Seasonal patterns of atmospheric mercury in tropical South America as inferred by a TGM continuous record at the Chacaltaya Station (5240 m) in Bolivia

January 19, 2021

Authors response to referee 1:

The authors would like to thank the anonymous referee for the time-consuming review of this admittingly quite long manuscript, and thank for the comments which helped in improving it. Below, we repeat the referees' observations (bold), our comments (normal font) and the according changes made to the manuscript (italic):

Line 125: Amazon

The capitalization mistake has been corrected.

Amazon

Line 218: What is IQR?

Inter-quartile-range. We agree that this might not be self-explanatory, and added the following clarification after the equation in line 218:

,where IQR is the inter-quartile-range and n is the number of data points.

Figure 2: "distance in degrees" is quite unusual. What it would be in km?

Although native to the used coordinate system, we acknowledge that "distance in degrees" is not totally intuitive, so we decided to provide a conversion factor. We added the following caption in all relevant figures:

Dashed range circles show the distance to CHC in degrees, convertible to km by using the conversion factor 1° = 108.6 km, with an error below 3% in the whole domain.

Figure 3: The meaning of the black dots is not mentioned in the caption.
We agree that this is not self-explanatory (considering the varying definitions used in literature for the whiskers of a boxplot) and added the following to the caption:

Whiskers extend until the highest/lowest data point within the interval [1st quartile – 1.5 IQR, 3rd quartile + 1.5 IQR], values outside that range are shown as black dots.
We would like to highlight that with the correction done to the equation in line 218, the term IQR is already defined in the text as "inter-quartile-range".

Figure 6b: The meaning of data vertical lines is not clear. Comparably to the above case, we added the following to the caption:
Whiskers extend until the highest/lowest datapoint within the interval [1st quartile – 1.5 IQR, 3rd quartile + 1.5 IQR], values outside that range are not shown.

Authors response to referee 2:

We would like to thank the anonymous referee for reviewing this extensive manuscript. We thank for the positive feedback and appreciate the helpful comments and suggestions. Below, we repeat the referees' observations (bold), our comments (normal font) and the according changes made to the manuscript (italic):

lines 77-78: There are also CARIBIC flights to northern South America (Bogota andCaracas)
We changed the sentence slightly to include these destinations as well:

Lastly, some data on South American upper tropospheric TGM concentrations is provided by CARIBIC flights (https://www.caribic-atmospheric.com/) for the routes with São Paulo, Santiago de Chile, Bogota, or Caracas as destination (Slemr et al., 2009, 2016).

Section 2.2.1: Given the low pressure at this high altitude site: Did you use the standard Tekran pump? What was the air flow in the Tekran instrument?

At CHC, air flow is indeed something to be careful about. Yes, we used the standard Tekran pump. The air flow in the Tekran was 0.7 L/min (at STP conditions, 273.15 K, 1013.25 hPa) and was permanently checked by an internal mass flowmeter. In addition, every three months we also checked the flow manually with an external volumetric flow meter. We added the following to the text, in the proximity of line 147:

The instrument worked with a flow rate of 0.7 L/mn at STP conditions, which was permanently checked by a Tylan calibrated and certified internal mass flow meter. In addition to that, every three months the flow rate was controlled manually with an external volumetric flow meter.

line 185: Please give abbreviation MAC

Noting that this acronym is only used once in the text, we decided to put it into "written out" form instead. We replaced MAC with:

mass absorption cross section

Section 4.5 Could it be that a significant part of the volcanic Hg is in the form of PBM and thus not detected by your setup?

Yes, indeed, especially given the certain "affinity" of mercury towards sulfates. To address this, we added the following sentence at the end of the section:

Besides, given that our setup does not detect mercury in particulate form, the magnitude of any volcanic signal received at CHC also depends on the mercury gas-particle partitioning at the time of emission, as well as the transformations it undergoes during the transport.

lines 753-753 I would suggest to add the actual best guess emission factors here oncemore.

We added the following sentence at a convenient place within that paragraph:

The former allowed us to deduce a TGM/CO emission ratio of $(2.3 + -0.6) * 10^{-7}$ $ppbv_{TGM}$ ${ppbv_{CO2}}^{-1}$*, while we used the latter to infer a "best guess" TGM/CO2 uptake ratio of* $0.058 + -0.017$ ${ngm^{-3}}_{TGM}$ ppm_{CO2}^{-1}.

Do you plan to continue measurements at CHC? As the only downside of this work is the still short data set.

This kind of experimental work is highly demanding in terms of technical support, logistics and expenses. This was only possible thanks to the collaboration with our Bolivian colleagues. We agree that a longer dataset at CHC would be of great value to the mercury community, and that extending this set is a goal worth pursuing. Although no concrete plans exist in the present, we deeply hope to be able to expand this dataset in the future.