

Interactive comment on “Worldwide trend of atmospheric mercury since 1995” by F. Slemr et al.

Anonymous Referee #2

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This is a very good paper. The analysis is solid, the paper is well written, and the results are very important. However I do have a number of comments and suggestions that the authors should consider for the final version. The two most important issues are that they should at least consider the possibility that changes in technology or methodology could be important and they should consider several alternate hypotheses to explain the drop in global Hg concentrations.

Specific comments below: Pg 2360, line 20: I appreciate that the authors have given the ref temp! Pg 2361, line 18: It would also be appropriate to discuss the role that undersampling could play for the manual samples. This can be estimated from S/\sqrt{N} . Pg 2365, line 1: The word “overwhelming” is a bit much here. Really we have only one site that has continuous observations with the same technique. I am not challenging the authors analysis, they have probably done the best that can be done given the available data. I would disagree with the term “overwhelming evidence” when we have only

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one site that has continuous observations over the entire period. Pg 2365, Line 10: In addition to the hypotheses proposed, I can suggest some others: It is possible that our estimate of the GEM lifetime is much shorter than one year. If this were true, then the observations in the north and south Atlantic would not reflect global distributions, but more regional ones. Thus the emission declines in NA and Europe would appear more strongly and not be offset by emission increases from China. I admit that this does not account for the similarity of the hemispheres. (But neither does the authors' hypothesis!) An additional hypothesis is that the ocean/air exchange has somehow been modified. Keep in mind that the ocean is undergoing warming and acidification that could have significant implications for Hg. Also consider that a large amount of Hg is cycled through the upper surface of the ocean prior to ultimate removal. Regarding the hypothesis that the atmospheric decline is associated with declining soil emissions from historical emission, I am puzzled as to how this could be consistent with the 80-100 year lifetime for soils? For example, a 30% drop in 15 years would imply a much shorter lifetime for soil Hg and would imply that soils represent a much greater fraction of the global emissions than is currently believed ($\sim 1/3$). I think all of this points to how poorly we understand the global Hg cycle. A few other suggestions:

Table 1: Mention Cape Point in caption.

Figure 1: It would be helpful to add an additional code or color to indicate which records are manual, which automatic.

So in summary, this paper presents some very interesting data and a plausible/strong argument that global atmospheric Hg has declined significantly over past 15 years. I would say that the authors' hypothesis to explain the results is not very plausible, but there is probably no simple explanation given our current understanding of the global Hg cycle.