

This manuscript presents a comprehensive mercury dataset comprising air, aerosols, precipitation, glaciers, soils, surface waters, glacier ice cores, and lake sediment cores collected across the Third Pole. The authors have made a commendable effort to establish the integrated monitoring network through the Atmospheric Pollution and Cryospheric Change (APCC) program, thereby making it accessible to collect samples from harsh environments across the Tibetan Plateau and its surrounding regions. The data are publicly available. I believe this dataset will be of high interest to the Earth system science community, particularly for improving predictions of mercury cycling in cryosphere environments and evaluating its impact under rapid climate warming and cryosphere ablation on the Third Pole.

We thank the reviewer for recognizing the value of this dataset and for raising important scientific and presentational points.

My comments are as follows:

1. Section 2. Observation site descriptions and section 3. Field sampling and measurement methods share a similar structure for introducing various environmental matrices. Is it possible to combine these two sections?

Response: We understand the suggestion to merge Sections 2 and 3. However, we prefer to keep site descriptions and methods separate for clarity: Section 2 provides the geographic context of the sites, and Section 3 describes the sampling and analytical procedures. Merging them would likely lead to overly long paragraphs and disrupt the logical structure. Instead, we have improved the transitions in lines of 226-229 the revision.

2. Observation site descriptions: 1) L152: format error for Huang et al., 4.

Response: Corrected to "Huang et al., 2020a" in lines 151-152 in the revision.

3. Field sampling and measurement methods:

1) Vegetation is a useful environmental compartment to explore mercury cycling between the atmosphere and terrestrial ecosystem. Why didn't the authors collect vegetation samples?

Response: The reviewer rightly notes that vegetation is an important compartment. We acknowledge this limitation. In the early APCC program, we prioritized cryospheric and atmospheric matrices. Vegetation sampling is now underway and will be included in a future data release. Therefore, vegetation was not systematically collected in this phase but is being incorporated into ongoing APCC monitoring.

2) L237: Hg_p is not defined.

Response: We have added the definition at first use in line 242 of revision: "particulate-bound Hg (Hg_p)".

3) L305: If the same analytical procedures were applied as for aerosol and cryoconite samples, these analytical details should be presented above when you describe the aerosol and cryoconite samples.

Response: Since the analytical details for aerosols and cryoconite are already provided in Sections 3.2 and 3.4, we have removed the redundant sentence "The same analytical procedures

were applied as for aerosol and cryoconite samples” from the revision.

4) L317: What is MOS-grade?

Response: MOS-grade HCl is defined as metal-oxide-semiconductor-grade ultrapure acid for Hg sample pretreatment. Has been clarified in line 321 of the revision.

5) L336-338: The authors did not specify which samples were processed for isotope analysis. For aerosol samples, aqua regia digestion cannot eliminate the influence of interfering elements remaining in samples, which may cause the lower recovery of samples and have an impact on the accuracy of mercury isotope analysis. The authors need to point out this limitation.

Response: Thank you for your concern. In our study, all solid samples, including aerosols, were processed using the dual-stage combustion-trapping protocol described in Section 3.8, rather than aqua regia digestion. This method avoids the matrix interferences inherent to acid digestion, achieves high and consistent Hg recovery ($99 \pm 6\%$), and maintains low procedural blanks (<0.1 ng Hg). Therefore, the limitation regarding residual interfering elements from aqua regia digestion does not apply to our isotope analyses. We have clarified this in lines of 340-345 in the revised manuscript.

4. Data descriptions. 1) There are no mercury isotope data from other matrices, why?

Response: We currently present Hg isotopes for aerosols, soils, and lake sediments. Isotope data for air (TGM) and precipitation are not yet available due to insufficient sample mass and analytical challenges. We have added a sentence in lines 342-343: "Hg isotope measurements for air, precipitation, snow, and ice are planned for future studies as analytical sensitivity improves."

2) L352: Do you mean yearly TGM rather than monthly TGM?

Response: Thank you for pointing this out. It was a typo; the correct term should be "yearly TGM" rather than "monthly TGM." This has been corrected in the revised manuscript.

3) L410: There is no MeHg in Fig. 3b.

Response: Thank you for noting this. It was a typo; there is indeed no MeHg in Fig. 3b. We have corrected the text accordingly.

3) L440: here and elsewhere, is the difference significant?

Response: Thank you for raising this point. We have added statistical significance tests for Hg comparisons where appropriate throughout the revised manuscript. For example: "Southern glaciers influenced by monsoon circulation showed higher mean Hg concentrations (66.0 ± 29.3 ng g⁻¹) compared to northern glaciers (42.5 ± 20.7 ng g⁻¹; t-test, $p < 0.05$)." All such additions are highlighted in the revision.

4) L457-463: The expression of “n” is not consistent.

Response: We have standardized to "n = X" throughout Section 4.

5) L531-536: There is no description of lake sediment core $\delta^{202}\text{Hg}$ values. Based on $\Delta^{199}\text{Hg}$, I think it cannot illustrate the rising anthropogenic Hg emissions originating from South Asia, especially for the Tanglha Lake sediment, mercury photochemical reactions can also lead to the positive $\Delta^{199}\text{Hg}$ value. Anthropogenic Hg emission signal may be modified by the atmospheric redox before deposition into the lake sediment. The last sentence, “The dataset offers empirical constraints on Hg distribution, with an emphasis on observational evidence rather than source attribution”, looks strange in the current context.

Response: Thank you for your constructive comment. We fully agree and have accordingly removed the original text you noted. The only remaining statement is "This dataset provides evidence that transboundary atmospheric transport delivers Hg from South Asia northward to at least the Tanglha Mountains in the northern Himalaya-Tibet" in the revision. The revised text in lines 550-552 now focuses solely on observational evidence, as you recommended.

6) There is no further discussion about the mercury isotope data of aerosols and soils.

Response: Thank you for your suggestion. We have added a very brief discussion of the Hg isotope data for aerosols and soils as you recommended. The corresponding text has been included in lines of 540-542 in the revised manuscript.

(7) I think many of the Hg isotope data from the third pole, including air and vegetation, are not included.

Response: Thank you for your valuable comment. The main reason why Hg isotope data from other research groups (including air and vegetation) are not included in this study is due to copyright restrictions. Therefore, this paper focuses solely on data from the APCC monitoring network, which is led by our own research group. We will certainly take your constructive suggestion into account in our future synthesis review on Hg research in the Third Pole.

5. Dataset limitations and applications: The discussion about potential applications is very broad and vague. Please try to be more specific.

Response: Thank you for the comment. We have now revised the manuscript in Section 5 to provide specific, itemized guidance on recommended and not-recommended uses for each subset (e.g., atmospheric Hg, precipitation, snowpits, sediment cores, soils, water). The revised text clearly states what the data can be used for (e.g., seasonal analysis, model evaluation, deposition-flux estimation) and what they should not be used for (e.g., regional extrapolation, long-term trend detection for short-term media, cross-matrix comparison). This addresses the vagueness and makes the applications concrete.

Figures: Fig. 4 is not referred to in the main text.

Response: We have added a citation of Fig. 4 at an appropriate place in Section 4.4 (line 428 of the revised manuscript).

Fig. 7 only shows the sampling location. Is it possible to add THg concentrations like other figures?

Response: Thank you for this valuable suggestion. We have attempted to follow your advice;

however, adding THg concentrations to Fig. 7 is challenging due to the nature of the surface water data (rivers, lakes, glacier runoffs). Unlike discrete point measurements at specific times, these concentrations come from long-term, continuous monitoring across multiple sites (APCC dataset I-6), resulting in a large dataset that cannot be readily condensed into simple concentration comparisons as shown in the other figures of the manuscript.

Fig. 9 only shows the lakes from the northern slopes. Why not show the data from the southern slopes?

Response: We appreciate this constructive suggestion. Accordingly, we have added Fig. 10 in the revised manuscript, which now shows the lake sediment core data from the southern slopes.

Tables: The information in tables doesn't match well with the main text. The authors need to carefully check all the details.

Response: We have performed a thorough cross-check of all tables (Tables 1-5) against the main text. Specifically, we verified the station names, coordinates, elevations, and abbreviations in Table 1; the glacier names, coordinates, elevations, and snowpit information in Table 2; and the lake sediment core locations, depths, and Hg concentrations in Table 3. All discrepancies have been corrected in the revised manuscript.