

## Response to reviewer

The manuscript has been improved by the revision. The following points should still be considered:

L396 “In addition, vegetation-associated oxygenation of surface sediments may suppress N<sub>2</sub>O-producing pathways while promoting N<sub>2</sub>O reduction, contributing to lower observed N<sub>2</sub>O concentrations”, in my opinion, this sentence contradicts the statements in paragraph L345ff (and at other places in the text, e.g. Line 416ff), which point out that oxygen input into the sediment by mixing leads to higher N<sub>2</sub>O concentrations. Please explain why this should be different due to O<sub>2</sub> input from plants.

We thank the reviewer for highlighting this apparent inconsistency. We want to clarify that vegetation-driven oxygenation of surface sediments can both increase and decrease N<sub>2</sub>O production by shifting the balance between nitrification and denitrification. While oxygenation can stimulate nitrification near roots and denitrification in adjacent anoxic zones (e.g. Nyer et al., 2022), sustained and strong oxygenation can suppress denitrification and lead to more complete reduction to N<sub>2</sub> thereby lowering N<sub>2</sub>O fluxes (Murray et al., 2015).

We have added this clarification to the manuscript.

Murray, R., Eiler, D., & Eyre, B. (2015). Nitrous oxide fluxes in estuarine environments: response to global change. *Global Change Biology*, 21. <https://doi.org/10.1111/gcb.12923>.

Nyer, S., Volkenborn, N., Aller, R., Graffam, M., Zhu, Q., & Price, R. (2021). Nitrogen transformations in constructed wetlands: A closer look at plant-soil interactions using chemical imaging. *The Science of the Total Environment*, 151560. <https://doi.org/10.1016/j.scitotenv.2021.151560>.

L422 “Additionally, higher N<sub>2</sub>O concentrations outside the bays may partly reflect wind-induced mixing in the more exposed areas, as already discussed earlier.” This repeats the previous sentence (Line 416ff) and does not need to be repeated here again.

We removed the sentence as suggested by the reviewer.

L440 The discussion from this point onwards should be supplemented with references, e.g.: Coupled processes such as nitrate-dependent anaerobic methane oxidation can also link CH<sub>4</sub> and N cycling in non-linear ways (Ref.?).

Finally, sediment disturbance from the research vessel in very shallow areas could explain these anomalous patterns (Ref.?).

What is meant here by the word “microenvironments” – particles in the water column or confined areas in the sediment? Are there any references that should be cited?

In this context microenvironments are referring to confined areas in the sediment.

We have added the following citations:

Briggs, M., Day-Lewis, F., Zarnetske, J., & Harvey, J. (2015). A physical explanation for the development of redox microzones in hyporheic flow. *Geophysical Research Letters*, 42, 4402 - 4410. <https://doi.org/10.1002/2015gl064200>.

Welte CU, Rasigraf O, Vaksmaa A, Versantvoort W, Arshad A, Op den Camp HJ, Jetten MS, Lüke C, Reimann J. Nitrate- and nitrite-dependent anaerobic oxidation of methane. *Environ Microbiol Rep*. 2016 Dec;8(6):941-955. doi: 10.1111/1758-2229.12487. Epub 2016 Nov 9. PMID: 27753265.

Liu, S., Gao, Q., Wu, J., Xie, Y., Yang, Q., Wang, R., & Cui, Y. (2023). The concentration of CH<sub>4</sub>, N<sub>2</sub>O and CO<sub>2</sub> in the Pearl River estuary increased significantly due to the sediment particle resuspension and the interaction of hypoxia.. *The Science of the total environment*, 168795 . <https://doi.org/10.1016/j.scitotenv.2023.168795>.

Nylund, A.T., Mellqvist, J., Conde, V. *et al.* Coastal methane emissions triggered by ship passages. *Commun Earth Environ* **6**, 380 (2025). <https://doi.org/10.1038/s43247-025-02344-8>

L500 “degraded”, Please replace the word, as before.

We replaced “degraded” with “disturbed”.