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Atmospheric Chemistry and Physics Discussions

Interactive comment on "A 2 year record of atmospheric mercury species at a background Southern Hemisphere station on Amsterdam Island" *by* H. Angot et al.

Anonymous Referee #2

Received and published: 23 August 2014

General comments:

This paper presents a valuable data set in light of sparse atmospheric mercury measurements in the southern hemisphere. The attribution of high (GEM/PBM) concentration events to continental outflow and fire activity using radon, satellite and meteorological data is convincing. The paper is clearly organized and well written (with the exception of minor grammar errors that I have attempted to identify). I recommend publication after minor revisions.

I would like to see more quantification of the results. For example, how much of

your data set (what fraction) was defined as high GEM or low GEM events (and high RGM/PBM)? Of these, how many were associated with local surface emissions/long-range transport/unknown, based on the radon data? There is no time series for the whole period for radon, so the reader cannot even estimate the number of "radonic storms."

I found the paper to be somewhat under-referenced, with a few too many uses of "e.g. [single reference]" where the citation was not a review paper.

I generally agree with the comments of reviewer 1 and have attempted not to duplicate too many points.

Specific comments (marked *)/technical corrections:

p. 14440

l. 10-11: From the text, I believe the lower end of the RGM and PBM ranges given is actually the estimated detection limit (DL) value that you have replaced the <DL data with. Therefore the range would be better stated as "<DL-4.07" etc. Or just report the maximum.

l. 23: "exposition" should be "exposure"

p. 14442

l. 14: The island is downwind, not upwind, of Africa (based on Fig. 2)

l. 20: ". . .and carbonaceous aerosol."

p. 14443

l. 1-2: ". . .in detail by Polian et al. (1986) and relies on. . .the decrease in alpha radioactivity. . ."

*I would prefer here, since it is relevant to much of your discussion and is not as familiar to the Hg community, a sentence or two describing how 222Rn is differentiated from

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220Rn/212Pb.

l. 6: define CRDS acronym

l. 19-21: “we have monitored. . .the latter consisting of various oxidized. . .and hereafter defined as. . .”

p. 14444

l. 7: clarify that the sodalime trap and 0.2 micron filter are past the RGM and PBM collector in the sample train.

p. 14445

*Perhaps it is a North American bias on our part, but I agree with the first reviewer that I would like to know how your QC criteria compare with AMNet/CAMNet ones that are published [1].

*l. 18-20: How much does the replacement of your <DL data with the DL change your statistics? It will bias your mean on the high side, and it may be appreciable given the low levels. I recommend you check and report if the mean using the actual measurements is appreciably different.

p. 14446

l. 9-10: “Precipitation was very frequent with total precipitation of 1262. . .”

l. 13: “peaking. . .” should be “peaked during winter months when the roaring forties were. . .”

p. 14447

l. 11: “did follow” should be “followed”

l. 20: “where” should be “were”

l. 29-2: Is there a reference for EBC? Sciare as well? Perhaps reword this sentence

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so that it is clear which two compounds are “commonly used as tracers for BB”

p. 14448

*l. 4-8: Is this defining the question you address in this section? If so, that is not clear as written.

l. 21: “a few mBq m-3 only” is unclear. Why not have a threshold like you do with 222Rn? 5 or 10 mBq?

p. 14449

*Why is the back trajectory for the 13/12/12 event only 4 days instead of 7 like the others? Can you quantify the scale of the transport compared to other events, if you can’t draw the 4 maps on the same scale?

l. 9: “On the contrary” is not used correctly. You can omit and just say “Most high GEM events. . .”

l. 10, 13: again, “only a few” and “low” 220Rn activity is confusing. It would be much clearer if you quantify as you do for 222Rn and wind speed.

l. 14-15: Was GEM not correlated with 220Rn in this event then?

*l. 18-21: Discuss the limitations of back trajectory models, i.e. back trajectories are increasingly uncertain as you go further back in time, and you are looking at 7 days back. They are also limited by meteorological measurement density, which is low over oceans. Dispersion models give more information about the region of influence; HYSPLIT does have an online dispersion model as well.

p. 14450

*l. 7-8: How did you determine this? By removing those events and comparing the means? If it is based on the mean=median, the “Indeed” is misleading.

*l. 8-14: Is there seasonality to the difference between mean and median? This would

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suggest that one would have to be aware of the season in order to use the Amsterdam Island concentrations as regionally representative. There isn't enough information here for the reader to answer these questions.

p. 14451

*l. 1-3: Did you explore the relationship between precipitation events and RGM or PBM levels to test this assumption? Even just dividing the data set between days with and days without precipitation, similar to your seasonal box plot? Or was there precipitation every day?

l. 5: omit "primary" and "an"

l. 6: "Due to its short lifetime. . ."

l. 6-7: add "in the boundary layer"? As mentioned, RGM can be transported further in the free troposphere (e.g. [2])

*l. 10-11: I believe it is GEM that evades from DGM, not RGM, and the cited reference supports my interpretation. RGM is far too soluble to come out of solution. If there is another reference that suggests evasion of RGM, please correct the reference.

l. 18: remove "at stake"

*l. 22-2 (next pg): I guess you didn't have radiation data? Did you look at diurnal patterns in RGM? Also, why so much detail about methane and temperature, unless you would like to draw the conclusion that OH is not a significant oxidant of GEM, in which case please be explicit.

p. 14452

*l. 12: I would consider March-April to be fall, not late summer. Also, please clarify the relevance here.

l. 14-15: What point sources would emit PBM, if it originates by adsorption of gaseous

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species onto particles? I would suggest that PBM may also include crustal minerals that contain Hg. Omit “GEM or” and “primary.”

l. 15-17: Agree with reviewer 1, more references needed.

*l. 23-25: Were there also twice as many high GEM events in 2013? Did the high GEM and high PBM events coincide?

p. 14453

l. 2-4: Please reword this sentence for clarity and grammar

l. 9-14: Could the discrepancy between AOD/PBM and emissions be related to dry and/or wet deposition rates? Or particle growth rates? Probably beyond the scope of this paper but I am curious.

Fig. 3: Caption indicates “hourly-average. . .PBM. . .and RGM”, which I believe is incorrect.

Fig. 5 (AND throughout text): “Fire counts” (not “fires counts”)

*Fig. 6: It is hard to distinguish 222Rn, 220Rn and wind speed. Please enlarge figure and consider using different colours. Also, I agree with reviewer 1 that dGEM should be aligned on the x-axis.

*Fig. 7: Why is (a) a 4-day back trajectory and the rest are 7-day? Also, is it possible to fix the output maps such that the reader can see the comparative scale of the four event back trajectories (i.e. have them all on the same map)?

Fig. 8: Please state how events are defined

References

1. Steffen, A.; Scherz, T.; Olson, M.L.; Gay, D.A.; Blanchard, P., A comparison of data quality control protocols for atmospheric mercury speciation measurements Journal of Environmental Monitoring 2012, 14, 752-765.

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2. Strode, S.A.; Jaegle, L.; Jaffe, D.A.; Swartzendruber, P.C.; Selin, N.E.; Holmes, C.D.; Yantosca, R.M., Trans-Pacific transport of mercury. Journal of Geophysical Research D: Atmospheres 2008, 113, D15305.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 14439, 2014.