

Interactive comment on “Dissolved CH₄ coupled to Photosynthetic Picoeukaryotes in Oxic Waters and Cumulative Chlorophyll-a in Anoxia” by Elizabeth León-Palmero et al.

Anonymous Referee #2

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The manuscript "Dissolved CH₄ coupled to Photosynthetic Picoeukaryotes in Oxic Waters and Cumulative Chlorophyll-a in Anoxia" by León-Palmero et al. presents CH₄ measurements from the water column of 12 different reservoirs in southern Spain together with an assessment of different biological parameters, including the abundance of different plankton classes and specific functional genes that could indicate different CH₄ production pathways. The sampling included seasonal measurements from the stratification period, when a pronounced thermal stratification separated the surface from the bottom waters, and the mixing period, when a uniform temperature profile throughout the water column was observed.

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The authors clearly attributed the highest CH₄ accumulation with highly oxygen-deficient waters, typically found in the bottom waters during the stratification period. They could not attribute in-situ production to gene abundances indicating archaeal methanogenesis or methylphosphonate degradation, but they found a significant correlation in oxic waters between CH₄ and a number of variables (the abundance of photosynthetic picoeukaryotes (PPEs), the mean depth of the reservoir, temperature and cyanobacteria abundance), across the different reservoirs.

The manuscript is generally well written and the results are consistent, but I am not fully convinced of the interpretation of the results. While I can agree with the authors' argumentation for the accumulation of CH₄ in oxygen-deficient waters, I have some difficulties with the explanation for the CH₄ distribution in the oxic waters where the authors attribute the CH₄ distribution mainly to in-situ production by PPEs. Looking at the individual CH₄ profiles, a correlation between PPEs and CH₄ is not obvious, and I wonder if the overall significant correlation found by the authors rather reflects the variability between the reservoirs. Is there a significant correlation between PPEs and CH₄ within the individual reservoirs?

I am furthermore not convinced that the vertical transport of CH₄ plays a rather minor role for the CH₄ distribution. The individual CH₄ profiles seem to show the largest surface concentrations in reservoirs with a pronounced CH₄ accumulation in the bottom waters (Type 1), which seems to indicate that vertical transport may indeed be an important source for CH₄ in the surface.

The reservoirs' mean depth is a rather indirect proxy for vertical transport. Did the authors try to quantify the vertical flux based on the thermal stratification and the measured CH₄ gradients? Are there other transport processes like ebullition or degassing that may introduce CH₄ from the bottom waters to the surface? It would also be important to know how representative the sampling stations are for the entire reservoir. Can the authors give any information on the spatial variability within the reservoirs?

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Specific comments:

Title: the title should state that the study is based on measurements from reservoirs.

Line 41: "CH4 inputs may become from..." replace "become" with "come"

Line 88: It would be good to have some additional information about the sampled reservoirs. A map showing the locations and shapes of the sampled reservoirs and the sampling location within the reservoirs would be very useful. What is the main purpose of the reservoirs? Are there human-induced parameters (e.g. periodic water discharge, nutrient input) that could impact the greenhouse gas budgets of the reservoirs? I think this information is necessary to understand the potential variability across the reservoirs, particularly since the information given in the cited reference is in Spanish.

Line 89: replace "next" with "following"

Line 91: are reservoir volume and surface area constant variables? I can imagine that these numbers may show some variability.

Line 91: the description of mean depth calculation and equation (1) are somewhat redundant. I would either remove equation (1) or the description.

Line 105: Please give additional information about the water sampler. What is the volume and the closure mechanism of the sampler?

Line 111: What is the sampled volume for CH4 analysis and the relation between the sampled volume and the volume of the water sampler? Did the authors test for potential CH4 loss during the sampling procedure?

Line 280: replace "exportation" with "export"

Line 285: I would imagine that apart from their origin, the Chla content of the water column is more closely related to POM than DOM, so I am wondering if particulate organic matter (POM) would be more important for the CH4 production than DOM.

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Figure 1-3 and S1-S9: while I found the general presentation of the individual reservoirs very useful, the partly logarithmic scale and the different scaling used for the individual profiles made the intercomparison of the data challenging. Maybe the authors could choose a uniform scaling for the profiles and use inserts to highlight the distribution where necessary.

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