Please see below the point-by-point responses to the reviewers and the actions taken regarding their concerns. In the text below, the suggestions and comments of the reviewers are in black and plain font, and our responses are in italics and blue font.

Anonymous Referee #2

COMMENTS TO THE AUTHOR (S)

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?

In this manuscript, we concluded that the dissolved CH_4 concentration in oxic waters results from several non-exclusive sources as the vertical transport in shallow reservoirs, temperature, and in situ production by photosynthetic picoeukaryotes (PPEs) and cyanobacteria. The abundance of PPEs explained the largest part of the variance in the dissolved CH_4 in the GAM model for the twelve reservoirs during the stratification period (Figure 9), and was significant, along with mean depth, during mixing (Figure 10). The variance explained by each driver may vary among reservoirs when they are analyzed individually, because of intrinsic reservoir properties and a reduction in the range of variability. Therefore, the correlation between PPEs and CH_4 may not appear obvious in all the profiles. The scale variability of this work was across reservoir typologies, not within reservoirs. However, despite that within reservoirs was not the scale of this study, we found a significant and direct correlation between PPEs and the dissolved CH_4 in the next reservoirs: Jándula (p-value < 0.01), Los Bermejales (p-value < 0.05), Francisco Abellán (p-value < 0.01), El Portillo (p-value < 0.01), and Colomera (p-value < 0.001).

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?

The vertical transport did not play a minor role in the dissolved CH_4 distribution. In the manuscript, we have explicitly shown that the mean depth (i.e., surrogate of vertical *transport) was significantly related to the dissolved CH_4 concentration in oxic waters both during the stratification (Figure 9) and during the mixing (Figure 10). According to the results of the Generalized additive models (GAMs), vertical transport was the second driver in importance explaining the dissolved CH_4 in the oxic waters during the stratification period and the first one during the mixing period.*

We think that other processes as ebullition or degassing that might introduce CH_4 from the bottom waters to the surface, but we did not measure the vertical flux based on the thermal stratification and CH_4 gradients. We considered that the mean depth is a worthy, easy to obtain proxy for the vertical transport of CH_4. Unfortunately, we did not study the spatial variability within the reservoirs. The target scale of this work was across-reservoir variability during the stratification and the mixing period. Within-reservoir spatial variability would require a more detailed study maybe just in one or two reservoirs, but hardly feasible in 12 reservoirs.

Specific comments:

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

We have included the word "reservoirs" in the title.

Line 41: "CH4 inputs may become from..." replace "become" with "come"
Line 89: replace "next" with "following"

We replaced these words in the manuscript (Lines 42 and 103).

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.

According to the reviewer´s suggestions, we have included a new figure (Figure 1) and two tables in the revised version of the manuscript to describe the study reservoirs. Figure 1 shows the geographical location of the reservoirs, and in Table 1 we have included the geographical coordinates, the year of construction, and the morphometric parameters of the reservoirs. In Table 2 we have included basic reservoir characteristics: carbon/phosphorus/nitrogen, and chlorophyll-a concentrations
The main purpose that led to the construction of these reservoirs was the water supply and agriculture irrigation (Lines 97-98). We have also included a recently published reference of a study performed in these twelve reservoirs (León-Palmero et al. 2020). In this publication, we studied the importance of the watershed on the emissions of greenhouse gases and the information for each reservoir is very detailed there.

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

Reservoir volume and surface area are not constant variables. However, in this work, we studied a very heterogeneous group of reservoirs, and we assumed that within-reservoir variability was less critical than across-reservoir variability. Therefore, we assumed that the values obtained from the general dimensions were representative of such heterogeneity.

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

We removed the description and kept the equation (1) (Line 107).

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

We took the water samples using a UWITEC sampling bottle of 5 liters of capacity. The water sampler was self-closing (Lines 121-122).

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?

The water sampler has 5 liters of capacity, and we filled three 125 mL Winkler bottles or two 250 mL Winkler bottles. We measured dissolved CH_4 using headspace equilibration in a 50 ml air-tight glass syringe by duplicate (in 250 mL bottles) or triplicate (in 125 mL bottles) from each Winkler bottle. We took a quantity of 25 g of water (± 0.01 g) using the air-tight syringe. Therefore, the sampled volume for CH_4 analysis in the Winkler bottles is 7.5 % - 10 % of the total bottle volume.
We tried to minimize the CH_4 loss by filling up the Winkler bottles very carefully from the bottom to avoid the formation of bubbles and sealing the Winkler bottles with Apiezon® grease to prevent gas exchange.

Line 280: replace "exportation“ with "export“

We did the correction suggested by the reviewer (Line 359).

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 CH_4 production than DOM.

Usually, the POM pool more dynamics than the DOM pool and is well correlated to chlorophyll-a, but also exopolymers released by phytoplankton and bacteria contribute significantly to POM pool and export. In the study reservoirs, the dissolved organic carbon concentration was significantly related to the age of the reservoirs and the forestry area in their watersheds (León-Palmero et al., 2019). *Therefore, in terms of quality, the total DOM may represent the allochthonous, aged and more resistant to* *microbial degradation of the carbon pool. In contrast, the autochthonous organic matter derived from phytoplankton may represent a labile and biodegradable fraction (Lines 363-367).*

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.

We agreed with the reviewer that the inter-comparison of the data might be challenging because of the different scaling. We used the same scale for water temperature and dissolved oxygen concentration. However, the dissolved CH_4 *concentration among reservoirs ranged up to four orders of magnitude (0.02-213.64* μ*M), and to be able to see differences among reservoirs was impossible to use, unfortunately, the same scale for dissolved* CH_4*.*

References

León-Palmero, E., Reche, I. and Morales-Baquero, R.: Atenuación de luz en embalses del sur-este de la Península Ibérica, Ingeniería del agua, 23(1), 65–75, doi:10.4995/ia.2019.10655, 2019.

León-Palmero, E., Morales-Baquero, R. and Reche, I.: Greenhouse gas fluxes from reservoirs determined by watershed lithology, morphometry, and anthropogenic pressure, Environ. Res. Lett., 15(4), 044012, doi:10.1088/1748-9326/ab7467, 2020.