Research brief
Increasing mercury trend observed at Cape Point Global Atmosphere Watch (GAW) Station from 2007 – 2015

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Gaseous elemental mercury (Hg^0) is the dominant form of natural and anthropogenic Hg emissions and is transported globally through the atmosphere. Mercury, released into the environment by natural and anthropogenic activities, cycles between the atmosphere, water, and land reservoirs. Because of fast mixing processes in the atmosphere, monitoring of tropospheric mercury concentrations and of its deposition will thus be the most straightforward way to verify the decrease of mercury emissions expected from the implementation of the Minamata Convention. According to Zhang et al. (2016) worldwide anthropogenic emissions decreased from 2890 tonne Hg yr^{-1} in 1990 to 2160 tonne yr^{-1} in 2000 and increased slightly to 2280 tonne yr^{-1} in 2010. However, there is indeed some recent evidence that the downward trend in the Northern Hemisphere is slowing or even turning upwards (Weigelt et al., 2015). Here we report on the atmospheric mercury trend observed at the Cape Point (CPT) Global Atmosphere Watch (GAW) station from March 2007 till June 2015.

In a recent study by (Martin et al., 2017) - briefly summarized here the long-term dataset collected at CPT was analyzed using The Mann-Kendal test for trend detection. Figure 1 shows the monthly average GEM concentrations calculated from all data from March 2007 until June 2015, and in the lower panel monthly average GEM concentrations were calculated from baseline data, i.e., GEM concentrations measured at ^{222}Rn concentration ≤250 mBq m^{-3}, which is considered to represent essentially marine air. The slope of the least-squares fit of all data (0.0222 ±0.0032 ng m^{-3} $year^{-1}$) is not significantly different from the slope calculated from the baseline data only (0.02190 ±0.032 ng m^{-3} $year^{-1}$). Sen's slope and trend significance were found to be 0.0210 ng m^{-3} yr^{-1} for all data and 0.0208 ng m^{-3} yr^{-1} for background data respectively. Sen's slopes tend to be somewhat lower than the slopes from the least-squares fits, but they are in agreement within the 95% uncertainty range. All trends are highly significant, i.e., at a level ≥99:9 %. The results are essentially the same whether monthly median or monthly average concentrations are used. This shows that the trend is robust and not influenced by occasional pollution or depletion events. This is the first analysis that suggests an increase in atmospheric mercury concentrations. During the 2007–2015 period the highest upward trend was found in austral spring. Hg emissions from biomass burning in South America and Southern Africa both peak in August and September. Biennial variation of the GEM concentrations at Cape Point, (not shown here) suggest that climatological changes of transport patterns can also play a role in seasonally different trends.

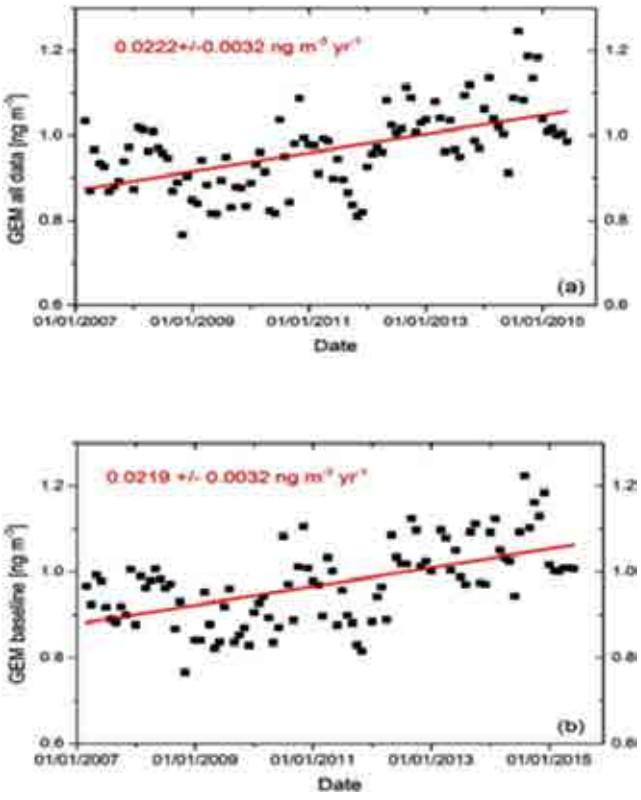

Figure 1: *Monthly average GEM concentrations and their least-squares fit: upper panel – all data; lower panel – baseline data (i.e., only GEM concentrations at ^{222}Rn concentrations ≤250 mBq m^{-3} [taken from Martin et al. 2017]*

We report here an upward trend for mercury concentrations at CPT for the period 2007–2015. We show that the observed

trends of GEM concentrations at CPT result from the trend of worldwide mercury emissions and are modulated by regional influences. Combining all this evidence, we conclude that the worldwide mercury emissions are now increasing, after a decade or two of decreasing emissions. This finding is consistent with the temporal development of mercury emissions in the most recent mercury inventory.

References

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