

Point-by-point response to Reviewer #2.

Original review comments are in black, and our responses are in blue.

General comments

In this manuscript, the authors reconstructed the global distribution of Pb and its isotopes in seawater with machine learning models. I'm not familiar with machine learning at all. So, I make some comments on this manuscript as a sea-going scientist. The models seem unique and provide some interesting points of view for us. For example, black carbon in air is one of the important factors to reconstruct the global Pb distribution in this model. From this result, I realized that the simultaneous determination of black carbon and Pb isotopes in aerosols is a good topic in the field studies. I think this manuscript is challenging but has possibility to give us some insight on the marine biogeochemical cycles of Pb.

We thank this anonymous reviewer for the positive and constructive feedback. We provide below detailed responses to all comments made by the reviewer.

Specific comments

Line 310, “km/m³”: Is this unit correct?

Thanks for spotting this typo. The unit has been corrected to “kg/m³” (L311).

Line 322 - 325: Is this meaningful description?

We revised the whole paragraph and omitted the sentence in question from the revised version of the manuscript.

Line 365 – 366, “further studies of the Pb isotope compositions of dust and black carbon sources to the atmosphere”: I could not find so many references for these topics, but at least one reference concerning the topics (e.g. Nizam et al., 2020) should be mentioned.

We thank the reviewer for the suggested reference, which has now been added to the text (L364).

Line 370 – 372, “Moreover, black carbon is not only emitted due to fossil fuel consumption, but also from forest fires and coal combustion, which might have substantially different Pb isotope signatures compared to other industrial and urban sources.”: Recently, sources of black carbon in aerosol were discussed from the radiocarbon measurements (Gustafsson et al., 2009; Li et al., 2016). Considering these references, the authors should discuss the sources of the black carbon at this moment.

We expanded our discussion on black carbon sources and included the references suggested by the reviewer in the revised manuscript (L368-374).

Line 385 – 386, “The only exception to this trend is the North Atlantic Ocean, where mapped Pb concentrations at 1000 m and 2500 m are higher than at 10 m.”: From the observational studies, subsurface maxima of Pb were reported in the North Pacific (Wu et al., 2010; Zurbrick et al., 2017; Zheng et al., 2019; Chan et al., 2024; Jiang et al., 2025). Were these features found in this model?

Yes, they were also observed in the model but at different depths than the intervals presented in the figures (between 70 and 500 m depending on location), hence they were previously not discussed. However, for clarity, we have modified the text between L388 and L392, and this now mentions the subsurface maxima in the North Pacific in agreement with observations.

Line 400 - 403: In the Northwest Pacific, the subduction and ventilation process of the North Pacific mode waters and NPIW were considered to elevate Pb concentrations in the subsurface layers (Jiang et al., 2021). Since numbers of data are relatively small in the Northwest Pacific, this feature might not be captured in this model.

Yes, in agreement with the answer above, we also see subsurface maxima in the Northwest Pacific. The sentences between L404 and L409 were modified to include this point in the discussion.

References

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