

Biogeosciences Discuss., referee comment RC2
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Comment on bg-2022-135

Anonymous Referee #2

Referee comment on "Highest methane concentrations in an Arctic river linked to local terrestrial inputs" by Karel Castro-Morales et al., Biogeosciences Discuss.,
<https://doi.org/10.5194/bg-2022-135-RC2>, 2022

Summary of the paper: *The highest methane concentrations in an Arctic river are linked to local terrestrial inputs*. Castro-Morales et al. studied methane concentrations on a 120 km portion of the Kolyma River during the late freshet (twice in June 2019). They observed a strong spatial disparity along the river bed with higher concentrations linked to warmer temperature, low conductivity and closeness to the river bank. This high spatial resolution study in the Kolyma River is the key start to better understand methane concentration pattern in (Arctic) rivers and their potential as methane source/sink. The correlation with temperature is interesting as it poses the question of increasing methane emission from Arctic rivers during the current global warming. It would be great to confirm if the microbes detected during this study are alive (active in the river itself) or dead (originating from the nearby permafrost surficial soils as stated by the authors) by sequencing RNA, although this type of sampling comes with logistical challenges in such remote environments. Overall this study is well done and brings key findings.

Main comments:

- Why did the authors choose to only study dissolved organic carbon (DOC) as a food source of their methanogens while particulate organic carbon (POC) could a food source as well? Especially because the GF/F filter used to filter the water for DOC could be used to quantify POC. Eventually, DOC concentrations are not used at all in this study and could be removed.
- Were there any new OTU detected during the study? If so they should be deposited in GenBank.

Minor comments:

L364, 369: Could you add the instrumental error on the measurement of pCH₄?

L437: Was the river anoxic where Methanobacterium, and Methanoregula were detected? If not, are they rather active or dead (originating from the nearby terrestrial environment)? Did you consider methane production within the river as this has been detected in other aquatic environments (see Bogard et al., 2014 (Oxic water column methanogenesis as a major component of aquatic CH₄ fluxes, Nature).

L457: $r^2 = 0.11$ and 0.21 are rather low correlation coefficients, can you add p values? If p is not significant this needs to be indicated so as to not mislead the reader on the presence of correlation.

L459-470: The paragraph on DOC concentration comes a bit out of the blue after the microbial analysis, maybe add its separate paragraph? Especially because it is not used afterwards

L585: Some methanogens have been detected in oxic environments before, see Bogard et al., 2014 (Oxic water column methanogenesis as a major component of aquatic CH₄ fluxes, Nature).

Typographical corrections:

Since you choose to simplify methane as "CH₄" please to do homogeneously in the manuscript