Response to Comments (paper # EGUsphere-2022-30)

# Variations in dissolved and particulate organic carbon in the lower Changjiang River on time scales from seasonal to decades

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We gratefully thank Reviewer for your time and valuable comments on our manuscript. We have carefully considered these comments and revised the manuscript accordingly. Our response to reviewers' comments point by point is given below. The original comments (in blue text) are also provided followed by our detailed response (regular font size).

**Reviewer #1:**

This study investigated the monthly variations of particulate and dissolved organic carbon (POC, DOC) in the lower Changjiang River. The used stable carbon isotope approach combined with concentration measurement and ultrafiltration technique to elucidate the sources and seasonal variations of POC and DOC in the river as related to the discharge and possible influence of human activity and climate changes in the river. This is an interesting study and it provides valuable new information for our understanding of the sources and dynamics of terrestrial organic matter transported by the Changjiang River which is one of the largest rivers in the world and has great influence on the carbon cycling and biogeochemical processes in the East China Sea. Overall, it is a nice paper and I like to see its publication in Biogeosciences after some minor to moderate revision. The following lists some suggestions.

**Response:** Thank you very much for your positive comments.

1. The results indicated that the concentrations of SPM (suspended particulate matter) didn't show good correlations with river discharge and seasons during 2016-2019. Could this be related to the sampling variations? I expect that SPM is not like DOC, it may not be distributed uniformly in the river. It is not mentioned how much water was filtered for SPM. Was the water volume consistent used for all SPM sample collections? Any duplicate SPM samples were collected? This should be an easy thing to do.

**Response:** Thank you for the comments. In the Changjiang River, it was generally regarded that higher river discharge in the summer should always be accompanied with higher SPM concentrations, largely due to the enhanced soil erosion induced by elevated water discharges in summer (Dai et al., 2016). This situation was indeed true a few decades ago because of the intensive deforestation over the river basin. However, due to the increased damming effect and decreased deforestation over the river basin, the difference in SPM concentrations between flood and dry seasons in the Changjiang River became smaller and smaller (see Figures D11 and D12, the letter D means the reference of Dai et al. [2016], similarly hereafter). Therefore, based on our observed SPM data between 2016 and 2020 (see data in this manuscript) and those reported for the same sampling locations in 2009–2010 (see Figure G4a of Gao et al. [2012]), no significant difference in SPM concentrations was found between flood seasons and dry seasons in the Changjiang River during the recent years from 2009 to 2020.

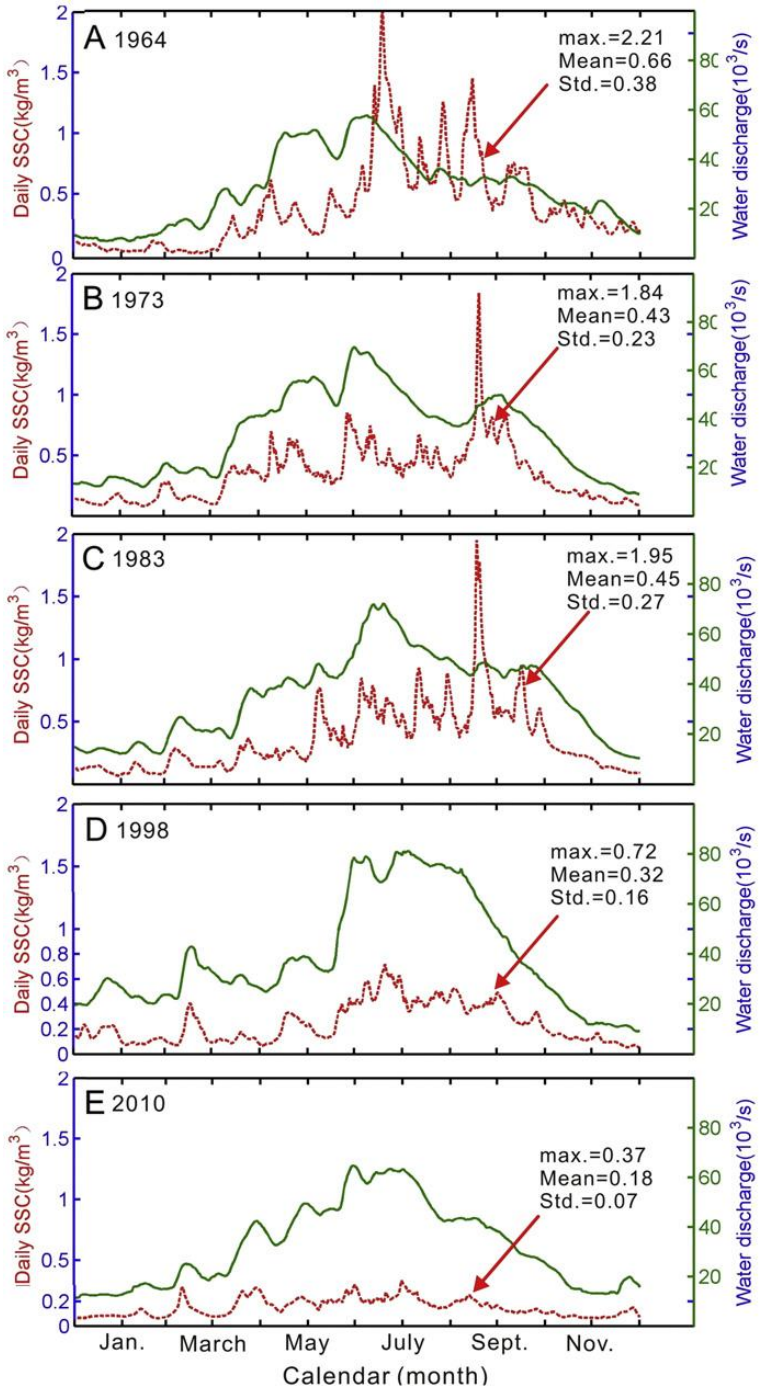


Figure D11. Daily SSC (suspended sediment concentration) and water discharge in different flood years: A) 1964; (B) 1973; (C) 1983; (D) 1998; (E) 2010.

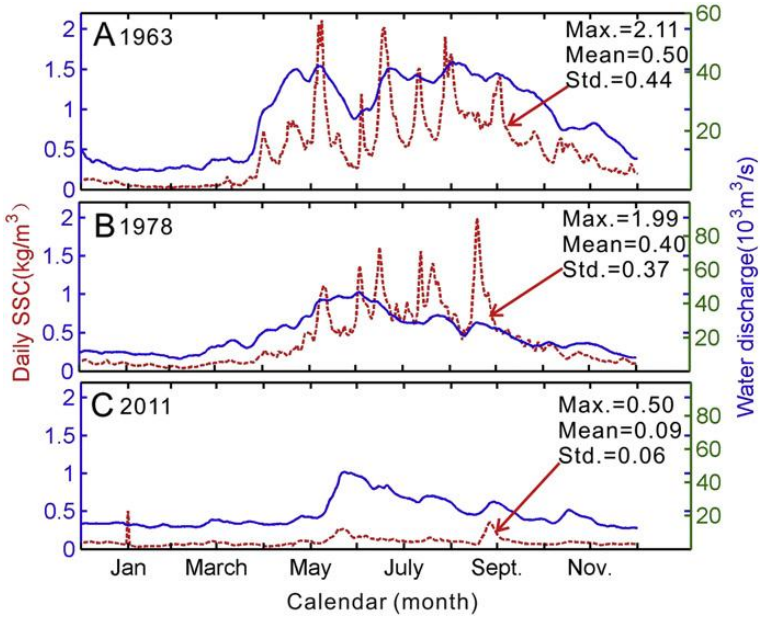


Figure D12. Daily SSC and water discharge during different drought years: (A) 1963; (B) 1978; (C) 2011.

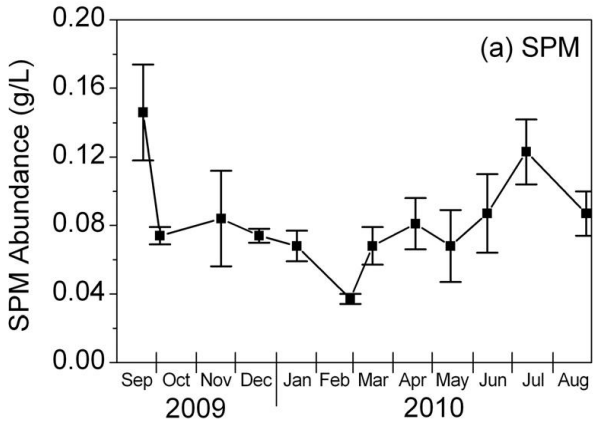


Figure G4a. Variations of the monthly average values (±standard deviation) of SPM abundance measured at station #4 during the sampling period September 2009 to August 2010.

Regarding the 35 samples involved in this study, the water volumes used for filtration were based on the specific SPM concentrations, ranging from 150 mL to 400 mL, with an average value of 266 ± 126 mL. In order to assess the reproducibility and repeatability, ten duplicate filtrations, with the same water volume (250 mL), were conducted for a Xuliujing sample collected in July 2021. The obtained SPM

concentrations were 30.6 ± 2.6 mg/L ($n$ = 10) with a relative standard deviation of 8.4%. This information has been added into the revised manuscript.

References:

Dai, Z., Fagherazzi, S., Mei, X., and Gao, J.: Decline in suspended sediment concentration delivered by the Changjiang (Yangtze) River into the East China Sea between 1956 and 2013, Geomorphology, 268, 123-132, https://doi.org/10.1016/j.geomorph.2016.06.009, 2016.

Gao, L., Li, D., and Zhang, Y.: Nutrients and particulate organic matter discharged by the Changjiang (Yangtze River): Seasonal variations and temporal trends, J. Geophys. Res.: Biogeo., 117, G04001, https://doi.org/10.1029/2012JG001952, 2012.

2. Small water volume (400 ml) was used for the ultrafiltration in this study. Did the efficiency of the ultrafiltration method using different pore sizes filters have been tested using standard compounds of knowing molecular weight? I think the authors probably did. If so, please add this information in the Method Section.

**Response:** The stirred cell ultrafiltration unit used in this study had a maximal volume of 450 mL. In addition, compared to seawater, river water normally contains higher DOC and DOM. For our measurements of DOC and DOM here, 400 mL is sufficient, which was consistently used for ultrafiltration. Regarding the pore-size or nominal molecular weight cutoffs (NMWCOs) of membranes used in this study, those from manufacture's specification or cutoff ratings were given/listed in the manuscript for easy comparisons with other studies and to avoid confusing since the actual NMWCOs could be higher than those of manufacture's rated cutoffs (e.g., Xu and Guo, 2017; Zhou and Guo, 2015). For the 1 kDa membrane, we used vitamin $B_{12}$ solution (MW = 1.3 kDa) to check membrane's integrity, as described in previous studies (Guo et al. 2000; Xu and Guo, 2017). On average, <15% of vitamin $B_{12}$ was measured in the <1 kDa ultrafiltrate. For better comparisons, the same ultrafiltration membranes and protocols (ultrafiltration permeation model or concentration difference) are highly recommended. And this technical issue has been discussed in details in Zhao et al. (2021). Following reviewer's suggestion, related sentences describing this technical issue have been added into the Method section of the revised manuscript.

References:

Guo, L., Wen, L.-S., Tang, D., and Santschi, P. H.: Re-examination of cross-flow ultrafiltration for sampling aquatic colloids: evidence from molecular probes, Mar. Chem., 69, 75-90, https://doi.org/10.1016/S0304-4203(99)00097-3, 2000.

Xu, H. and Guo, L.: Molecular size-dependent abundance and composition of dissolved organic matter in river, lake and sea waters, Water Res., 117, 115-126, https://doi.org/10.1016/j.watres.2017.04.006, 2017.

Zhao, L., Gao, L., and Guo, L.: Seasonal variations in molecular size of chromophoric dissolved organic matter from the lower Changjiang (Yangtze) River, J. Geophys. Res.: Biogeo., 126, e2020JG006160, https://doi.org/10.1029/2020JG006160, 2021.

Zhou, Z. and Guo, L.: A critical evaluation of an asymmetrical flow field-flow fractionation system for colloidal size characterization of natural organic matter, J. Chromatogr. A, 1399, 53-64, https://doi.org/10.1016/j.chroma.2015.04.035, 2015.

3. On line 114, please state what is IS-MS for the first time.

**Response:** Sorry for the typo. It should read isotope-ratio mass spectrometer (IR-MS).

4.The Results Section can be more focused on the results only, some discussion sentences can be moved to Discussion Section.

**Response:** We agree. The other Reviewers also raised this issue. We have reorganized related sentences/paragraphs in the revised manuscript.

5. The lower reaches of the Yangtze River flows through the agricultural plain, and the use of a large amount of chemical fertilizers may have a great influence on river nitrogen. Some discussion on this may be necessary.

**Response:** Thank you for pointing this out. In the lower reach of the Changjiang River, the nitrogen and phosphorus concentrations have shown significant increasing trends over recent decades, largely due to the increasing fertilizer usage over the river basin (Li et al., 2007; Yan et al., 2010; Gao et al., 2012). In the revised manuscript, the sentences about the increasing trend of nutrients in recent decades have been added.

References:

Gao, L., Li, D., and Zhang, Y.: Nutrients and particulate organic matter discharged by the Changjiang (Yangtze River): Seasonal variations and temporal trends, J. Geophys. Res.: Biogeo., 117, G04001, https://doi.org/10.1029/2012JG001952, 2012.

Li, M., Xu, K., Watanabe, M., and Chen, Z.: Long-term variations in dissolved silicate, nitrogen, and phosphorus flux from the Yangtze River into the East China Sea and impacts on estuarine ecosystem, Estuar. Coast. Shelf S., 71, 3-12, https://doi.org/10.1016/j.ecss.2006.08.013, 2007.

Yan, W., Mayorga, E., Li, X., Seitzinger, S. P., and Bouwman, A. F.: Increasing anthropogenic nitrogen inputs and riverine DIN exports from the Changjiang River basin under changing human pressures, Global Biogeochem. Cy., 24, GB0A06, https://doi.org/10.1029/2009GB003575, 2010.

Again, we appreciate the Reviewer for the constructive and insightful comments and time spent on our manuscript. The comments have greatly improved our manuscript. We hope that our revised manuscript now meets the standard set by *Biogeosciences*.