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Supplementary Material for

Shifts in riverine POC sources reduce terrestrial OC burial in the subaqueous Changjiang Delta

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This Supplementary Material includes description of data processing and data calculation, as well as 7 Figures and 3 Tables.

19 **Data processing**

20 **1. Medium grain size of SPM and surface sediment**

21 The medium grain size of suspended particulate matter (SPM) and surface sediments
22 in the Changjiang Estuary and its adjacent area is a key factor controlling sediment
23 organic carbon (OC) retention capacity. In this study, grain size values reported in phi
24 (Φ) units in the compiled literature were converted to micrometers (μm) using the
25 standard formula:

26
$$D (\mu\text{m}) = 2^{-\Phi} \times 1000$$

27 where the D represents the diameter (μm) of the sediment particle.

28 **2 $\Delta^{14}\text{C}$ in SPM and surface sediment**

29 Radioactive ^{14}C levels serve as critical proxies for determining sediment age. In this
30 study, the modern ^{14}C fraction ($F^{14}\text{C}$ or F_m) reported in some compiled studies was
31 converted to $\Delta^{14}\text{C}$ according to the following formula (Stuiver and Polach 1977):

32
$$\Delta^{14}\text{C} (\text{‰}) = [F^{14}\text{C} \times e^{\lambda(1950-\text{yr})} - 1] \times 1000$$

33 where $\lambda = 1/8267$, and yr is the year of sample collection.

34 **Data calculation**

35 **1. OC Burial efficiency and OC preservation efficiency in subaqueous Changjiang Delta**

36 The OC burial efficiency and OC preservation efficiency in each sampling site are estimated based on the formula in the main text. To diminish
37 the influence of discrepancy sample numbers in each sedimentary unit, the OC burial efficiency and preservation efficiency in entire subaqueous
38 Changjiang Delta was calculated according to the following formula:

39

40
$$OCBE/PE_{subaqueous\ Changjiang\ Delta} (\%) = \frac{\frac{\sum_1^m OCBE/PE_{Delta\ front}}{m} + \frac{\sum_1^n OCBE/PE_{Prodelta}}{n} + \frac{\sum_1^p OCBE/PE_{Delta-shelf}}{p} + \frac{\sum_1^q OCBE/PE_{Shelf}}{q}}{4}$$

41

42 where the *OCBE/PE* indicates OC burial efficiency/preservation efficiency, and the *OCBE/PE_{Delta front}* denotes OC burial efficiency/preservation
43 efficiency in Delta front and so on; the *m*, *n*, *p* and *q* represent number of surface sediment samples in Delta front, Prodelta, Delta-shelf and Shelf,
44 respectively.

2. Riverine OC flux and OC net preservation flux

According to the OC content in SPM and riverine sediment load in June and July from 2001 to 2020 (Fig. S3), as well as estimated OC preservation efficiency, we furtherly evaluated the monthly riverine OC flux and amount of OC preservation based on the following formulas:

$$\text{Riverine OC flux (t/month)} = \text{OC (\%)} \times \text{monthly sediment flux (t/month)}$$

$$\text{OC preservation flux (t/month)} = \text{OC (\%)} \times \text{monthly sediment flux (t/month)} \times \text{OCPE (\%)}$$

where the *Riverine OC flux* denotes the monthly riverine POC input into the Changjiang Estuary, and the *OC preservation* represents monthly budgets of OC preserved in subaqueous Changjiang Delta, and thus the difference between *OC flux* and *OC preservation* can be identified as amounts of OC loss. The data were primarily collected in June and July, thereby capturing a representative period of the riverine POC fluxes and nearshore OC budgets in the Changjiang Estuary during the flood season. This interval corresponds to the most dynamic phase of POC transport within the annual cycle.

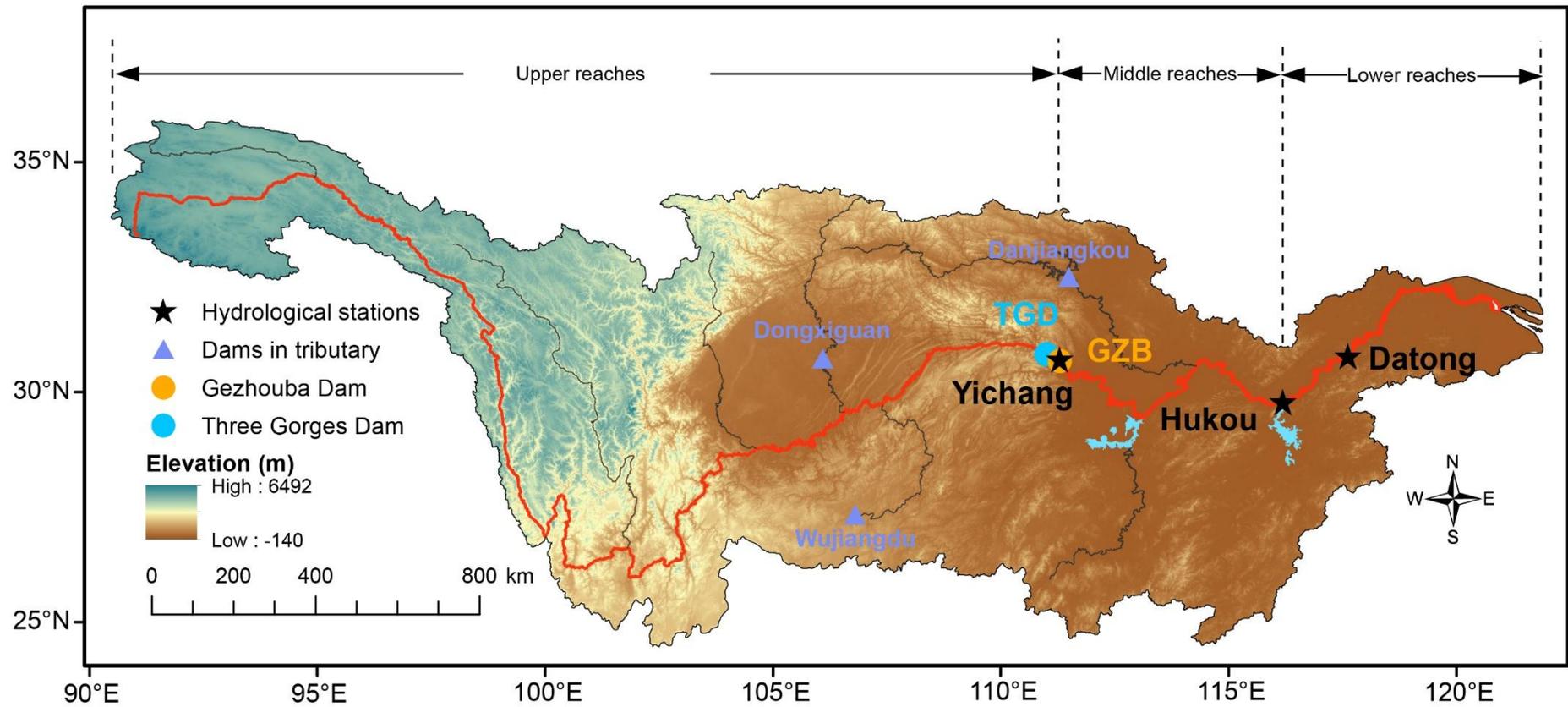


Fig. S1 Map of the Changjiang River Basin and locations of major dams constructed in mainstream and tributaries of the Changjiang River since 1960. Details of these dams are presented in [Table S1](#). TGD: Three Gorges Dam, GZB: Gezhouba Dam.

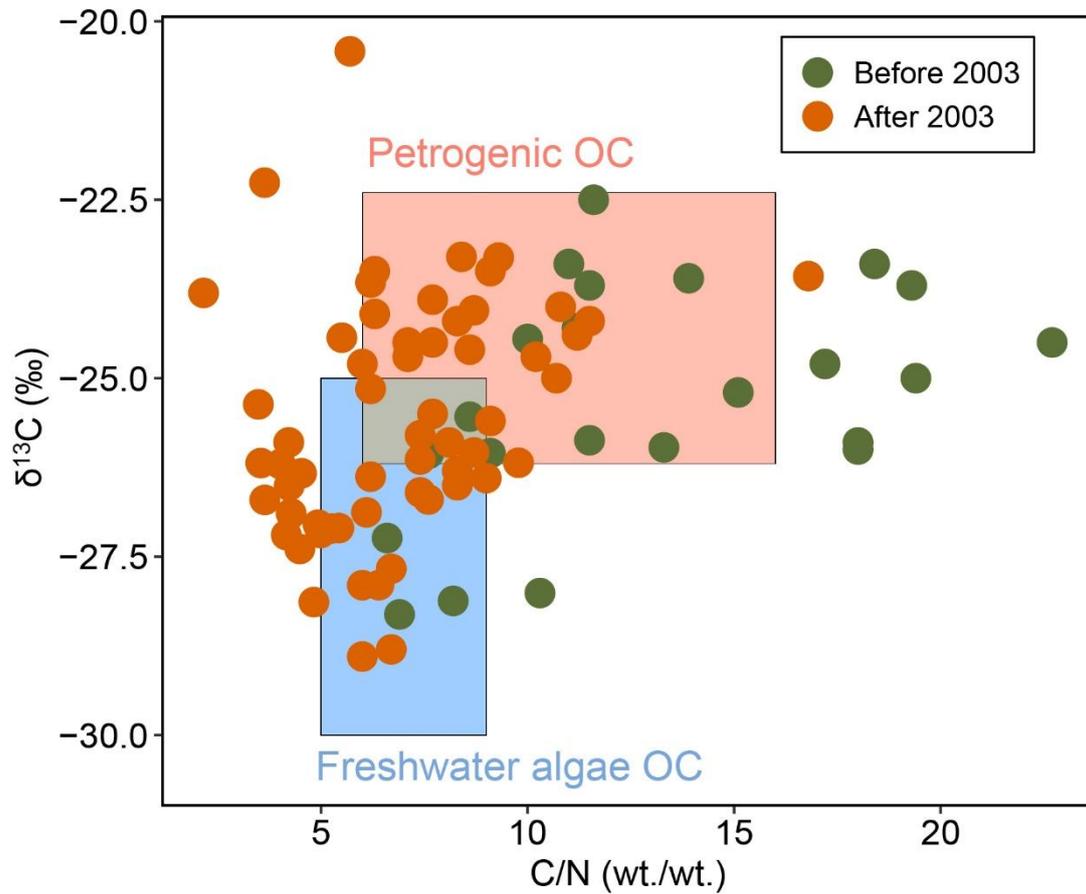


Fig. S2 Relationships between $\delta^{13}\text{C}$ and C/N in riverine suspended particulate matter (SPM) delivered by the Changjiang River. Light red and blue areas represent approximate ranges of $\delta^{13}\text{C}$ and C/N corresponding to terrestrial OC derived from petrogenic and freshwater algae OC sources, respectively, in terms of [Lamb et al. \(2006\)](#) and [Menges et al. \(2020\)](#). Note different colors of points indicate the samples collected in two periods (before 2003 and after 2003).

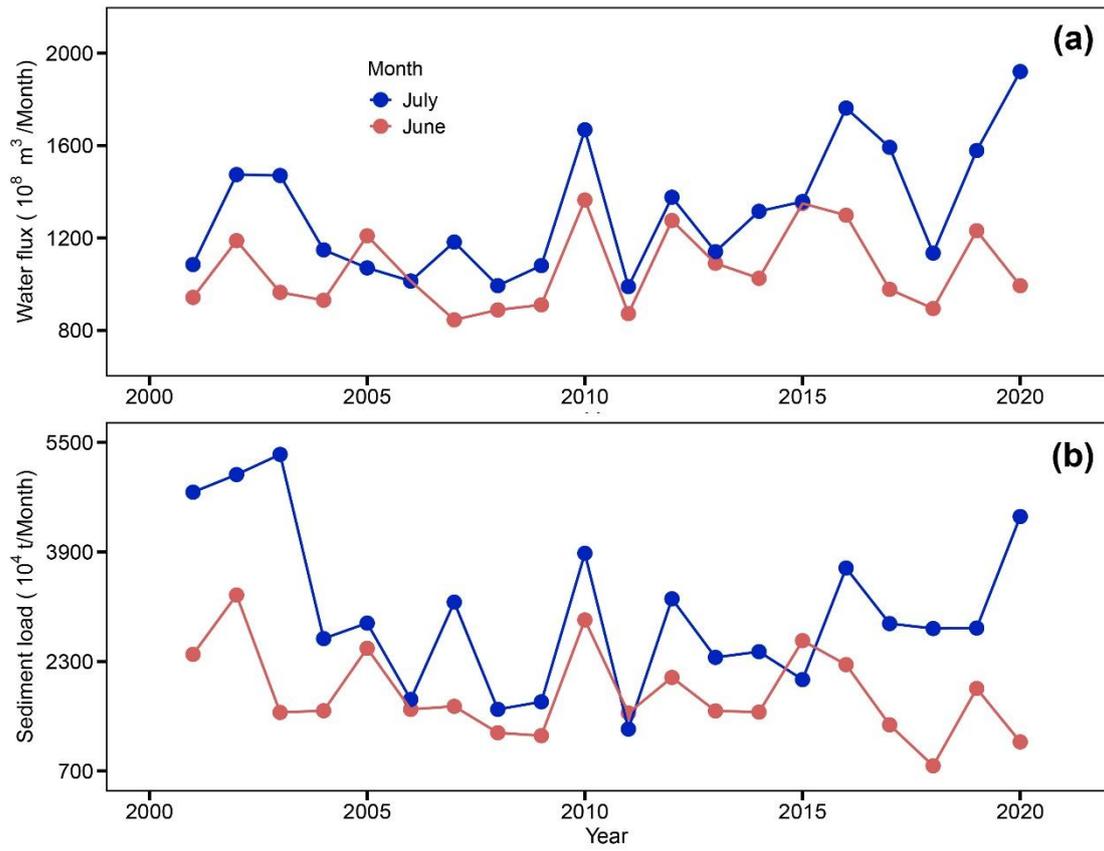


Fig. S3 Water flux (a) and sediment load (b) of the Changjiang River in June and July in Datong Gauge Station from 2001 to 2020.

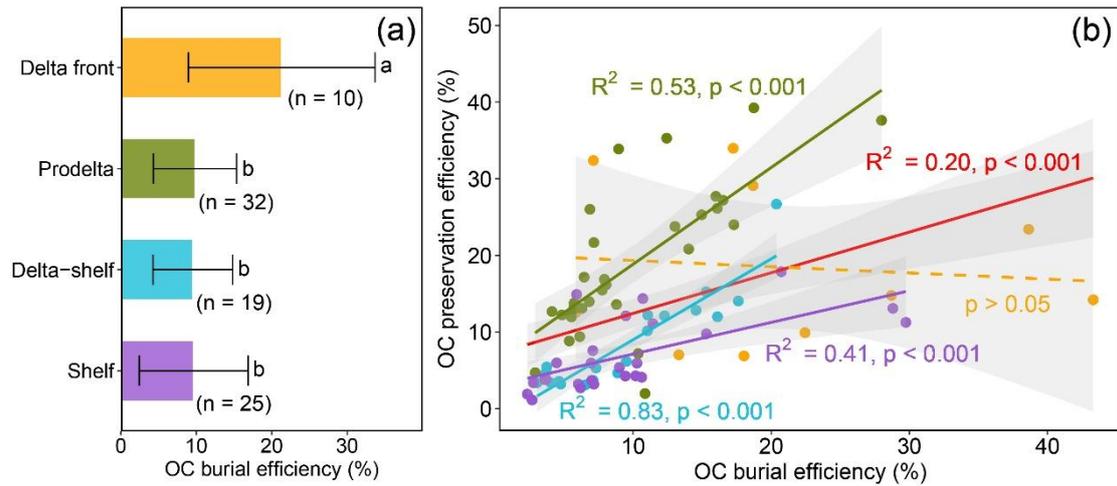


Fig. S4 Burial efficiency of terrestrial organic carbon (OC) in different sedimentary units of the subaqueous Changjiang Delta (a). Relationships between OC preservation efficiency and burial efficiency in different sedimentary units (b). The solid and dashed lines represent statistically significant ($p < 0.05$) 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 units (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 units.

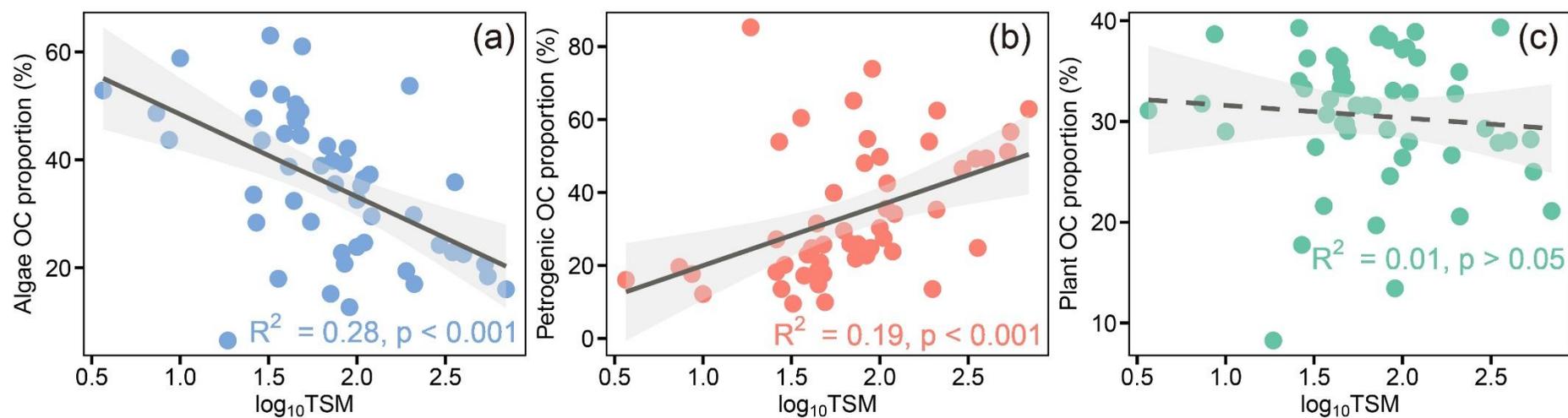


Fig. S5 Relationships between log-transformed total suspended matter (TSM) and proportion of algae (a), petrogenic (b) and C3 plant (c) OC sources. The solid and dashed lines represent statistically significant ($p < 0.05$) and insignificant ($p > 0.05$) relationships, respectively, and the light gray areas around the line indicate 95% confidence interval.

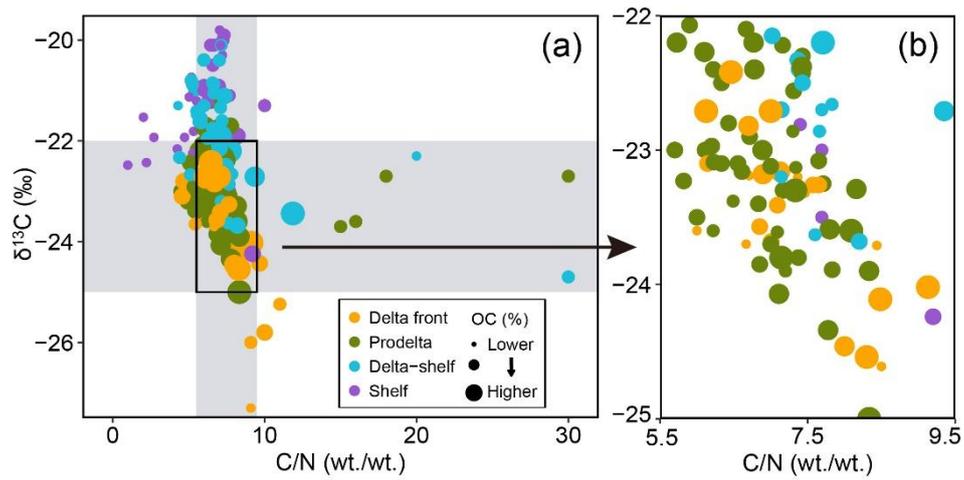


Fig. S6 Values of $\delta^{13}\text{C}$ versus C/N in bed sediments in different sedimentary units of the subaqueous Changjiang Delta (a), the light gray areas indicate approximate ranges of $\delta^{13}\text{C}$ and C/N characterized by higher OC contents. Details of the delimited area is amplified in panel (b). Points with high OC content correspond well to petrogenic OC components in terms of end-member values of C/N and $\delta^{13}\text{C}$.

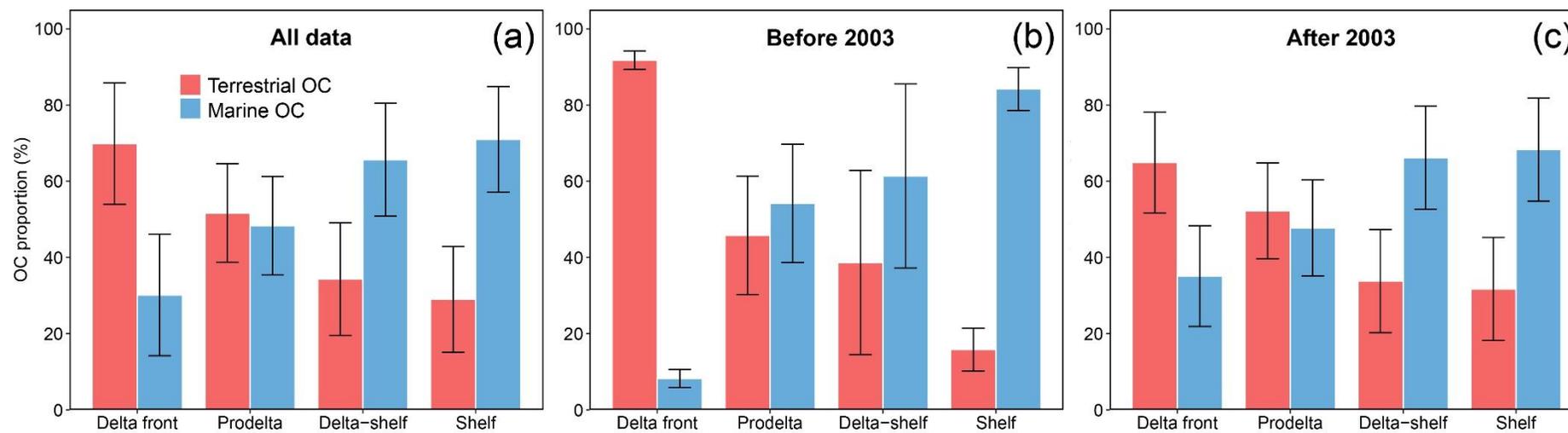


Fig. S7 Proportion of terrestrial and marine organic carbon in surface sediments across four sedimentary units, presented for (a) all data, (b) the period before 2003, and (c) the period after 2003.

Table S1 Major reservoirs in main stream and tributaries of the Changjiang River operated since 1965.

Reservoir	River	Commissioning year	Capacity (10⁸ m³)
Danjiangkou	Hanjiang	1968	290.5
Wujiangdu	Wujiang	1979	23
Gezhouba	Main stream of Changjiang River	1981	15.8
Dongxiguan	Jialingjiang	1996	5.98
Three gorges	Main stream of Changjiang River	2003	450.4

Table S2 Endmember values of $\delta^{13}\text{C}_{\text{org}}$ and N/C in different sources of particulate organic carbon (POC) in terrestrial suspended particulate matters (SPM).

POC sources in SPM	$\delta^{13}\text{C}$ (‰)	N/C (molar ratio)
Algae	$-28.5 \pm 2^{\text{a}}$	$0.184 \pm 0.011^{\text{b}}$
Petrogenic	$-22.4 \pm 4.9^{\text{c}}$	$0.045 \pm 0.066^{\text{d}}$
C3 Plant	$-26.8 \pm 0.1^{\text{e}}$	$0.038 \pm 0.019^{\text{b}}$

^a [Shan et al. \(2021\)](#).

^b [Tao et al. \(2009\)](#), [Ru et al. \(2020\)](#) and [Zhang et al. \(2022\)](#).

^c [Aucour et al. \(2006\)](#), [Li et al. \(2018\)](#) and [Wang et al. \(2019\)](#).

^d [Cremonese et al. \(2014\)](#) and [Menges et al. \(2020\)](#).

^e [Sun et al. \(2021\)](#)

Table S3 Characteristics of various parameters, as well as contents of different sources of OC separated from Bayesian end-member mixing model in suspended particulate matters (SPM) delivered by the Changjiang River.

Sampling date	OC (%)	TN (%)	C/N (wt./wt.)	$\delta^{13}\text{C}$ (‰)	Algae OC (%)	Petrogenic OC (%)	C3 Plant OC (%)
June 1980			12.93 ± 2.88	-23.5 ± 0.58			
November 1981			18.53 ± 2.34	-25.0 ± 0.80			
July 2001	1.17 ± 0.82	0.14 ± 0.12	9.00 ± 2.12	-26.6 ± 1.28	0.44 ± 0.31	0.33 ± 0.30	0.41 ± 0.26
June 2011	0.87 ± 0.19	0.08 ± 0.02	11.05 ± 0.38	-24.4 ± 0.43	0.18 ± 0.07	0.43 ± 0.04	0.25 ± 0.09
March 2012	0.69 ± 0.09	0.07 ± 0.02	10.73 ± 3.45	-24.3 ± 1.09	0.14 ± 0.04	0.36 ± 0.12	0.18 ± 0.04
July 2013	1.06 ± 0.11	0.15 ± 0.04	7.33 ± 1.23	-24.3 ± 0.46	0.23 ± 0.07	0.55 ± 0.02	0.28 ± 0.06
July 2014	1.11 ± 0.25	0.14 ± 0.04	8.18 ± 0.71	-25.0 ± 1.30	0.31 ± 0.16	0.44 ± 0.14	0.35 ± 0.15
July 2018	0.87 ± 0.26	0.12 ± 0.04	7.18 ± 1.10	-24.7 ± 1.30	0.23 ± 0.17	0.38 ± 0.08	0.26 ± 0.15
July 2019	4.01 ± 2.11	0.65 ± 0.36	6.35 ± 0.55	-25.2 ± 2.46	1.27 ± 1.09	1.56 ± 1.20	1.18 ± 0.88
June 2020	2.20 ± 1.78	0.34 ± 0.29	6.81 ± 1.26	-28.0 ± 1.00	1.22 ± 0.99	0.28 ± 0.24	0.70 ± 0.59
March 2021	1.02 ± 0.16	0.13 ± 0.01	7.73 ± 0.60	-25.5 ± 0.91	0.31 ± 0.11	0.36 ± 0.08	0.35 ± 0.10
March 2025	1.28 ± 0.19	0.25 ± 0.03	5.25 ± 0.54	-26.7 ± 0.31	0.60 ± 0.32	0.25 ± 0.13	0.42 ± 0.22
July 2025	1.70 ± 0.28	0.35 ± 0.07	3.83 ± 0.25	-25.8 ± 0.51	0.73 ± 0.49	0.44 ± 0.20	0.53 ± 0.34

References

- Aucour, A.M., France-Lanord, C., Pedoja, K., et al., 2006. Fluxes and sources of particulate organic carbon in the Ganga-Brahmaputra river system. *Global Biogeochem. Cy.* 20, GB2006.
- Cremonese, L., Shields-Zhou, G.A., Struck, U., et al., 2014. Nitrogen and organic carbon isotope stratigraphy of the Yangtze Platform during the Ediacaran – Cambrian transition in South China. *Palaeogeogr. Palaeoclimatol.* 398, 165–186.
- Lamb, A.L., Wilson, G.P., Leng, M.J., 2006. A review of coastal palaeoclimate and relative sea-level reconstructions using $\delta^{13}\text{C}$ and C/N ratios in organic material. *Earth-Sci. Rev.* 75, 29–57.
- Li, B.Y., Zhang, D.W., Pang, X.Q., et al., 2018. Paired $\delta^{13}\text{C}_{\text{carb}}$ and $\delta^{13}\text{C}_{\text{org}}$ records of the Ordovician on the Yangtze platform, South China. *Aust. J. Earth Sci.* 65, 809–822.
- Menges, J., Hovius, N., Andermann, C., et al., 2020. Variations in organic carbon sourcing along a trans-Himalayan river determined by a Bayesian mixing approach. *Geochim. Cosmochim. Acta* 286, 159–176.
- Ru, H.J., Li, Y.F., Sheng, Q., et al., 2020. River damming affects energy flow and food web structure: a case study from a subtropical large river. *Hydrobiologia* 847, 679–695.
- Shan, S., Luo, C.L., Qi, Y.Z., et al., 2021. Carbon isotopic and lithologic constraints on the sources and cycling of inorganic carbon in four large rivers in China: Yangtze, Yellow, Pearl, and Heilongjiang. *J. Geophys. Res. Biogeo.* 126, e2020JG005901.
- Stuiver, M., Polach, H.A., 1977. Discussion Reporting of ^{14}C Data. *Radiocarbon* 19, 355–363.

- Sun, X.S., Fan, D.J., Chen, P., 2021. Source, transport and fate of terrestrial organic carbon from Yangtze River during a large flood event: Insights from multiple-isotopes ($\delta^{13}\text{C}$, $\delta^{15}\text{N}$, $\Delta^{14}\text{C}$) and geochemical tracers.
- Tao, F.X., Liu, C.Q., Li, S.L., 2009. Source and flux of POC in two subtropical karstic tributaries with contrasting land use practice in the Yangtze River Basin. *Appl. Geochem.* 24. 2102–2112.
- Wang, J., Hilton, R.G., Jin, Z.D., et al., 2019. The isotopic composition and fluxes of particulate organic carbon exported from the eastern margin of the Tibetan Plateau. *Geochim. Cosmochim. Acta* 252, 1–15.
- Zhang, J., Guo, Q.J., Wang, Z.T., et al., 2022. Phytoplankton dominates the suspended particulate nitrogen source in the Yangtze River. *J. Hydrol.* 615, 128607.