

## ***Interactive comment on “Atmospheric mercury in the Southern Hemisphere – Part 2: Source apportionment analysis at Cape Point station, South Africa” by Johannes Bieser et al.***

### **Anonymous Referee #2**

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The authors arrive at a number of, fortunately succinct, conclusions concerning the cycling of mercury in the southern hemisphere. While the conclusions themselves are not surprising, they are important because of the dearth of data from below the equator and therefore it is important that they are part of the scientific literature. I wholeheartedly recommend publication in ACP. That said, the manuscript is a little long-winded at times, some serious editing and perhaps moving some of the longer descriptions of the results to a Supplementary Information section would make the article more readable and accessible to the readers not familiar with the global mercury cycle. The conclusions could quite reasonably provide an outline for the structure of the manuscript which would make the article easier to read. The role of the South

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African continental landmass and ocean regions and their associated characteristics (S. America: biomass burning/ASGM emissions, warm ocean (Agulhas- emissions), cold ocean (Antarctica- little variation)), for example. As it is, the manuscript provides a lot of information but little direction to where it is wants to arrive.

A few more detailed comments follow.

Abstract:

L17 'fulfill' maybe complete is better L21 the meaning of 'legacy emissions' may not be clear to all readers L21 when the authors use 'levels' are they referring to burdens, concentration fields, deposition fluxes, totals in environmental media? Last paragraph. The measured concentrations and trends from long-range transport are independent of the source region, but year to year variability is due to mining and biomass burning. These do not occur in Antarctica, the authors need to explain more clearly what they wish to say.

Introduction:

L43 'forces'? Maybe 'commits' or something similar would be more diplomatic. L58 could you add the Part 1 paper to the reference list

Methodology:

L86-7 The station has been .... 1970s L90 Paper 1 in the references Figure 1. As far as I am aware the emission inventory from the GMA 2018 is not in the public domain, so the authors need a private communication reference or to use the previous emission inventory, which is not dissimilar.

Modeling:

Figure 2. This needs to be revised. Readers are probably not used to this projection and so it takes a while to realise we're looking at South America, South Africa and Antarctica. The scale is non-linear which is not mentioned. The dotted blue lines are

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not clear, nor is the fact that they represent latitude and longitude.

Regionalization:

A figure showing where the regions are would be worth a thousand words. L133 the choice L134 how much does the uncertainty increase? L142 Radon isn't anthropogenic, terrestrial maybe?

Identification of source/sink regions

Just a question, does the climate in South Africa divide into four seasons? L161 source/sink rather than just source regions L164 It might be more helpful to put this description in the caption figure, so that the figure is self-explanatory and reduce the descriptive text in the section. L173 low Radon shows less terrestrial influence, rather than less anthropogenic influence? Would it be possible to put quite a lot of this section into a series of bullet points/algorithm describing the procedure? Figure 3 needs a more descriptive caption.

Results:

If the authors stated their main findings and then described how the data/analysis supports these findings it would so much easier to read this section. Section 3.2 is the description of a table, very difficult to read. Section 3.3 L330 to L336 along with L349/50 sum up almost all that is necessary to say here, it seems. Section 3.4 If the authors removed L352 - L356.5 and started the section with 'Air masses from long-range transport . . . make up 90%' would it change anything apart from the readability? The Results should present Results. Preferably with short sentences to improve clarity. Section 3.5 This is extremely interesting, unfortunately the 'having shown . . .' L388 is not convincing because the preceding sections are so prolix that the reader gets lost. L396 The identified processes are not stated clearly in the results section, or just not evident in all the extraneous description.

Conclusions:

Reading the article, the conclusions really were not made evident during the Results/Discussion (2) The Agulhas Current is mentioned twice in the article, and one of them is in the conclusions, so the reader should remember that the warm western boundary current flowing southwards between Madagascar and Mozambique is called Agulhas and influences atmospheric Hg concentrations in South Africa? I'm afraid the part that described its influence did not stand out in the Results. (3) So the measured Hg is of marine origin? (5) This is very interesting. How do the authors link gold mining though? The emission inventories we have do not cover these years, while biomass burning inventories are more up to date. Would it be possible to use a surrogate such as gold price which may indicate the profitability of artisanal and small scale gold mining. Industrial gold production is not an indicator of mercury emissions as the gold is refined using cyanide not mercury. (6) Very valid point, the ocean will mitigate mercury emission mitigation strategies for some time. The authors could highlight this, and also our current lack of knowledge of the details of the dynamics of ocean-atmosphere mercury exchange processes.

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