Review of: "Unexpectedly minor nitrous oxide emissions from fluvial networks draining permafrost catchments of the East Qinghai-Tibet Plateau"

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Potential competing interests: The author(s) declared that no potential competing interests exist.

GENERAL COMMENTS:

The paper present a study that combine field measurements, data analysis and model development to characterize N_2O emissions from the fluvial networks belonging to the permafrost area of the East Qinghai-Tibet Plateau. The paper is extremely

The paper deals with an extremely important and quite new topic. I found it very interesting and quite complete as it covers all the different aspects necessary to perform a solid characterization of the contribution of these fluvial networks to N_2O emissions. Despite this, one point of weakness of the paper is that small streams (stream order 1 and 2) are not directly analyzed and I would have expected a more detailed discussion on this aspect (see also my specific comment 8). I recommend the paper to be accepted for publication after minor/moderate revision.

SPECIFIC COMMENTS:

Comment 1 (Section "***Variability of N_2O concentrations and fluxes***" page 3) "*Thus, we had hypothesized that N_2O would also be entrained during the widespread processes of CH_4 bubble release.*"

How is this hypothesis supported by the analyzed data or literature data referred to similar areas? I suggest to the authors to better support this sentence or to remove it.

Comment 2 (Section "***Biogeochemical processes regulating N_2O dynamics.***" page 3) "*Riverine N_2O concentrations could not be effectively predicted by simple R^2 linear regressions with environmental variables [≤0.1 in most R^2 = cases, including dissolved oxygen (DO, P > 0.05, 0.004) and + R^2 =NH_4 concentrations (P < 0.001,0.1);Supplementary Table 4]*"

This is something very well known in literature and recent papers undeline the effects of stream-river hydrology/morphology in controlling that. Please add the reference to Marzadri et al., (2017, 2021) and Maavara et al., (2018).

Marzadri, A., Amatulli, G., Tonina, D., Bellin, A., Shen, L.Q., Allen, G.H., Raymond, P.A., 2021. Global riverine nitrous oxide emissions: The role of small streams and large rivers, Science of The Total Environment 776, 145148. https://doi.org/10.1016/j.scitotenv.2021.145148.

Maavara, T., Lauerwald, R., Laruelle, G.G., Akbarzadeh, Z., Bouskill, N.J., Cappellen, P.V., Regnier, P., 2018. Nitrous oxide emissions from inland waters: are IPCC estimates too high? Glob. Chang. Biol. 00, 1–

16. https://doi.org/10.1111/gcb.14504.

Comment 3 (Section "***Physicochemical processes governing N_2O dynamics.***" page 5) *"…with increasing stream order…".*

Please, add also the reference to Gariner et al., (2009). I saw the reference in the Supplementary Information but I will suggest to add it also here.

Garnier, J. *et al.* Nitrous oxide (N_2O) in the Seine river and basin: Observations and budgets.*Agriculture, Ecosystems & Environment* **133**, 223-233, doi:10.1016/j.agee.2009.04.024 (2009).

Comment 4 (Section "***Regional and global implications.***" page 5) *"Our upscaling…".*

Please add "(see Methods section)"

Comment 5 (Section "***Regional and global implications.***" page 5) *"Based on this logic, we estimated a total emission…".*

How can an estimation be provided from a logical consideration? Here the authors neglect the 1st and 2nd order streams that are expected to lead high N_2O fluxes and according to that they provide (without mentioning how) an estimation of their emissions.

Comment 6 (Section "***Regional and global implications.***" page 5) *"lotic systems worldwide [0.65 (range: 0.08–2.55) tN_2O-N km^{-2} yr^{-1} and 2.44 (range: 0.55–5.78) kg N_2O-Nyr^{-1}, respectively; Supplementary Table 9]."*

An appropriate reference is required here to support this sentence.

Comment 7 (Methods Section "***GIS analyses.***" page 7) *"Streams and rivers were extracted and Strahler stream order for all stream lines in the four catchments was calculated based on Digital Elevation Model (DEM) data."*

How? Please add here or in the Supplementary Information more details on the method or plugin used with the appropriate references.

Comment 8 (Methods Section "***Upscaling technique.***" page 7) *For 1st- and 2nd-order streams, a range of N_2O fluxes that extrapolated from the relationship in Fig. 3c."*

Figure 3c reports a trend of variation and not a clear relationship. Please, explain better to which relationship you are referring to.

Comment 9 (Methods Section "***Upscaling technique.***" page 7) "*For 1st- and 2nd-order streams, a range of N_2O fluxes that extrapolated from the relationship in Fig. 3c.*"

Replace "that" with "were"