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Atmospheric Chemistry and Physics
Discussions

# *Interactive comment on* "4D dispersion of total gaseous mercury derived from a mining source: identification of criteria to assess risks related with high concentrations of atmospheric mercury" *by* José M. Esbrí et al.

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The ACP-2019-1107 manuscript entitled "4D dispersion of total gaseous mercury derived from a mining source: identification of criteria to assess risks related with high concentrations of atmospheric mercury", offers an alternative for the characterization of environments contaminated by anthropogenic mercury gas. The manuscript contains original work and will be a valuable addition to the literature since report data of mercury obtained in different spatial region and temporal time (daily and different seasonal period). The authors have studied the extent to which monitoring work must



be extended to obtain sufficiently representative data. Ensuring the data representativeness in geochemical work has always been a major challenge. Working on soil geochemistry, this representativeness is highly dependent on heterogeneity for the elements studied, spatial distribution patterns, and aspects related to sample preparation and analysis. The gaseous character of mercury and atmospheric dynamics complicate the achievement of this purpose, and for this reason the manuscript proposes as necessary the extension in time and space of the monitoring works to ensure the representativeness of the data and thus be able to build a dispersion model of gaseous mercury in the study area. This approach of minimal monitoring work to do represents the main novelty of the manuscript and is adequately presented by the authors. Instead, there are limitations to this approach. The authors have selected a study area with passive mercury emission sources that are almost exclusively dependent on meteorology. It may be one of the simplest cases to monitor, but if the sources are active (for example, a chloralkali industry) or the emission sources are modified (for example, by remediation work on contaminated soils or mining environments), the constructed model shows weaknesses to offer useful data in a risk analysis context. The authors must explain these weaknesses of the model built in the discussion section or/and in the conclusions section. This explanation may be accompanied by a list of adaptation needs or its possible immediate application to different scenarios of interest: mercury contamination by artisanal gold mining, active industrial emissions (chlor-alkali industry, zinc ore smelters, etc) or including natural emissions of volcanism-related origin.

Thank you for the comments concerning our manuscript. As explained in the previous paragraph, the problem that this work sets out to solve was ensuring the data representativeness in the monitoring of areas contaminated with gaseous mercury. As stated in the text, our research group has worked extensively on these characterization procedures, on many occasions detecting data gaps that left part of the local cycle of mercury unexplained or characterized. We often tried to perform the characterization in the worst possible theoretical conditions, but later we found that it is not possible to know the worst possible theoretical conditions in all scenarios. The manuscript proposes a method with minimum work to do to ensure this representativeness, but it is true that the constructed model is adapted to the case study, and in this area, meteorological data can be used to model gaseous mercury concentrations since in the area emissions are passive and dependent on variations in temperature, wind and solar radiation. A paragraph at the end of the discussion section has been added to explain this weakness: “This approach is applicable with little variation to any area affected by diffuse Hg emissions, but will require adaptations if Hg emissions are active, whether it is anthropogenic (mostly industrial) or natural (volcanic related). In these cases, the monitoring procedures must be extended to the emission processes, with the aim of incorporating these data into the built model. In this way, the model will also serve to foresee changes in emission rates, either due to changes in technology in industrial activity, or due to changes in emission patterns in natural processes.”

Another important aspect to consider by the authors is the possibility of adapting this monitoring strategy to feed sufficiently representative data to models of dispersion of gaseous pollutants (Calpuff, ISC-Aermod, others).

This suggestion is very interesting for the future works. We believe that it goes beyond the main objective of the present work, the construction of a simple model based on correlations between parameters that allow the application of this methodology without much economic cost or learning time of the mentioned models. That is why we have not considered them in this work, although it could be an interesting future line of research.

The role of wet and dry deposition and particulate mercury in the local mercury cycle must also be better explained. There are some details in the introduction and a reference by the same authors studying the topic is cited, but there are no references in the text to this topic.

Dry deposition rates were published in a previous manuscript and seems not to be involved in the cycle of TGM in the area. Risk related with this solid material are more related with the incorporation to human trophic chain. We must take in consideration



that a large proportion of Hg appears as bound to humic acids, a Hg compound more available for crops and vegetables. We have added some details about PBM in the methodology section: ”Previous data of PBM of the area has shown that emissions are related with creation of diurnal mixing layer while dry deposition rates (317 $\mu$g m-2 year-1) were in the order of other rural areas, and lower than urban areas (Esbri et al., 2018b)”

The manuscript deserves to be published after this minor revision based on its novelty, presentation and quality of the data provided.

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