Responses to the Comments from the Reviewer 1

General comment: Jin et al. used a four-decade (1980–2021) dataset to analyze shifts in POC sources and their influence on OC burial in the Changjiang subaqueous delta before and after dam construction. It is commendable that this study employs multi-year data to examine OC burial in a highly human-impacted estuary. The study addresses a topic of interest and presents robust analytical work. However, the classification basis of different sedimentary units and the assumptions underlying the method require further clarification before publication. My specific comments are as follows:

Response: We sincerely thank you for your positive evaluation of our work and for recognizing the value of using a four-decade dataset to investigate changes in POC sources and OC burial in the Changjiang subaqueous delta. We also appreciate your constructive comments regarding the classification of sedimentary facies and the assumptions underlying our method. In the revised manuscript, we have clarified the criteria used to distinguish different sedimentary facies and have provided additional explanation of the methodological assumptions. We believe these revisions have improved the transparency and robustness of our manuscript. Detailed modifications are addressed point by point in the responses to your comments below, and we believe they have further improved the quality of our manuscript.

Specific comments:

(1) It is suggested that coastal currents be introduced in text and/or labeled in Figure 1.

Response: Thank you for this helpful suggestion. Because Figure 1 contains many sampling sites, adding all coastal currents directly to the figure would make it crowded and reduce readability. Therefore, we have added a supplementary figure showing the major current systems in the East China Sea. We have also introduced and described the relevant coastal currents in the main text to clarify the regional circulation pattern and its potential influence on sediment and organic carbon transport.

The newly added supplementary figure is as follows:

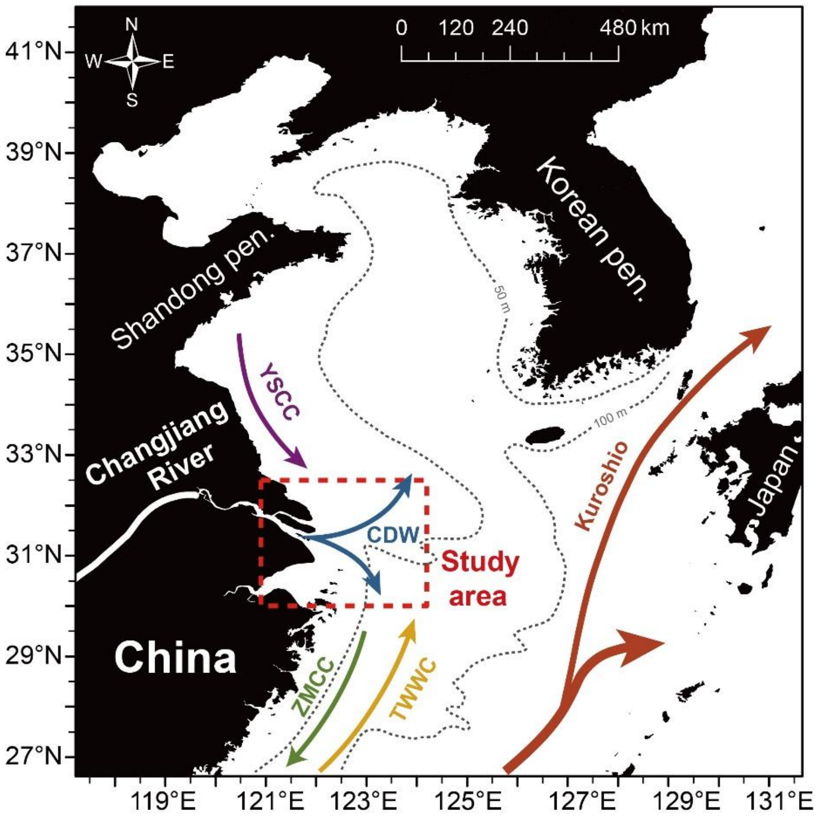

Fig. S2 Bathymetry and the major coastal and shelf circulation systems in the eastern Chinese marginal seas. YSCC, Yellow Sea Coastal Current; CDW, Changjiang Diluted Water; ZMCC, Zhejiang-Fujian Coastal Current; TWWC, Taiwan Warm Current. The circulation patterns were drawn based on previous studies (Xu et al., 2012; Yao et al., 2014; Lei et al., 2024; Sheng et al., 2024).

(2) Line 88-89. It is suggested that the authors briefly clarify the classification basis of these four sedimentary units, as well as their differences in sedimentary environments, including hydrodynamic conditions, sediment sources, sedimentation rates, and other relevant aspects.

Response: We thank you for this constructive suggestion. Following the suggestion from Reviewer 2, we have used the term “sedimentary facies” in the description and statistical comparisons of the classified regions, based on the terminology used in Chen et al. (1991). We have also added a brief clarification of the classification basis and environmental differences of the four sedimentary facies. Specifically, this classification relies on hydrodynamic conditions, sediment sources, and sedimentation rates.

Reference

Chen, Z.Y., Xu, S.Y., Yan, Q.S., 1991. Sedimentary facies of Holocene subaqueous Changjiang River Delta. Oceanologia et Limnologia Sinica 1, 29–37.

The relevant revised text is provided below:

Based on the characteristics of accumulated sediments, the Changjiang subaqueous delta can be subdivided into four sedimentary facies: the Delta front, Prodelta, Delta–shelf transition zone, and Shelf (Chen et al., 1991; Fig. 1a). The Delta front, located at water depths shallower than 12 m, lies above the wave base and has a gentle slope. It is dominated by silty sediments and is subject to strong river–tidal dynamics, resulting in relatively low sedimentation rates (Jia et al., 2018). The Prodelta, at water depths of 12–50 m, shows an offshore transition from silt to silty clay and is characterized by weaker hydrodynamic conditions and higher sediment accumulation rates (Wei et al., 2007). The Delta–shelf transition zone, at water depths of 50–60 m, contains mixed and poorly sorted sediments with abundant shell debris, indicating sediment reworking by storms and bottom currents, and thus relatively low and spatially heterogeneous sediment accumulation (Chen et al., 2000). The Shelf facies, located farther seaward at water depths greater than 60 m, is dominated by relict shelf sands and is more strongly influenced by regional shelf circulation, representing a shallow-marine depositional environment (Chen et al., 2000; Zhan et al., 2020). These contrasts in hydrodynamic conditions, sediment sources, grain-size composition, and sediment accumulation rates provide the sedimentological basis for comparing OC burial patterns across different depositional environments.

(3) Line 141. Since estuarine SPM may also contain marine-derived OC, the OC loading SPM here should represent terrestrial OC/SSA in SPM. Alternatively, I recommend that the authors clarify that the marine OC content in estuarine SPM is relatively low and can be neglected. It should be noted that neglecting marine OC may lead to an underestimation of OC burial efficiency.

Response: Thank you for this insightful comment. We agree that estuarine SPM may contain marine-derived OC and that neglecting this component may lead to an underestimation of OC burial efficiency. In the revised manuscript, we have clarified that OC loading in SPM was used to approximate the OC loading of terrestrially dominated SPM normalized to its specific surface area. This approximation is reasonable because the SPM samples were collected from low-salinity estuarine regions, where riverine inputs dominate and marine primary production is expected to have a limited influence (Yao et al., 2024).

Reference

Yao, J.L., Chen, Z., Ge, J.Z., et al., 2024. Source-to-sink pathways of dissolved organic carbon in the river–estuary–ocean continuum: a modeling investigation. Biogeosciences 21, 5435–5455.

The relevant revised text is provided below:

The OC burial efficiency in surface sediments in the Changjiang subaqueous delta was estimated according to Keil et al. (1997) through the following formula:

$$OC\ burial\ efficiency\ (\%) = \frac{OC\ loading_{\ Surface\ sediment}}{OC\ loading_{\ SPM}} \times 100\% \quad (6)$$

where the $OC\ loading_{\ Surface\ sediment}$ represents the loading of terrestrial OC (OC/SA× terrestrial OC proportion) in surface sediment, and the $OC\ loading_{\ SPM}$ denotes the OC/SA in SPM.

Note that $OC\ loading_{\ SPM}$ is used here to approximate the OC loading of terrestrially dominated SPM normalized to its specific surface area. Although this approximation may lead to an underestimation of OC burial efficiency because marine-derived OC was not explicitly separated from bulk OC, the studied estuarine SPM samples were collected from the low-salinity mixing zone, where riverine particles and terrestrial OC inputs generally dominate the suspended particle pool and the influence of marine primary production is expected to be limited (Yao et al., 2024). Thus, the contribution of marine-derived OC is likely minor relative to the terrestrial component, and the use of OC loading SPM as an approximation of terrestrial OC loading is considered reasonable.

(4) Section 3.1 overlaps somewhat with Sections 3.2 and 3.3. It is suggested that the authors consider merging the content of Section 3.1 into Sections 3.2 and 3.3 to improve the conciseness and logical flow of the manuscript.

Response: Thank you for this helpful suggestion. We have reorganized these sections by merging the relevant content of Section 3.1 into Sections 3.2 and 3.3 where appropriate, and have revised the corresponding subsection titles accordingly.

(5) "In Delta front, the values of δ 13C and C/N in surface sediment were increased and decreased over time, respectively". Please remove "were" from this sentence.

Response: Thank you for pointing this out. We have removed "were" from this sentence in the revised manuscript.

(6) Line 317-318. Here OC preservation efficiency is estimated based on OC content ratios, which are strongly influenced by sediment grain size. Therefore, the lower OC preservation efficiency after 2003 may be attributed not only to shifts in OC sources but also to changes in sediment grain size. I recommend that the authors consider grain-size variations when interpreting these results.

Response: Thank you for this valuable and constructive comment. We agree that sediment grain size is an important factor affecting sedimentary OC concentrations and therefore needs to be considered when estimating sedimentary OC preservation. Fine-grained sediments generally have larger specific surface areas (SA) and greater capacity for mineral-associated OC protection than coarser sediments (Bergamaschi et al., 1997; Bock and Mayer, 2000; Babakhani et al., 2025). Therefore, the lower OC preservation efficiency after 2003 may reflect not only changes in riverine OC sources, but also potential changes in sediment grain-size composition.

In the revised manuscript, we have clarified that the OC content-based preservation efficiency was used because our study aimed to evaluate changes in terrestrial OC concentrations from riverine SPM to deposited sediments during seaward transport. We have also added a clearer discussion on the mechanistic difference between this content-based preservation efficiency and the fine-grain/SA-normalized burial efficiency, which accounts for grain-size effects by evaluating OC loading normalized to sediment SA. Although the content-based metric does not fully remove grain-size effects, it was tightly correlated with the fine-grain/SA-normalized burial efficiency ($p < 0.001$; Fig. S5 shown below), indicating that it provides an assessment broadly consistent with the SA-normalized approach. This supports its use as an alternative indicator of terrestrial OC retention, particularly because sediment SA data are rarely available in published datasets, especially in earlier studies, whereas OC concentration data are much more widely reported. Nevertheless, we acknowledge that this content-based metric does not explicitly account for grain-size effects. Following your suggestion, we have therefore noted in the revised manuscript that grain-size changes may have potentially influenced variations in OC burial in the Changjiang subaqueous delta, although our data are insufficient to directly quantify this effect.

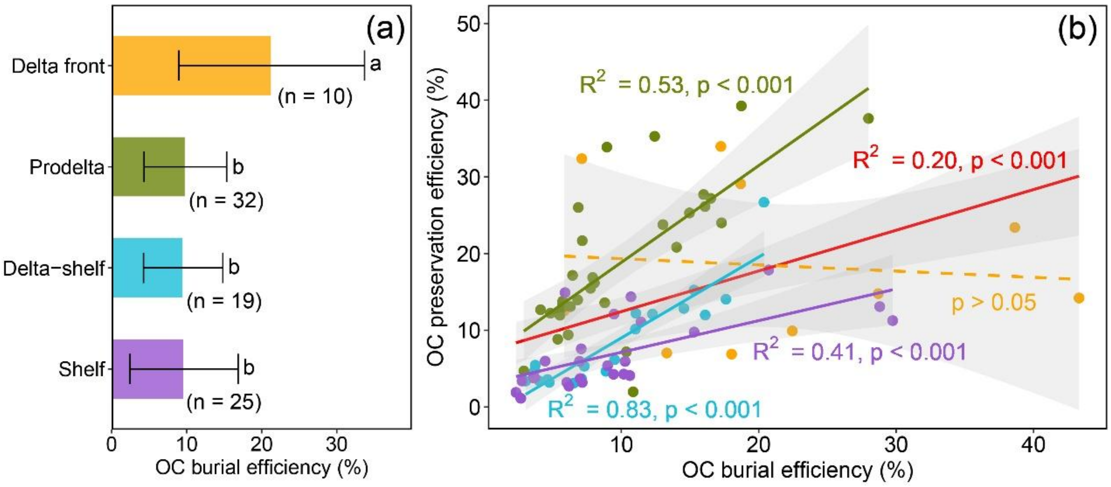

Fig. S5 Burial efficiency of terrestrial organic carbon (OC) in different sedimentary facies of the Changjiang subaqueous delta (a). Relationships between OC preservation efficiency and burial efficiency in different sedimentary facies (b). The solid and dashed lines represent statistically significant ($p < 0.05$) and insignificant ($p > 0.05$) relationships, respectively, and the light gray areas around the line indicate 95% confidence interval. Different colors in panel (b) represent different sedimentary facies (Yellow, Delta front; Green, Prodelta; Blue, Delta-shelf; Purple, Shelf), and the red line indicates relationships between OC preservation efficiency and burial efficiency for all points irrespective of sedimentary facies.

References

Babakhani, P., Dale, A.W., Woulds, C., Moore, O.W., Xiao, K.-Q., Curti, L., Peacock, C.L., 2025. Preservation of organic carbon in marine sediments sustained by sorption and transformation processes. Nat. Geosci. 18, 78–83.

Bergamaschi, B.A., Tsamakis, E., Keil, R.G., Eglinton, T.I., Montluçon, D.B., Hedges, J.I., 1997. The effect of grain size and surface area on organic matter, lignin and carbohydrate concentration, and molecular compositions in Peru Margin sediments. Geochimica et Cosmochimica Acta 61, 1247–1260.

Bock, M.J., Mayer, L.M., 2000. Mesodensity organo–clay associations in a near-shore sediment. Marine Geology 163, 65–75.

The relevant revised text is provided below:

Beyond assessing OC burial efficiency via OC loadings in riverine SPM and deltaic sediments, the ratio of terrestrial OC concentrations between SPM and surface sediments was also employed as a quantified metric (Blair and Aller, 2012). In our study, we calculated this metric and termed it “OC preservation efficiency” to distinguish from “burial efficiency” (Section 2.5). Unlike surface-area-normalized OC burial efficiency, this content-based metric does not explicitly normalize OC loading to sediment SA. This distinction is mechanistically important because sedimentary OC concentrations are controlled not only by degradation and preservation processes, but also by sediment grain-size sorting and mineral surface area. Fine-grained sediments generally have larger SA and greater capacity for mineral-associated OC protection, whereas coarser sediments tend to have lower OC retention capacity (Bergamaschi et al., 1997; Bock and Mayer, 2000; Babakhani et al., 2025). Therefore, variations in sediment texture may partly influence the calculated OC preservation efficiency and introduce uncertainty when environments with substantially different grain-size compositions are compared.

Nevertheless, the content-based preservation efficiency remains a useful metric for evaluating terrestrial OC retention, because the main objective of our study is to examine changes in terrestrial OC concentrations from riverine SPM to deposited sediments during seaward transport. Moreover, the OC content-based apparent preservation efficiency was tightly correlated with the OC/SA-based burial efficiency ($p < 0.001$; Fig. S5b), indicating that this concentration-based metric provides an assessment broadly consistent with the SA-normalized burial-efficiency approach. This relationship supports its use as an alternative indicator of terrestrial OC retention, particularly when sediment SA or OC loading data are unavailable. This advantage is important for integrating extensive published datasets, as OC concentrations in riverine SPM and surface sediments are much more commonly reported than sediment SA and OC loading data. Thus, although the content-based preservation efficiency should be interpreted as an apparent metric that may partly include grain-size effects, it remains appropriate for assessing temporal changes in terrestrial OC retention and loss in the Changjiang subaqueous delta.

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In addition, although our data are insufficient to directly quantify this effect, temporal sediment coarsening in the Changjiang subaqueous delta may have partly contributed to the decline in apparent OC preservation efficiency. This effect is likely more pronounced in the proximal delta, where reduced riverine sediment supply after the construction of the Three Gorges Dam in 2003 has been linked to erosion and sediment coarsening (Fig. 1; Wu et al., 2025). Because coarser sediments generally have a lower capacity for OC retention, such coarsening could reduce sedimentary OC concentrations and contribute to the observed decline in OC content-based preservation efficiency.

(7) Line 377-378. Based on the data presented in this study, it is difficult to determine whether a substantial proportion of OC in SPM occurs in a mineral-unprotected form.

Response: We sincerely thank you for this valuable comment. Our original intention was to interpret the contrast between riverine SPM and surface sediments from the perspective of OC retention. Specifically, the fine-grained fraction and specific surface area of riverine SPM are comparable to those of surface sediments (Sun et al., 2021), whereas the OC content of SPM is substantially higher than the surface sediment. This pattern suggests that the additional OC in SPM may not be fully explained by fine-grained sediment effects or mineral-associated protection alone.

However, we agree that the available evidence is insufficient to directly demonstrate that a larger proportion of OC in SPM occurs in a mineral-unprotected form. To avoid overinterpretation, we have revised the statement to indicate that SPM may contain a larger proportion of relatively labile OC components that are potentially more susceptible to loss during transport and deposition, rather than explicitly referring to mineral-unprotected OC.

References

Sun, X.S., Fan, D.J., Cheng, P., et al., 2021. Source, transport and fate of terrestrial organic carbon from Yangtze River during a large flood event: Insights from multiple-isotopes (δ13C, δ15N, Δ14C) and geochemical tracers. Geochim. Cosmochim. Acta 308, 217–236.

The relevant revised text is provided below:

Although the clay mineral assemblages are comparable between riverine SPM and surface sediments (Sun et al., 2022), the markedly higher OC loading in SPM suggests that SPM may contain a larger proportion of relatively labile OC, which is more susceptible to loss during sediment transport and deposition.