

## ***Interactive comment on “Air-surface exchange measurements of gaseous elemental mercury over naturally enriched and background terrestrial landscapes in Australia” by G. C. Edwards and D. A. Howard***

**Anonymous Referee #3**

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This is a useful and competent study of emissions of GEM from background and naturally enriched surfaces. It appears to use state-of-the-art methods (though more detail is needed here). Similar studies have been conducted in North America, but this is the first from the Southern Hemisphere.

The measurements themselves provide useful information. Given this data set, though, the authors could provide more quantitative analyses and comparisons (including providing key equations where appropriate) to facilitate further comparisons and parameterizations based on their measurements. In several places, discussions are confusing

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and/or non-quantitative.

The comparison with North American measurements, particularly those done in Nevada, is particularly interesting. Because of the extensive measurements done there, it would be useful to find out if the authors can tell us something about how generalizable measurements from either location might be. A scaling-up study to estimate how consistent or inconsistent any parameterizations based on these data would be, would be enormously helpful to the broader community.

I would overall suggest revisions to make the text more clear and quantitative in approach. Specific comments follow.

p 27928 line 20+: "At the 10th International Conference on Mercury as a Global Pollutant (ICMGP) several speakers remarked on the paucity of high quality mercury air-surface exchange data sets (UNEP, 2011)." True, but there must be a better citation than this.

p 27929 line 23: "Estimates of anthropogenic emissions for Australia suggest they account for approximately 7% of the total burden." Total burden of what?

It might be useful to discuss the (presence or absence of) measurements of fluxes of other chemical species in Australia. Based on this information, does the assertion that Australia is particularly different and thus necessary to measure hold up? If so, how different is it?

p 27930 line 16: is North America the only place where such information is available?

p 27931 line 13-14: what is a natural undisturbed measurement site? Is it a natural undisturbed site that was ID'd for measurements now? Or was it a measurement site used in the 1914-1924 period? The sentence is unclear. The later text seems to indicate it is hardly undisturbed, as the description references exploration activity. Please clarify.

p 27932 line 5-10: Yes, considerable progress has been made over the past decade

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in dynamic flux chamber design. Yet the authors reference sampling protocols from 2001 and 2005. It would be useful to enumerate exactly which improvements they have made from the later references in the previous sentence.

p 27936 line 13-14: "The litter results interestingly compare with Oe horizon litter THg reported recently by Obrist (2012) for 14 US forests." This sentence doesn't say anything particularly useful. Yes, they can be compared, but are they the same? Higher? Lower? This doesn't say, just that it is "interesting" (which is a rather poor word choice for a scientific analysis in any event).

p 27936 line 18-20: The structure (and heading of 3.2) makes it seem like this section describes all of GEM fluxes, but this is discussed in most of the other sections of 3 as well. This section seems to indicate magnitudes of total flux, so a revision of the heading may be in order. In general in this section, it needs more detail. "Consistent with those observed by others" doesn't really give me much information. What were the fluxes measured in these other studies? Day/night? What were the underlying mercury concentrations in substrates? This could be very useful information to include in, say, a table, and then discuss. "Congruent" doesn't help much either. In general, this information could be more quantitatively presented.

p 27938, discussion of temperature vs. UV-B: this is an important point, yet it's a bit hidden in the discussion here. Is there a way to make it more quantitative with respect to correlations? What are the mechanisms that this implies? It would be extremely useful to suggest a quantitative relationship explained by the data, and then compare that to quantitative relationships used elsewhere.

p 27938-27939 on the compensation point: what exactly is meant by "Following Xin and Gustin (2007)" here? A quantitative comparison to the results of Xin and Gustin would be warranted as well ("corresponds well" again doesn't tell me much)

Section 3.4 on comparison with northern hemisphere data is very interesting. The correlation is interesting and there is good discussion of the slopes. A related question is

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what sort of error might have been introduced with using NA data instead of Australian, magnitude-wise. If a quantitative comparison is made that can address the temperature variation, what would the difference in total emission have been? Does this data change our understanding of this?

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