

Interactive comment on “Worldwide atmospheric mercury measurements: a review and synthesis of spatial and temporal trends” by F. Sprovieri et al.

F. Sprovieri et al.

f.sprovieri@cs.iiia.cnr.it

Received and published: 13 May 2010

Response to Anonymous Referee # 3: Specific and technical comments 1262, 14-16, Beginning with “The world’s : : :” : This sentence is a run-on. Please rewrite.

Response: The sentence has been rewritten as follows: “The world’s oceans and seas are in fact both sources and sinks of Hg playing an important role into the Hg cycle.”

1264,6 “Recent studies: : :” this should start a new paragraph.

Response: It has been done.

1264, 20 “General scientific consensus: : :” This sentence doesn’t fit with the previous paragraph and doesn’t introduce or transition to the next topic. It is also has the only

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values provided in the introduction although many other components of the cycle are discussed which have important values, too. But what’s the point of putting them here? Why not mention other values, emission rates, fractions, deposition rate, speciation?

Response: Although Hg monitoring stations have increased in the past decade, the database is currently sparse, especially in remote locations and in the southern hemisphere; however, based on atmospheric Hg concentrations determined throughout both few stationary sites for long periods and measurement campaigns from moving platforms such as ships or aircraft and no-permanent sampling sites distributed on global scale, there is a general scientific consensus about the current global background concentration of airborne Hg of ca. 1.5 to 1.7 ng m⁻³ in the Northern Hemisphere and ca. 1.1 to 1.3 ng m⁻³ in the Southern Hemisphere. Therefore we re-organized the sentence in this part of the paper. Please see Section 1 “Introduction”, L. 20.

1264, 26 “Like atmospheric Hg: : :” this should start a new paragraph.

Response: It has been done.

1264, end and 1265, beginning: Here, the issue of monitoring networks is introduced, and then immediately dropped. But, you return to them again at the top of 1266.

Response: Following your suggestions, the paragraph has been re-organized. Please see Section 1 of the revised manuscript.

1265, 13: “Slemr et al. (2003): : :”, 21: “: : : Lindberg et al., (2007)..” you begin to discuss the results of two particular studies with regard to trends (which is the point of this paper). Why only mention these two papers at this point? It is not clear that they present any special data or conclusions. Then, the topic moves to a different approach (interstitial snowpack air) and deposition. What is the point?

Response: At this point of the paragraph, we mentioned Slemr et al., 2003 because they tried to reconstruct the worldwide trend of atmospheric Hg (TGM) concentrations from

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long-term measurements since 1977 carrying out Hg measurements at different sites in both hemispheres and multiple ship cruises over the Atlantic Ocean. We reorganized the paragraph. Please see section 1.

1266, 1. This paragraph and page begins with a sentence discussing TGM in the Southern Hemisphere. But, the next sentence jumps to efforts to expand monitoring networks in North America. And the next sentence is a description of the purpose of the manuscript. And the following sentences discuss shipboard measurements. This is incoherent. What is the point of this paragraph?

Response:Yes, we agree. It has been reorganized. Please see Section 1

1266, 23: “: : :1970: : :” should be “: : :1970s”. Response:It has been done.

And, you say that “: : : data are available for both hemispheres.” I was not aware that there was any southern hemisphere data from the 1970s. Since this is a review article, the author should include references to representative publications, or other publications which review the data.

Response:Yes, indeed - the sentence has been rewritten. Please, see below:

“Hg concentration measurements in ambient air of documented and accepted quality are available since the mid 1970s for the northern hemisphere and the mid 1990s for the southern hemisphere.”

1268, 24, “The project ‘Mercury : : :’” this should begin a new paragraph on the MOE project.

Response:It has been done.

1269, 18, “A comparison of : : :” this should start a new paragraph.

Response:It has been done.

1269, 20, “: : :have : : : “ should be “: : : has: : :”

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Response:It has been done. Thanks.

1270, 2, “: : : (MBL) lead : : :” should be “: : : (MBL) led: : :”

Response:It has been done. Thanks.

1270, 3, “: : : would lead : : :” should be “: : : would have led: : :”

Response:It has been done. Thanks.

1270, 7 “High HgII: : :” the topic has switched to HgII, but then goes to Hg exchange between the atmosphere and surface water. This doesn't fit and needs to be reorganized. At a minimum, air-sea exchange should be a new paragraph, perhaps a new section heading. But, the very next section is “Over water Hg measurements and air/water exchange”. This information should be moved to the next section.

Response:It has been done. In addition, the last sentence of the paragraph has been moved at the end of the section 2.1.

1271, 20 to 1272,4: on 1271,20 starting with “The transformations of : : : ” This is an introduction to aquatic mercury, which should be in the introduction paragraph of “2.3 Over water Hg : : :”

Response:According to your suggestion, the sentence has been moved into the paragraph 2.3.

1271, 24 “The major components : : :” This statement ignores methyl mercury (MeHg). While MeHg concentrations are usually quite low compared to Hg-tot, they are obviously of much greater importance because of their toxicity and bioaccumulation. The author needs to at least mention methyl mercury, and explain/justify why it is not discussed further.

Response:It has been done. Please, see Section 2.3

1272, 2: Why cite Schroeder and Munthe, (1998) here? Schroeder and Munthe (1998)

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is a review of the entire mercury cycle and doesn't focus on over oceans, air-sea exchange, or the Mediterranean.

Response:According to your observation, Schroeder and Munthe (1998) is a review of the entire mercury cycle and processes occurring within the Hg cycle itself. This is the principal reason of our citation at this point of the discussion. However, we thought to cite other specific references focusing on the topic of the paragraph. Please, see the following references cited.

1272, 2-4: "The efficiency of the evasion : : ." This statement needs references.

Response:The statement has been completed with references.

1272, 14-18: "Mason et al. (1994a): : ." and the Mason and Sheu (2002) are referring to global budgets and so are out of place in this section. Please delete these sentences. You do use values from the studies in the next page, which is fine. But, the sentence in 1273, 8 "Considering the estimations: : ." is all that is needed.

Response:It has been done.

1275, 22: " : : were higher UV radiations : : ." should be " : : was higher UV radiation: : ."

Response:It has been corrected.

1277,26 – 1277,1: Starting with "Fluxes were calculated: : ." Kuss and Schneider (2007) used the flux model of Weiss et al. (2007) (see full reference below), not Weiss-Penzias et al. (2007) as stated. Weiss, A.; Kuss, J.; Peters, G.; Schneider, B. Evaluating transfer velocity–wind speed relationship using a long-term series of direct eddy correlation CO₂ flux measurements. J. Mar. Syst. 2007, 66 (Special Issue), 130–139.

Response:It has been corrected.

1279, 2: " : : seem not be : : ." should be " : : seems not to be : : ."

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Response:It has been corrected. Thanks.

1279, 3: " : : it was observed: : ." makes this sentence ungrammatical. Replace with something like " : : there were : : ."

Response:It has been replaced. Thanks.

1280. There are many more studies from South America, why were only these two studies discussed? A review article should be more thorough. Or, the studies should be mentioned and a clear justification given as to why they are not discussed. For starters, in a quick search I found: Garcia-Sanchez, A., F. Contreras, M. Adams, and F. Santos. 2006. Airborne total gaseous mercury and exposure in a Venezuelan mining area. IJEHR, 16(5):361 – 373. Hacon S., Artaxo P, Gerab F, Et Al. (1995) Atmospheric Mercury And Trace- Elements In The Region Of Alta Floresta In The Amazon Basin, WATER AIR AND SOIL POLLUTION, 80, Issue: 1-4, 273-283. Almeida MD, Marins RV, Paraquetti HHM, et al. (2009) Mercury degassing from forested and open field soils in Rondonia, Western Amazon, Brazil, CHEMOSPHERE, 77(1), 60-66.

Also, Mexico is obviously not in South America, so why is Mexico being discussed in this section? While the monitoring history in Mexico is not comparable to that in the US or Canada, it doesn't make any sense to include it with South America. Either move the Mexico discussion to the North America section or retitle/restructure these sections.

Response:It has been retitle /reorganized and more information added. Please, see the revised section.

1280, 7: "TGM concentrations observed in urban and rural areas were up to 10 ng m⁻³ : : ." But, you go on to say that at Zacatecas mean concentrations were very high at 71.7 ng m⁻³. These two sentences are inconsistent. So, Zacatecas is neither urban, nor rural, nor adjacent to a mining area, then what is it and why does it deserved to be mentioned? The section is lacking clear structure and should be rewritten.

Response:This section of the paragraph is restructured.

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1280, 8: “: : :whereas Adjacent : : :” should be “: : : whereas adjacent : : :”

Response:It has been corrected.

1280, 12: “At two rural sites : : :” Where, in Mexico or South America? Since the previous sentence was referring to Mexico, I'd assume you are referring to Mexico. If so, two sites in Mexico can not be used to characterize rural concentrations in all of South America. This should be deleted or, preferably, the entire section should be rewritten. Response:It has been done. 1281, 14, 16, 22 “: : : ngm-3 ppbv: : :” should be “: : : ngm-3 /ppbv: : :” or “: : : ngm-3 ppbv -1: : :”

Response:It has been done.

1281, 24: “However, recent Chinese : : :” The topic has now drifted into emissions inventories. This topic doesn't fit in this section.

Response:We think that this topic fits at this point of the section because it highlights the discrepancy between the results on the Hg0/CO molar enhancement ratio observed in pollution plumes by Jaffe et al., 2005 at Mt. Bachelor and at Cape Hedo station in Okinawa and the Chinese emission inventories which are a factor of two lower than the ratio in the plumes.

1281, 26 “Fain : : :” . The topic has switched to atmospheric oxidation processes and so a new paragraph should be started. Response:It has been done. Also, the first reports of high HgII at high altitude were by Landis et al., (2005) in Mauna Loa, HI. And, Swartzendruber et al., (2006) were the first to analyze high HgII at high altitude (Mt Bachelor, OR) and show that it was due to atmospheric oxidation and not related to pollution. Both of these papers are already in your bibliography and so you should cite them accordingly, here. Or, you need to justify why you don't want to include or discuss them. Also, you would do well to point out that these three studies found very similar observations all the way from Hawaii to Oregon and Colorado.

Response:Your suggestions have been taken. We added the results from the studies

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performed by Landis et al., 2005 and Swartzendruber et al., (2006) within the paragraph. Please, see the section 2.6.

1282, 4: “: : : reduction, : : :” you mean oxidation.

Response:It has been corrected.

1282, 7 : “Most air quality: : :” This sentence and following are a summary or overview of this section. This section is lacking in structure and should be rewritten. I suggest taking most of the content from 1282,7 to the end, and using this as a start, then list the high altitude sites (like you've done at the end of 2.6) and then organize it around the two or three major scientific issues that these sites/platforms have made a contribution. I.e. studying where transport occurs in the atmosphere, looking at TGM/CO ratios, and atmospheric oxidation studies.

Response:It has been done. Please see the revised section 2.6.

1282, 10-12: “Studies have shown : : :” This needs references.

Response:It has been done.

1282, 17: “: : : : Swartzendruber et al., 2006): : :” This paper is on Mt. Bachelor and doesn't cover any aircraft research. Do you perhaps mean Swartzendruber et al., 2008, J. Geophys. Res., 113, D10305, doi: 10.1029/2007JD009579?

Response:It has been corrected.

1282, 18: “: : : of aircraft ahs : : :” should be “: : : of aircraft has : : :”

Response:It has been corrected. Thanks.

1282, 22: “: : : Mt. Batchelor : : :” should be “: : : Mt. Bachelor”

Response:It has been corrected. Thanks.

1282, 23: “: : : (Jaffe et al., 2003).” This paper doesn't discuss Mt Bachelor. Perhaps you are thinking of Weiss-Penzias et al., 2007, which is already in your bibliography.

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Response:Yes, It has been corrected. Thanks.

1283, 11: “Nguyen et al., : : :.” This sentence is very awkward and unclear. Please split it and improve its readability.

Response:It has been done.

1283, 26: “Hg-species: : :.” This sentence is a run-on and is awkward. Please split it and improve its readability.

Response:It has been done.

1283, 28: I don't any discussion of the Jaffe et al., (2005) observations of Hg at the Cape Hedo station, which would be appropriate, and the reference is already in your bibliography. This would be a good place to mention these observations and their role in highlight the discrepancy in the emissions inventories. Also, they should be included in Table 6.

Response:It has been done within the section 2.6.

1283, 29: “Monthly mean concentrations : : :” These data need citation(s).

Response:It has been added.

1284, “2.8.1 Monitoring network and trends”. There is only one station, the GAW, correct? If so, this does not constitute a network, as the section title states.

Response:The sub-title 2.8..1 has been deleted.

1284, 8: “ : : : the first data obtained until June 1999.” This is awkward and the meaning is not clear. Please reword.

Response:It has been done.

1284, 18: “The Cape Point : : :.” This statement needs a reference, or is it the author's conclusion?

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Response:The reference has been inserted.

1285, 15-20. “During the 3-month : : :.” This sentence is a run-on and is hard to understand. It could easily be broken up into 2 or 3 sentences. I suggest starting with something like: “First identified at Alert in the Canadian High Arctic (Schroeder et al., 1998), AMDEs occur during the 3-month period following polar sunrise.” Then, summarize what happens in the AMDEs.

Response:The sentence following your suggestion is reorganized as: “First identified at Alert in the Canadian High Arctic (Schroeder et al. 1998), AMDEs occur during the 3-month period following polar sunrise. During these events, gaseous elemental mercury (Hg⁰) may be converted to reactive and water-soluble forms, HgII and/or Particulate Mercury, Hg-p, that deposit quickly thus increasing the mercury fluxes and deposition processes in the polar ecosystems. Springtime AMDEs have also been observed in Antarctica (Ebinghaus et al., 2002).”

1287, 20: “ : : : the production and : : :” the remainder of this sentence has multiple errors and needs to be rewritten.

Response:It has been done. Please see the revised section 3.

1288, 14: “ : : : same goal is all : : :” I think you mean: “ : : : same goal is always : : :”

Response:Yes, It has been corrected.Thanks

1288, 24: “ : : : it will possible “ should be “ : : : it will be possible: : :”

Response:Yes, It has been corrected.Thanks

1289, 2-9: “The need, therefore : : :” This sentence is a run-on and the meaning is not clear. It should be broken up into 2 or 3 sentences.

Response: Yes, I'm agree with you. The sentence has been synthesized.

Table 1. There are too many significant figures for all of the RGM and TPM data. At the

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absolute most there are two significant figures (or perhaps three for some of the larger values) but certainly reporting to 0.01 pg m⁻³ is unnecessary and adds visual clutter.

Response: Yes. The Table has been revised following your suggestions. Please, see revised Table 1.

Table 5. Why aren't the Fain et al. (2009b) data or the Landis et al. (2005) data listed here? Fain et al., (2009b) is North America. Along with the Mt. Bachelor data, they could all be described as "Remote Sites", or High Altitude or Free Tropospheric.

Response: It has been done.

Table 6. Probably should include data from Jaffe et al., (2005) from the Cape Hedo station to be consistent with 1283, 28.

Response: It has been done.

Figure 1. This map does not include any sites from North America. Please change the title or add a figure (in Fig 1 or a new figure) that has sites from North America.

Response: Figure 1 has been removed completely because on one side was too complicated to make a map will all the requested information and on the other side was not really necessary to have it in.

Please also note the supplement to this comment:

<http://www.atmos-chem-phys-discuss.net/10/C2622/2010/acpd-10-C2622-2010-supplement.pdf>

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 1261, 2010.