Comment on bg-2021-109

Anonymous Referee #3

Referee comment on "Fluvial carbon dioxide emission from the Lena River basin during the spring flood" by Sergey N. Vorobyev et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-109-RC3, 2021

This study presents a very interesting dataset. There is a significant lack of data on GHG emissions during the spring flood of Arctic rivers, so the data collected and presented is very insightful. Becasue of this I recommend putting in some extra work to make the most of the data, streamline this paper and make the conclusions stronger.

Comment to line 170: You change to comparing to k_{600} values from literature, which is not the same as k values but you do not define k_{600}.

Comment to line 176-177: Why did you use air concentrations from Mauna Loa Observatory and not closer stations such as Cherski or Barrow? What pCO_2 air concentration values were used to calculate the fluxes?

Comment to section 3.3: The discussion of the correlation of pCO_2 with landscape parameters is not entirely consistent from the results to the conclusion. For example according to Table 3 pCO_2 is correlated with riparian vegetation, but later on in the conclusion it is stated that it is correlated with the width of the riparian zone. So the riparian vegetation is a proxy for the width of the riperian zone? I note you did these correlations for the tributaries which gives interesting results, but how about for the main stem? It would be interesting to see since in the main stem pCO_2 increases from south to north. The first sentence in the results section (L247-250) gives to understand that you did this but based on the captions of Table 3 and Figure 5 you only did the correlations with data from the tributaries- correct?

Comments to section 3.4: The calculations of the areal lotic C emission for the entire open water season are not entirely clear to me. Did you use different pCO2 and k values for the main stem and the tributaries? You state that 1 to 2 g C m^{-1} d^{-1} covers full variability of the large and small tributaries and the Lena River main channel (L291-293) but Tables 1-2 show that there is values lower and higher than this. Also L348 states that the range in the tributaries is (0.2 to 3.2 g C m^{-2} d^{-1}) and L289 that the Aldan river had considerable higher emissions than Lena river main stem, how was this taken into consideration in the areal C emission calculation?
In terms of the k values used: You answered to the comment from reviewer 2 that you use the k values 4.46 m/d from Karlsson et al., 2021, this is not clear in L167-169. It reads as if you used the value 4.6 m/d based on Serikova et al., 2018 and Karlsson et al., 2021. You do then in L218 state that 4.46 m/d from Karlsson et al., 2021 is used. I would

suggest changing L167-169 so this is consistent.

The dataset collected is very interesting and provides a lot of great insights. To me it is a bit of a missed opportunity to not utilise it more when estimating the areal lotic C emissions of the Lena basin. I would have liked to see how estimated areal CO2 emissions during the spring flood months, calculated with a k value corresponding the higher flow, a larger water surface area (281000 km^2) and your slightly higher pCO_2 values compare to the summer month, calculated with a k value corresponding the lower flow, a smaller water surface area (281000 km^2 - 5022 km^2) and previously published slightly lower pCO2 values. I note that you replied to reviewer 2 that decreasing the water surface area for summer reduced the result by less than 15% which is below the range of your uncertainty. It would be good to see this more explicitly in the publication, this is not clear in section 3.4. Is this what the number 0.67±0.15 (n = 47) (L281) indicates? It would also be interesting to know how much the Lena River main stem contributes to the areal CO2 emissions in contrast to the tributaries.

Comment to lines 383-385: You compare your estimated C evasion to the DOC+DIC lateral export of the Lena River determined by other studies. Since you also collected DOC and DIC data I was wondering if how your data to compares to that of those studies? In L243 I understood that you compared it to your own collected DOC and DIC data, or is this also a comparison with published results? In that case a reference in L243 would be good. In general there is a lack of further discussion of your DOC and DIC data.

The grammar and sentence structuring throughout needs improving, this will greatly help with the overall cohesion and readability.

L 327 says there was no relationship but then in brackts says: (p < 0.05)

Inconsistent use of units:
- L168 4.6 m day^{-1} then L170 m d^{-1}
- L351 Tg C yr^{-1} then L353 Tg C y^{-1}