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Atmospheric Chemistry and Physics
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Discussions

Interactive comment on "First Measurement of Atmospheric Mercury Species in Qomolangma Nature Preserve, Tibetan Plateau, and Evidence of Transboundary Pollutant Invasion" *by* Huiming Lin et al.

Anonymous Referee #2

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The authors present speciated Hg measurements (GEM, GOM, and PBM) at a high-altitude station in Tibet near the border to Nepal. They show a pronounced concentration differences between pre-monsoon and monsoon periods and explain them by changing transport patterns encompassing different source regions, especially those in Pakistan, India, and Bangladesh. They also show influence of biomass burning.

There are only a few measurements in this part of the world and, thus, they deserve to be published. Their interpretation is sound. Unfortunately, the data presentation is marred by at times awkward wording, imprecise citation of references, uninformative

figure captions, etc., and thus it needs a good deal of editing. Some improvements are proposed below.

Factual comments

Section 2.2: This section describes essentially the GOM and PBM measurement but not the measurement of GEM. Sampling time for GEM measurements has to be stated. The reason is that the GEM (with usually 5 min sampling), GOM, and PBM data are probably biased low due to problems with the internal default integration because less than 10 pg was collected for the individual analysis (Slemr et al., 2016; Ambrose, 2017). This problem is especially important at the QNNP station because only flow rates of 0.75 and 7 l(STP) min-1 were used for GEM and GOM/PBM measurements, respectively, instead of the usual 1 and 10 l(STP) min-1. The authors should mention the bias and assess its average magnitude using Fig. 3 of Slemr et al. (2016). This is needed when the data are compared to measurements at other sites. A definition of standard pressure and temperature would be also helpful.

Section 2.4: The use of backward trajectories for identification of the source areas seems to me to be questionable in this particular case. If I understand it properly the trajectory arrival height was set 1500 above the station, i.e. at an altitude of some 5800 m. In addition, the station is located in a very complex terrain (mountains above 8000m) with local winds due to glacier coverage. The question is how well the trajectories are representative for the air analysed at the station? Can the authors say anything about it?

Section 3.1: Averages and standard deviations should always be given with the number of measurements since only with it the significance of the differences can be determined. Are the difference of GEM, GOM and PBM concentration between PISM and ISM periods statistically significant?

Lines 278-283: Subsidence is probably only a part of the explanation, lack of precipitation could be another part.

Table 2 claims to summarise global measurements of GEM, GOM, and PBM which is far from being true. Outside of Asia only three US sites are listed which is only a small fraction of all measurements (Sprovieri et al., 2010, 2017; Gay et al., 2013). In addition, these three US sites are not mentioned in the text. Since a comprehensive list would fill several pages I would recommend to concentrate on the measurements in Asia and for comparison with worldwide concentrations only to refer to above references.

Section 3.2: In the text a sum of GOM and PBM is discussed but in the legend of Figure 3 symbols are declared as PBM or GOM. Please correct. The caption of Figure 3 reads as if the presented diurnal variations were representative of different periods, i.e. as averages of several days, but the reader has an impression that diurnal variations on a single day are presented. Are the diurnal variations measured on a single day (which one?) or do they represent an average of several days? If latter, how many days were averaged and what are the standard deviations or errors of the means? If averages are presented – are their differences. i.e. the average diurnal variation statistically distinguishable and different for different periods?

Lines 500-504: Cai et al. (2007) mentions only a transport from upper level but not from stratosphere. Lelieveld et al. (2018), on the contrary, mentions a flux from the troposphere into the stratosphere in the region but not from stratosphere in the troposphere. Please refer correctly to cited literature.

Lines 506-507: "Atmosphere Hg has been reported to have strongly declined. . ." reads as a universal downward trend. That is generally not true – the downward trend has been observed only in North America and Europe in the last 10 – 20 years. Hg concentrations decreased in the southern hemisphere between 1996 and 2004, increased between 2007 and 2012 and remained nearly constant since. The records for East Asia are mostly too short to allow a general statement – see also the cited work by Tang et al. (2018). In this discussion, I would recommend to use emission inventories and their temporal change instead of trends Hg concentrations.

Editorial comments

Line 42: Why "unexpectedly"? Increase of GOM concentrations with altitude is predicted by some models and evidenced by observations such as at Mount Bachelor.

Line 62-63: The term "half-life" is unusual in atmospheric chemistry. "Lifetime" is usually used and clearly defined. A lifetime of 1- 2 years is somewhat long, current global models estimate GEM lifetime as short as several months. Please add references.

Line 80: "invasions" reads like a military term, "flux" or "import" may be more appropriate.

Lines 90-92: "The ..Hg concentrations. . . originated from. . ." is incorrect because as a consequence of the long GEM lifetime nobody can say where Hg came from. "The air masses carrying high Hg concentrations originated or, better; passed over. . .." would sound more appropriate.

Lines 120-122: "This monitoring site.."repeats a statement in lines 96-97. One of these statements is redundant.

Line 124: Why "comprehensive" when GEM, GOM and PBM are listed?

Line 254: "significantly" – at which level of significance?

Line 542-543: "air masses passed over Himalaya" is more credible than "air masses passed through Himalaya".

Lines 566-567: "Atmos." Instead of "Atoms." Dtto lines 560, 572, 588, 606, 608, 734, etc. Page numbers?

Figure captions contain generally too few information about what the figures display. A figure with its caption should be understandable without reading the paper.

Fig. 3: Solar radiation is difficult to discern, please correct.

Fig. 4: What are the units of wind speed? Please add to the figure or state in the figure

caption.

Fig.5: It would be desirable if the caption contained some information about what the authors understand under “back trajectories analysis”.

Fig. 6 - caption: What “concepts” are shown by the maps?

Fig S2 – caption: What do the diagrams show? Presumably averages, medians, some percentiles – but what is what?

Figure S3: The capture states “Changes of snow cover rate and diurnal index...” Why rate when the y-axis is called snow coverage? What is the diurnal index? In both cases, the percents are of what?

Figure S4: The caption does not mention the diagram.

References

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