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Comment on bg-2022-170

Anonymous Referee #1

Referee comment on "Role of formation and decay of seston organic matter for the fate of methylmercury within the water column of a eutrophic lake" by Laura Balzer et al.,
Biogeosciences Discuss., <https://doi.org/10.5194/bg-2022-170-RC1>, 2022

General comments on the manuscript

The paper aims to assess the role of seston in the production of methylmercury in a eutrophic lake. The paper is based on water, seston, trap and sediment sampling at seven dates between April and November 2019.

The paper is well written and structured, methods thoroughly described, and results generally well presented. In general, I like this paper, but I find that there are weaknesses in the design of the research and then over-interpretation of some results.

- MeHg has not been measured in the dissolved phase, then there is no clear picture of the overall situation. Based on partition coefficients, and on the concentration of seston in water column, it appears that usually most the MeHg in the raw water column is in the dissolved (or colloidal phase) (see Gallorini and Loizeau 2022, Chemosphere).
- The authors rule out the possibility of diffusion of MeHg from the sediment, without clear evidence, as there is no measurement of seston and MeHg in the water column below RTZ. They invoke "that mixing is minor during times of high productivity (line 265)", however diffusion seems to occur and shown by the Mn profiles.
- The "pronounced" maximum concentration at the RTZ that is at the base of the all discussion and interpretation is not so evident. On line 250 it reads "During periods in which the RTZ was clearly defined, MeHg concentrations in seston showed a pronounced maximum at the RTZ that did not occur in April, when no RTZ was observed (Fig. 3)." The pronounced maximum is clear only in Aug. 19.
- Some discussed variations are very small and probably within uncertainties (e.g. C/N ratio). But the authors do not give uncertainty of the measurements, so it is impossible to evaluate the relevance of the variations.

Detailed remarks

L25 "The methylation of inorganic divalent forms of Hg(Hg(II)) to toxic MeHg is carried out...". The sentence implies that Hg(II) is not toxic, which is not the case.

L 29 " being influenced by temporal and spatial variabilities". It is not clear to which processes these variabilities refer.

L 32 all these references on marine environment (19) are too much. Better to select the most relevant for your purpose.

L50 About MeHg formation in lake snow, see Gallorini and Loizeau 2022, Chemosphere.

L84 As a pump and tubing have been used to sample water and seston, how potential contaminations (mainly for dissolved THg in water) have been evaluated?

L89 text reads "PE Falcon tubes for." The end of the sentence is missing.

L94 text reads "but in most cases covered the upper 4 m". However most figures indicate that the lower sample is at 5 m depth. Moreover, it is not clear why samples below 5 m were not collected.

L97 Is electrical conductivity corrected for temperature? Explain how it and other parameters were measured ? From CTD or on the boat?

L99 The exposure time of the sediment trap (141 days) is very long, and then the material experience early diagenesis if no preservative was added. Then it is not clear why this sample was collected.

L162 change "the" to "then"

L182 and following. It should be better stressed how the author link parameters to productivity. For instance, L188 text reads "Chlorophyll a concentrations were 2.5 to 2.8 8 µg, indicative of low phytoplankton productivity." Chl a is not a measurement of the

productivity, as other factors may change the Chl a concentrations (for instance grazing). Chl a may be a direct proxy of algal biomass, not productivity.

L202 the profile of Fe in May is strange, as Fe(III) is essentially insoluble. So what is the "dissolved" species found in the upper layer in May? Then what happened in August 19, Fe dropped from > 500 to 100 ug/L and increase again > 500 in September.

L203 text reads "After mixing in November, the Mn and Fe concentrations were uniformly low". From Fig 1, Mn isn't low in November, with values much higher than in surface waters measured the other months.

L207 C/N ratio compare organic carbon to organic nitrogen in samples. Is all C in the sample from organic matter? For instance, the sediment trap results indicate C concentration of ~9%, that is 18 to max 30% of the sediment is organic matter. What is the composition of the remaining 70% of the sediment? Does it contain C as carbonates? This point should be clarified.

L213 The decrease of C/N ratio explained by mineralization is not obvious. A reference is needed here, as usually it is the reverse that is observed as mentioned the given reference Meyers and Lallier Vergès 1999. Moreover, is the decomposition the only processes, what about selected grazing or change in composition of the seston (phyto vs. zooplankton) to explain the C/N variation?

L260 text reads "This would explain the continuous increase in MeHg concentrations with depth..." What is the explanation? The absence of microniches does not explain the formation of MeHg at depth, where O₂ saturation is still > 20%. Diffusion from sediments?

L294 Mass loss is the only explanation of the THg increase with depth. However, C concentration decrease by max a factor 3.9, whereas THg increase is a factor 26. Then the mass loss cannot account totally for the increase in THg concentration.

L314 text reads "The sulphide produced may form insoluble complexes with Hg (Shanks and

Reeder, 1993; Bianchi et al., 2018), such as Hg sulphides (HgS), meaning that Hg becomes less available for methylation" It is not so clear that the presence of S decreases the bioavailability of Hg. Barrouilhet et al 2022 ESPR show that methylation potential increases with S concentration before to decrease at high S concentration.

L318 text reads "Thus, THg and MeHg fluxes to the sediment are largely determined by changes in OM composition and mass loss during decomposition." While these processes may change the MeHg fluxes, it is not clear why these processes change the flux of THg: i) if the authors are correct, the increase in THg concentration is due to mass loss in OM, then the quantity of THg remain the same, so the flux, and transformation of THg to MeHg will not change the flux of THg as MeHg is included in THg.

L341 MeHg concentrations in the sediments are not sufficient to assess fluxes from sediments to interstitial water to overlying water.

L354 "Water column MeHg formation and degradation in eutrophic lakes appears to be intense and occurs rapidly and at rates similar to what we observed within the bottom sediments" This statement is not supported by the data/discussion. No rate has been determined neither in the seston nor in sediments.

Fig 1. The scales do not cover the entire range of the results.