

Interactive comment on “Identification of potential regional sources of atmospheric total gaseous mercury in Windsor, Ontario, Canada using hybrid receptor modeling” by X. Xu and U. S. Akhtar

Anonymous Referee #1

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General comments:

In this paper, one year of measurements of total gaseous mercury (TGM) in an urban setting (Windsor, Ontario, Canada) are presented. The data are examined for seasonal variation and compared to meteorological variables. The main effort here was to identify source areas contributing to the TGM signal at the measurement location, using commonly employed techniques: backward trajectory modeling and the potential source contribution function (PSCF). High-emission, industrial regions in the US are identified as important contributors.

I feel that there are problems with the methods used in this paper. A major shortcom-

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ing is the choice of running only one backward trajectory per day, and using a rather dubious start time and starting height. I do not think the chosen criteria can result in a high-resolution or particularly meaningful PSCF (even though, admittedly, their PSCF seems to make subjective sense given the distribution of Hg sources in the U.S.). For this reason, I do not think the paper can be accepted in its present form.

I think the manuscript is reasonably well-presented. I would rate the paper as “fair” to “good” in terms of scientific significance, according to ACP’s criteria. I would not say that it is extremely novel in approach or results given that a number of similar back trajectory studies are available in the literature. However, they present a useful Hg data set and some effort to contribute to our understanding of regional Hg sources in North America, so I do think the paper has merit. It is potentially publishable were the authors to redo their analysis with a more defensible set of set of criteria for their trajectory/PSCF analysis, or at least a more rigorous explanation of how/why they chose to run one trajectory per day, at the same odd starting time. For this reason, I vacillate somewhat between an outright rejection or simply requiring major revisions.

Specific comments P24850 – how close is Windsor (and the research site) to urban Detroit? The authors claim in the Abstract that there are no local sources of Hg. Is this really correct? The authors must firmly establish this.

P24851 – the authors mention quality control – was this needed? Were there any extended periods where data needed to be discarded, and for what reasons? This type of information is highly useful for other groups who are involved in long-term Hg observations.

P24851, line 11 – 10km is a long distance. Can the authors give any indication of how representative the meteorological data are of their specific location, particularly given the urban setting (I presume the airport is somewhat more rural)? If not, this seems to be a potential source of uncertainty. Also, what is the resolution of the meteorological data?

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P24851, section 2.2 – for what purpose were five –minute TGM values averaged to hourly values? Was this for the comparison with meteorological data? I am unsure why the authors would not just simply use the raw, five minute data for any comparisons or determination of seasonal means etc.

P24852, section 2.3.1. – was only one trajectory run per day? If this is the case, this is a serious shortcoming of the paper. Air trajectories can change quickly, as can TGM concentrations. Based on many previous studies, I would say that three trajectories minimum is more appropriate for a full PSCF picture. Furthermore, the single trajectory was run at night, with a starting height of 500 m. This seems highly suspect. Can the authors establish that there is no nocturnal boundary layer or what its' height is? Starting heights of 500 m are often chosen because they represent a midpoint of well-mixed, convective boundary layer. Otherwise, the trajectory may be completely decoupled from the actual TGM observation (for a reference on these considerations, I recommend a similar study by Sigler and Lee, 2006, Recent trends in anthropogenic mercury emission in the northeastern United States, *J. Geophys. Res.* 100, D14306, doi:10.1029/2005JD006814). P24853, line 10 – what was the “certain value” that constituted a high-Hg event, and by what criteria did the authors decide on it?

P28854 – the authors note that seasonal/annual means were used as criteria values. Why? This is somewhat subjective, and the authors could easily have elected to use a much higher value, such as the 85th percentile, which could potentially make their final map more meaningful in terms of local/regional source areas. At the very least, I think the authors should explain/defend their criteria value or cite some previous research that substantiates this.

P24856- it might also be possible that because the measurements are taken in an urban setting, there is a much weaker sink from deposition to vegetation, which can be quite strong during spring and summer at rural sites.

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P24856, line 16 – minor point, but are there any available ozone data from provincial agencies (or perhaps Michigan state agencies) that could be used to better demonstrate this claim? These agencies often have monitoring sites in urban areas.

P24857, line 10-12, section 3.3.1 – again, I feel that this is problematic. One trajectory combined with a daily mean (and a trajectory run at night) seems far too coarse to demonstrate a realistic picture of source regions. TGM concentrations can change rapidly. An above-average daily mean can result from a very brief period of high concentrations, and one trajectory may therefore falsely indicate a source region of Hg.

P24857, line 16 – it is interesting that the Gulf of Mexico would be a source region of elevated TGM to Canada. Can the authors elaborate on this? Are they postulating high re-emission and long-range transport from the marine boundary layer?

P24857 – what is the source of the data presented in Figure 4b?

P24858 – I don't understand the step of using annual criteria values (seasonal makes more sense) to do seasonal PSCF maps. It seems that this could be eliminated.

P24860 – can the authors provide anything concrete to back up the claim of high summertime emission from coal-fired power plants – any data for coal consumption in certain states, or electric power consumption by month or season? The US. Energy Information Administration may provide something useful.

Technical corrections

Table 1 and figure 2 captions should provide more information on which data were used (hourly TGM/met data? Five minute averages?)

P24848, Abstract – This sentence is unwieldy. I recommend removing the dash and the reference to Windsor being the automotive capital of Canada. P24848, Abstract, line 9-11 – if standard deviation is provided for the annual mean, why not for the seasonal means? P24849, line 17 – the 1-3% is comprised by reactive Hg (HgP and RGM), not species “such as reactive Hg”) P24850, line 8 – delete “work” P24852, line 9 – extra ‘s’

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in Polissar P24852, lines 10-15 – it seems this passage is really not needed and can be deleted, or it should be moved to section 2.3.2.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 24847, 2009.

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