the weaker northeastward or southwestward currents in winter. To address this, we have refined our approach in the NAS case (i.e., no ambient shelf currents) by excluding HYCOM-derived water levels and velocities. This adjustment allows for a clearer assessment of the influence of South China Sea (SCS) circulation while eliminating potential inaccuracies arising from monsoon-driven currents and Kuroshio intrusions. As a result, our model now provides a more accurate representation of the underlying physical processes. We believe these revisions enhance the robustness of our findings, and we sincerely appreciate your insightful suggestions.

Comment:

Line 372: It is vague to say “widespread expansion of the river plume”. Figure 5A does not look like the plume spreads far into the sea; it seems to hug the coast.

Response:

Thank you for your comment. The primary reason for this is that our previous analysis focused on the vertically averaged salinity field. In the revised manuscript, we now present both surface and bottom salinity fields. The surface salinity field more clearly highlights the significant eastward expansion of the plume. We have made the necessary modifications to the manuscript accordingly.

Comment:

Line 389: vague to say “pathway is wide but magnitude is weak”. You could be less vague by giving quantitative scales here (and elsewhere).

Response:

Thank you for your feedback. We have made the necessary revisions as per your suggestions.

Below is the rewritten version:

"*The westward transport pathway follows the region where the water depth is shallower than 30 m, with a riverine sediment flux of 10–20* g^{-1} *m* s^{-1}*. In contrast, the eastward transport pathway occurs in the 30–60 m depth range, but the riverine sediment flux is below 10* g^{-1} *m* s^{-1}*.*"

Comment:

Line 384: Confusing and vague to say "predominantly transported westward and eastward". Suggest something like "there are both westward and eastward fluxes of riverine sediment (Figure 5c)."

Response:

Thank you for your feedback. We have made the necessary revisions as per your suggestions.

Comment:

Line 386: refers to the diversion around Taiwan Bank. However, this feature is not obvious in Figure 5c. Adding bathymetric contours that show Taiwan Bank may help. The time- and depth-averaged currents (figure 5a) show cross-shore variability; but the reported upwelling feature is not obvious.

Response:

Thank you for your suggestion. We have now added bathymetric contours to Figure 5 and have redrawn the figure to illustrate both surface and bottom currents. The bottom currents clearly show strong cross-shore upwelling.

Comment:

Line 449 – 450: is it wind and wave “mixing” that impact the plume behavior; or wind and wave forcing which would include net momentum terms as well as turbulent mixing? Also, you are vague here saying “wider” instead of length scale for the width.

Response:

Thank you for your suggestion. We have now removed this section. Regarding the role of wind, we have chosen not to consider it in this study. The results from the NWS-Control case only represent the estimation bias associated with neglecting wave effects. We have ensured that wind stress is consistent across all our simulations. In this study, wave forcing includes both the net momentum terms generated by the waves and turbulent mixing.

Comment:

Lines 521 – 528 and associated text. Phrases like ‘Near region” and “Far off region” are awkward. Suggest “proximal” and “distal”.

Response:

Thank you for your suggestion. We have now updated the text by replacing "Near region" and "Far off region" with "proximal" and "distal" to ensure consistency and clarity.

Comment:

Lines 555, 558, 561: the authors use the word “transported” but, then provide the percentages that are “retained”. Suggest using the words “deposited” or “retained” if you are talking about the sediment deposition.

Response:

Thank you for your suggestion. We have now adopted the term "retained" in our text.

Comment:

Supplement Line 63: the 43 stations are not identified; text should refer to Figure 1.

Response:

Thank you for your feedback. We have made the necessary revisions as suggested, and the text now refers to Figure S1b for the identification of the 43 stations.