Discussion on the 2nd Anonymous Referee review

Referee comment on "Particulate organic matter in the Lena River and its Delta: From the permafrost catchment to the Arctic Ocean" by Olga Ogneva et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2022-183-RC2, 2022

Comment types: Authors' Response: "AR", Referee Comment: "RC"
Comment colors: Authors Response: "blue", Referee Comment: "black"
Comment fonts: When it was possible, we highlighted changed text by the **bold font**, the text from the manuscript copied to this review was taped *cursive*

RC: This paper reports majorly the measurement of TSM, POC, $\delta^{13}C$ and ^{14}C in the Lima River during 2019, a year that represented "lower-than-average" TSM exports and showcased a strong positive influence on phytoplankton growth. The paper highlights the importance of deltaic processes. Findings are potentially important because they inform how climate change may influence Arctic carbon fluxes to the ocean. However, the paper has a few areas that require improvement. The authors fail to provide a discharge time series for the year of data collection and ArcticGRO sampling period to put their findings in context. The paper can be improved if the following changes are made:

AR: Thank you for your review of our manuscript, we highly appreciate your time and work. We have answered all your comments below and revised the manuscript accordingly. As requested by Biogeosciences, the revised manuscript will be uploaded at a later stage after responding to all reviewer comments. There will be a track change version of the manuscript, as well as a clean version including all modifications following your and the 2 other reviewers' suggestions. All the line numbers refer to this clean revised version.

RC: In the introduction section, explain the importance of Lena River and why it is important to study it in 3 sub-sections (as mentioned in lines 180-183). Further, add statements about the research gap and focus of the current study.
AR: Thank you for suggestions! We have changed our introduction to highlight the research gap and the importance of the Lena River and its Delta, which also clarifies the subdivision of the data set/study area.

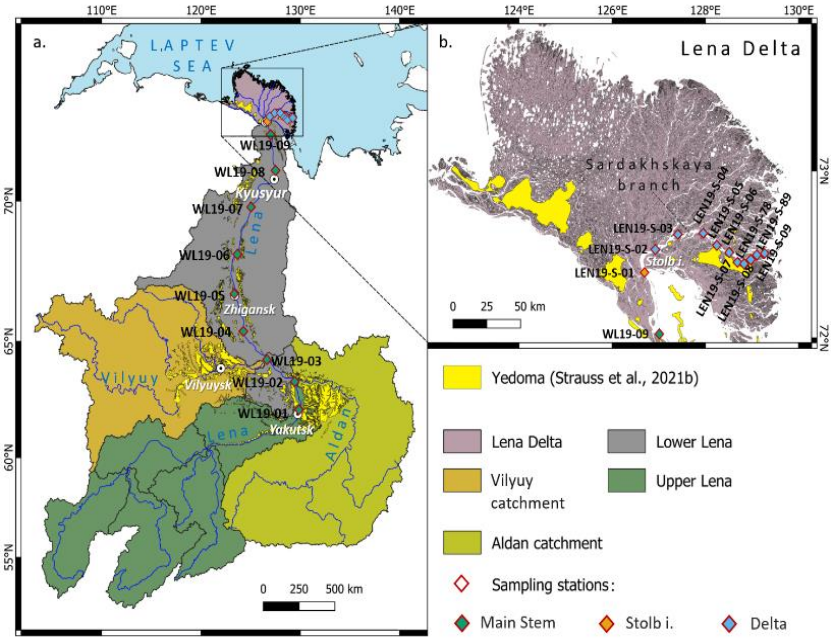
L73-78: *"Thus, for example, sampling from the Lena River,* ***which transports the largest amount of particulate organic C (POC) of all Arctic rivers to the Arctic Ocean (McClelland et al., 2016) and has one of the world's biggest deltas****, took place ~ 800 km upstream from the Lena Delta at the town of Zhigansk. This long distance of the sampling site from the areas, where the river enters the Arctic Ocean, and the*

deficit of information about the delta and the potential biogeochemical processes taking place there (OM transformation/sedimentation/enrichment) which may lead to a distortion or a lack of information about the final state of OM reaching the Arctic Ocean."

L79-82: *"In this study, we aim* ***to bridge this gap and to*** *characterise POC along the Lena River over a transect from upper reaches of the Lena River near Yakutsk (approximately 1640 km from the coast) north to the Lena Delta in order to decipher the distribution, main sources, and transformation of particulate organic matter (POM) on its way from the permafrost catchment to the Arctic Ocean."*

RC: Figure 1: Include the information on the sample number in the caption. Also, try to showcase three divisions of sample groups for easy understanding

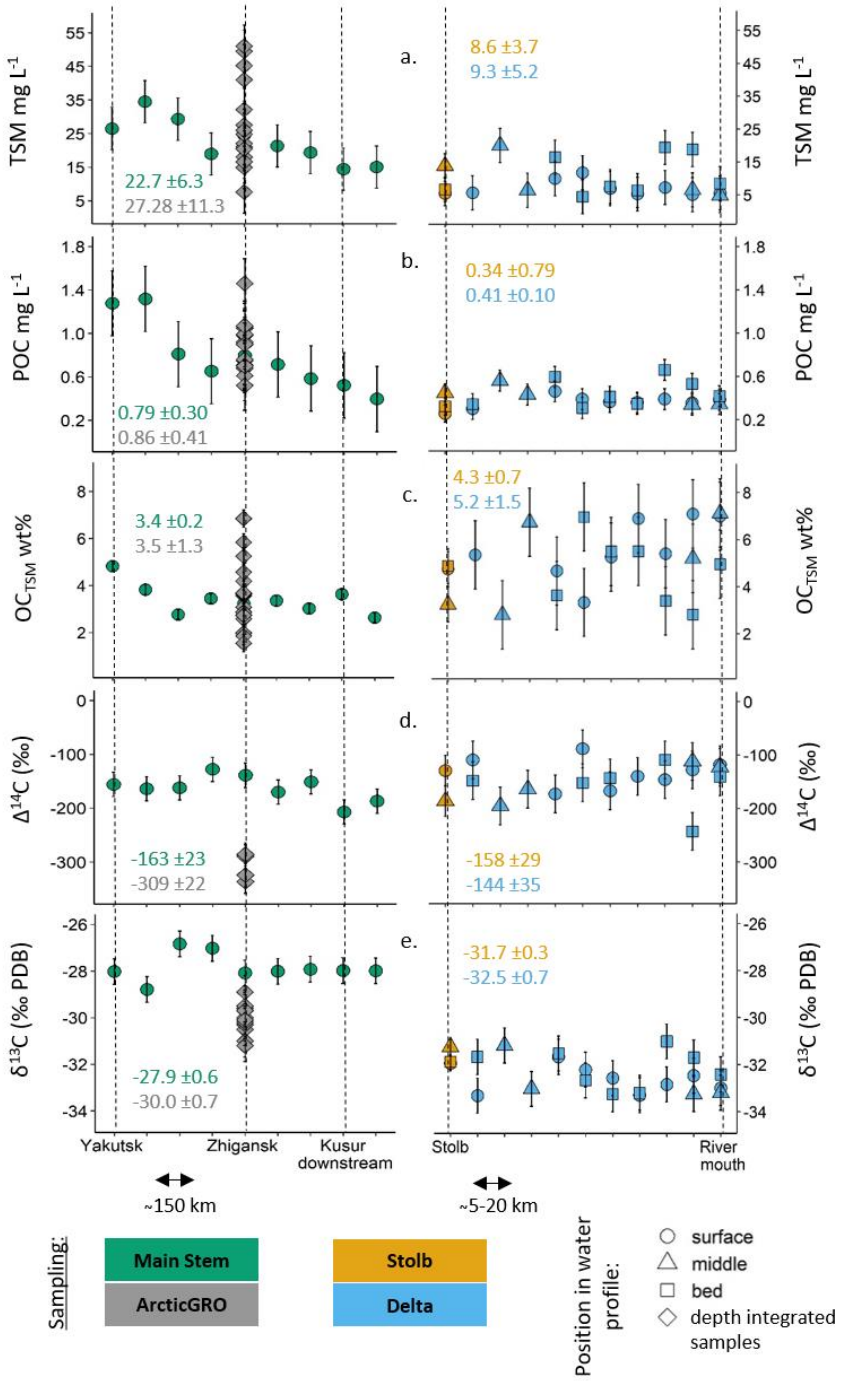
AR: The Figure 1 and the caption for Figure 1 were modified as suggested:



"Figure 1. The Lena River catchment and its Delta with Yedoma distribution (Strauss et al., 2021b) in the catchment. a) Sampling locations along the Lena River main stem (n of samples = 9) and the Lena River catchment area; b) Sampling locations at Stolb Island (n of samples = 3) and in the Lena Delta along the Sardakhskaya branch (n of samples = 20)."

RC: Figure 2: Edit and add mean values of your results and ArcticGRO which you are discussing in Sections 3.2.2 to 3.2.4

AR: Figure 2 and its caption were modified as:



"Figure 2. Distribution of studied parameters along the transect in the Lena main stem, the Lena Delta, and for the ArcticGRO dataset (mean ±stdev); values on each panel represent the average (±stdev) for every sampling group: a. TSM mg L-1; b. POC, mg L-1; c) OCTSM, wt%; d) ∆14C of POC, ‰; e) δ13C of POC, ‰."

RC: Show the river discharge time series data relative to ArcticGRO. It is necessary to fully interpret these results.

AR: *We added this information to the supplements and refer to it within the text:*

L36-307: *"…relationship between discharge and TSM and POC concentrations* ***(Figure S2)****…"*

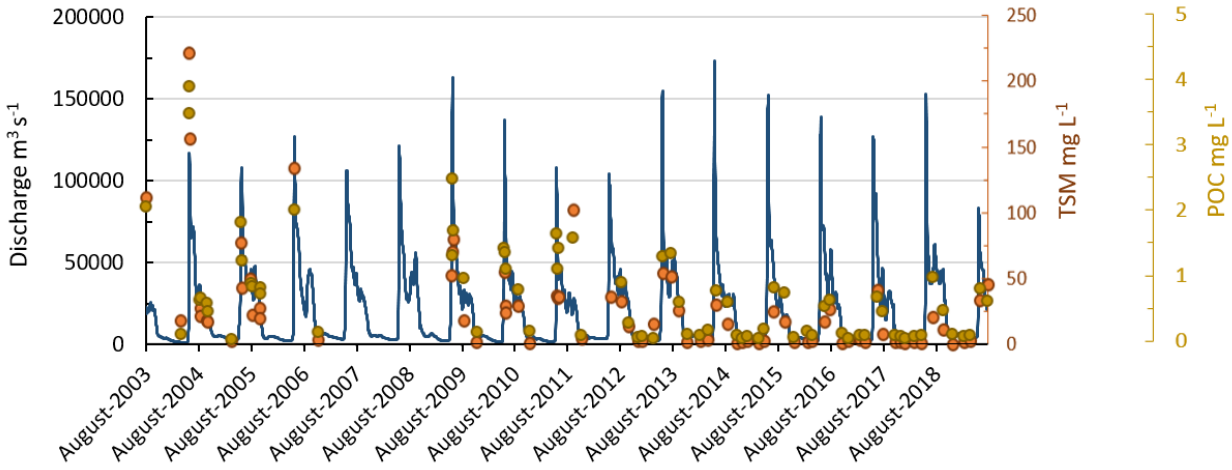


Figure S1: Time series of the Lena River discharge provided by ArcticGRO for 2003-2019 and TSM, POC concentration fluctuation.

RC: Lines 301-302 mention that 2019 was a year of lower-than-average TSM export. Discuss the variation in TSM and POC on a large timescale and present a plot of temporal variation for better clarity.

AR: This chapter (4.1.1) was shortened a lot according to suggestions of the 1st anonymous review. Thus, the revised manuscript does not contain the discussion on the POC and TSM fluctuation any more. To get your suggestion integrated we would like to note that in the new version of the chapter we referred to the Supplement, which includes the requested additional information about TSM, POC, and annual fluctuation (Figure S1, S2).

RC: Lines 309-310: Provide a figure or table comparing the POC variation with the published data

AR: Thank you. We would like to point the reviewer to the sentence cited below from our original manuscript, where we refer to a figure comparing the published data with our new results, which he/she perhaps accidentally overlooked.

L315-316: *"On the other hand, our deltaic POC concentrations are similar to previously published POC data for the Lena Delta (Winterfeld et al., 2015)* ***(Figure 3)****."*

RC: Also utilize discharge data to calculate the flux of TSM, and POC and compare it with previous reports.

AR: That would be a very interesting topic to highlight! Nevertheless, the calculation of OM fluxes are beyond the scope of this manuscript. Further, we would like to mention that intensive hydrological measurements at our sampling sites would be needed to provide such calculations. Any attempts to estimate the discharge on our database which was not designed for such calculations would lead to misleading numbers. We therefore

would like to refrain from the calculation of TSM and POC fluxes.

RC: Section 4.1.1 and 4.1.2: Again, it would be helpful to see the discharge time series for the ArcticGRO period of sampling vs other years such as 2019. These variations in POC% are hard to interpret without seeing the discharge time series. Further, it is often helpful to calculate the ratio of the coefficient of variation (CV) of your parameter (e.g., POC%) to the CV for Q; CVc/CVq to determine how much discharge is affecting the variation.
AR: The time series plot for the ArcticGRO was added to the supplement (Figure S1). Concerning your question on the additional statistical parameters for our data, such a detailed analysis of discharge was not the aim of our work. Moreover, we have changed section 4.1.1. by shortening it according to the first anonymous review. In detail, we removed potentially misleading sentences about POC variation.

RC: Minor comment: Check the mention of the figure numbers in the text. There is no figure 3c
AR: Thank you very much for mentioning this! We changed this to fig 3a
L381: "*In contrast to main stem POC, deltaic POC was more depleted in $\delta^{13}C$ (mean -32.5 ±0.7 ‰) (Figure 2e;* ***3a****)".*
L413: "*…weeks (11 July – 25 July 2017), suggesting that an algal bloom developed between the two sampling dates (Figure* ***3a****)."*

RC: Lines 420-421: Provide a reason for not analyzing δ13C of DIC. Additionally, you need to provide reasons why you considered that low δ13C of POC suggests a 13C depleted DIC pool with more references.
AR: Unfortunately, due to the complicated logistics in the region of sampling, difficulties occurred during the transit of samples from the Lena Delta to the Bremerhaven. We were therefore unable to analyse the samples we initially took for $\delta^{13}C$ of DIC. The citation was put into the right place (Brunet et al., 2005) see the comment below.

RC: Line 420: $\delta^{13}C$ of DIC was found to be negatively correlated with DOC concentration. Is this the observation of Brunet (2005)? If yes, please rewrite the sentence with the proper citation.
Thank you, we changed this accordingly.
L420-423: "*suggests a ^{13}C-depleted DIC pool. Low $\delta^{13}C$ in DIC can be caused by several processes as shown for riverine DIC in the rivers of Patagonia: degradation of dissolved OC (DOC) containing soil organic C will result in low $\delta^{13}C$ of DIC, and $\delta^{13}C$ of DIC was found to be negatively correlated with DOC concentration* ***(Brunet et al., 2005)****."*

RC: General comment. Do your data suggest any influence of lakes on your TSM and POC concentration? How do you rule them out?

AR: This question was not taken into account during our research, despite the fact that we find it very interesting! We suggest that the input of lakes despite their very particular role in the C turnover system and their effect on qualitative and quantitative characteristics of Lena POM would not be significant due to the Lena extensiveness compared to the lakes as it was shown for DOC (Stolpman et al., 2022).

The team of authors would like to thank AR for their work, time, editing and contribution to our manuscript and we wish them all the best!

References used in this response:

Stolpmann, L., Mollenhauer, G., Morgenstern, A., Hammes, J.S., Boike, J., Overduin, P.P., and Grosse, G.: Origin and Pathways of Dissolved Organic Carbon in a Small Catchment in the Lena River Delta, Front. Earth Sci. 9:759085. doi: 10.3389/feart.2021.759085, 2022