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Interactive comment on "Statistical exploration of gaseous elemental mercury (GEM) measured at Cape Point from 2007 to 2011" *by* A. D. Venter et al.

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Summary

In the article the authors analyze a gaseous elemental mercury (GEM) time series from the Cape Point Global Atmosphere Watch (CPT GAW) station ranging from 2007 until 2012. Different statistical methods and back-trajectory analysis were applied to identify the origin of high and low mercury concentrations. Furthermore, multiple linear regression (MLR) was used to predict mercury concentrations at CPT GAW from trace gas concentration and other atmospheric parameters. The regression was also used to gain insight into the relation of the parameters with mercury concentrations.

General impression

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I regard the measurement series especially at this location in the southern hemisphere as highly important. Therefore, the analysis of this series is of great interest. Generally I would argue that the methods used to either identify source regions or estimating GEM concentrations are not suitable and not well enough applied to draw concise conclusions.
I encourage the authors to reconsider their methods before resubmitting the manuscript. The data-set is highly interesting and worth being published.

Major comments

1. Cluster analysis

The cluster analysis was used to distinguish between high an low concentrations. Strangely only two clusters were formed. The authors justify this choice with a high silhouette number for two clusters (fig. 2) and significant amount of GEM data. But since only two groups are formed I would assume the separation at 0.904 ng/m^3 amounts about to the mean or median concentration, which could serve as a separation equally good.
The problem with using only two clusters is visible when looking at the source region analysis. Here they compare all the values above 0.904 ng/m^3 with the ones below. Yet most of the measurement points lie very close to this line and are certainly not containing much valuable information and still dominate the plots (fig. 4). I would argue that using quantiles on their data and comparing for example data below the first quartile (low concentrations) with data points above the third quartile (high concentrations) would result in much more detailed plots. It would focuse the analysis on the extreme data points, not on the majority of data points lying in the middle. I therefore question the cluster analysis as the adequate method in this case.

2. Multiple linear regression

When looking at part 3.3. I question that multiple linear regression (MLR) has been adequately applied here. Since the root mean square error (RMSE) is always decreasing

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with increasing variables, the choice of eight variables for the MLR comes at random. The choice of number of variables must be made according to a criterion which penalizes an MLR with many variables (expl. Akaike Information Criterion (AIC)).
However, the relationship they obtain from the MLR can also be obtained by simply doing individual linear regression of the chosen parameters with the GEM measurements.

3. Conclusion

In Section 4 the authors present a summary of their work and an outlook, but the conclusions are missing. It is not clear what processes; ships or cities are responsible for GEM emissions.

Minor comments

- Some acronyms are not defined in the manuscript, or too late
- US and British English is not used consistently.
- Fig. 6, showing the GEM concentration against duration above the ocean in the same plot would be interesting
- on fig. 5 it would be interesting to enlarge the point of interest; South Africa
- a figure of the whole GEM series with lower resolution and plotted mean concentration would be interesting
- on p.4037, l.27, WD (wind direction) is not mentioned as a parameter included on the MLR (eq. 1). However, eq. 1 does not include WD.(?)

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