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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Monsoon-facilitated characteristics and transport of atmospheric mercury at a high-altitude background site in southwestern China" *by* Hui Zhang et al.

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General comments

RC 1: The topic of the manuscript is important and pertinent to the special issue of the journal.

The paper presents new data of long-term monitoring of air mercury and mercury speciation within GMOS network obtained at the Ailaoshan monitoring station, southwestern China. The title clearly reflects the contents of the paper, the main points of the research tasks, methodology of the data acquisition and calculation are described in the Abstracts. The measurements have been made using unified GMOS standard

operational procedures for total mercury and mercury speciation. The emphasis is on the study of the reasons of the atmospheric mercury variations, dependence on Indian Summer (ISM) and East Asia Summer (EASM) Monsoons, long-term atmospheric transfer, and discussion on characters and geographical location of mercury emission sources. The paper is based on comprehensive mercury monitoring and meteorological data for backward trajectory calculation, which have provided sound evidence of mercury transfer with ISM and EASM air masses and explanation of the air mercury variations in southwestern China based on monitoring at the Ailaoshan station. The obtained data, calculations, and discussions are well structured and presented in the text and Conclusions. The manuscript has a comprehensive reference list. AC: We appreciate the reviewer's insights and supportive comments for our study. Despite the difficult physical conditions at ALS, we were able to collect the data with the support of the GMOS program. We very much appreciate the vision of GMOS and it is our goal to share the data with Hg research community to advance the understanding of atmospheric Hg transport in Asian region under the influence of monsoonal weather.

Specific comments

RC 2: 1). Commonly authors discuss a long-distance transfer for all mercury species, e.g., at lines 272-274: "These westerlies could take the Hg from South Asia and Southeast Asia into southwestern China. Thus, the dependence of atmospheric Hg species on wind was likely attributed to an interplay of regional sources and the long-range transboundary transport of Hg". The drastic difference in the lifetime for air mercury species is well known. Gaseous elemental mercury (GEM, or Hg(0)) dominated in air has the longest lifetime in atmosphere (about one year) that provides really long-distance transfer for dozens thousand kilometers, whereas the lifetime of GOM is about 1 day, and it can be transported from its emission source to a distance only of 300-500 km. Thus, sources and origins of mercury species registered at the site can be different.

AC: We thank the reviewer for pointing this out and have revised the statement as

suggested in the revised manuscript (lines 275-277, page 8).

RC 3: 2). A reference to dependence of the GOM measurement on air humidity (lines 118- 121 and 279-280): “Several previous studies reported that different GOM compounds (HgCl2, HgBr2 and HgO) have different collection efficiencies for the KCl-coated denuder surface, as high relative humidity can passivate KCl-coated denuder and make GOM recoveries decrease (Huang et al., 2013a;Gustin et al., 2015;Huang and Gustin, 2015)”. “A new study reported that high RH could reduce the collection of GOM by the KCl-coated denuder (Huang, Gustin et al. 2015). This could be another reason why the GOM was low in summer”. In this respect, it is very important to compare possible range of uncertainty of the GOM measurement due to humidity variation, with the GOM measured values to confirm or cast doubt on real reason of the GOM variations.

AC: We agree with the reviewer that the variation of humidity could affect the collection efficiencies of the KCl-coated denuder based on the findings of Gustin’s group, and we also observed the extremely low GOM concentrations due to the high humidity at ALS during ISM period.

RC 4: 3). It is not clear what parameters were measured at the Ailaoshan station along with mercury and meteoparameters, particularly, if the discussed CO concentration was measured at the station.

AC: We just measured CO at the ALS along with mercury and meteoparameters, but due to the limited conditions at ALS, we just beginning to continuously measure CO from October 2011 and collected CO data in non-ISM period (The distribution of the Indian monsoon index (IMI), Wind direction, CO and TGM at ALS is shown in Figure 1).

RC 5: Authors mention SO2 measurement only once, in Introduction. The monitoring data of acid gases (such as SO2, NOX) are very useful for mercury emission source identification, e.g. for separating mercury emitting by forest fires or biomass burning

from coal combustion plumes. That can be useful for future research.

AC: Considered that the measurement of CO is sufficient to identify the potential sources, we appreciate the reviewer’s insightful comment. We agree that criterion air pollutants such as CO, SO2, NOX and O3 are important for the data analysis of TGM.

Technical corrections

RC 6: 1). Various writing, compare: 66 : : : trans-boundary transport 68 : : : associated transboundary transport

AC: The wording has been revised as suggested in the revised manuscript (line 67, page 2).

RC7: 2). A misprint at line 84: 82 : : :. to establish a global 83 mercury monitoring network for ambient concentrations and deposition of Hg though ground-based 84 observational platforms and oceanographic aircraft campaigns (Sprovieri et al., 2013). Obviously, here should be 82 : : :. to establish a global 83 mercury monitoring network for ambient concentrations and deposition of Hg though ground-based 84 observational platforms, oceanographic, and aircraft campaigns (Sprovieri et al., 2013)

AC: The statement has been revised as suggested in the revised manuscript (lines 83-85, page 3).

RC 8: 3).Lines 110-111 PBM ($\leq$0.2 μm) were removed using a 47 mm diameter Teflon filter (pore size 0.2 μm). It seems, the correct should be PBM ($\geq$0.2 μm) were removed, or PBM ($\leq$0.2 μm) were collected

AC: We thank the reviewer for pointing this out and the statement has been revised as suggested in the revised manuscript (line 111, page 4). Reference: Wang, X., Zhang, H., Lin, C. J., Fu, X., Zhang, Y., and Feng, X.: Transboundary transport and deposition of Hg emission from springtime biomass burning in the IndoâĂŘChina Peninsula. Journal of Geophysical Research: Atmospheres, 120(18), 9758-9771, 2015. Fu, X. W., Zhang, H., Yu, B., Wang, X., Lin, C. J., and Feng, X. B.: Observations of atmospheric

mercury in China: a critical review, Atmos Chem Phys, 15, 9455-9476, 2015.

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Figure 1 The distribution of the Indian monsoon index (IMI), Wind direction, CO and TGM at ALS

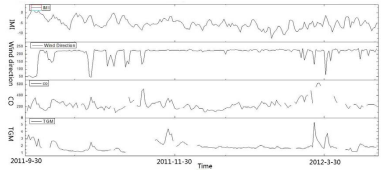

Fig. 1. The distribution of the Indian monsoon index (IMI), Wind direction, CO and TGM at ALS