# ATMOSPHERIC MERCURY MEASUREMENTS AT CAPE POINT, SOUTH AFRICA: LATEST TRENDS AND FINDINGS

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## Introduction

Measurements of gaseous elemental mercury (GEM) made at Cape Point, South Africa, since September 1995 represent the longest existing time series of GEM measurements in the southern hemisphere. Two techniques were used: a low resolution manual technique until the end of 2004 (Slemr et al., 2008) and a high resolution automated technique since March 2007 (Slemr et al., 2011). An analysis of the low resolution data (about 150 measurements per year, each covering 3 h sampling time) by Slemr et al. (2008) revealed a substantial decreasing trend and a seasonal variation with maximum GEM concentrations in austral summer. Slemr et al. (2011) analyzed the combined low and high resolution data until the end of 2009 and found: a) no evidence of a data discontinuity due to the change in techniques, b) an agreement with ship measurements made in the vicinity of Cape Point and c) a pronounced decreasing trend amounting to $-0.034 \pm 0.005$ ng m$^{-3}$ yr$^{-1}$. In the meantime the high resolution data revealed the existence of hitherto unexplained short depletion events (Brunke et al., 2010). In this paper we will present a trend analysis of the data set extending till the end of 2014 and a re-analysis of seasonal variation from the high resolution data as well as the influence of El Niño Southern Oscillation (ENSO) Index on the Cape Point GEM.

## Methods

The Cape Point station is part of the World Meteorological Organization´s (WMO) Global Atmosphere Watch (GAW) network. It is located about 60 km south of Cape Town on top of a coastal cliff 230 m above sea level at the southern-most tip of the Cape Peninsula. Between September 1995 and December 2004 mercury was collected on cartridges packed with Au or Ag coated quartz wool which were then analysed manually in a laboratory (Slemr et al., 1985).

## Results

Fig. 1 shows an updated time series of GEM median concentrations of all measurements at Cape Point since September 1995 until the end of 2014. Annual medians and averages from the “all data set” were found to be statistically the same as the annual medians and averages for the baseline data (defined as GEM concentrations at $^{222}$Rn $\leq$ 250 mBq m$^{-3}$ (Brunke et al., 2004). All measurements were thus used in Fig. 1a, because $^{222}$Rn measurements are available only since March 1999 and the application of the baseline filter on the other low resolution data would reduce the data base to merely 30 measurements per year. Over the

whole period the GEM concentrations decreased with a significant trend of -0.028 ng $m^{-3}$ $yr^{-1}$ (Sen´s slope estimate, significant at the 99.94% level) for low resolution manual technique. However, an increasing systematic trend is visible in the high resolution data since March 2007 to Dec 2014. Fig 1b, summarized a comparison between two Hg species (i.e. GEM and TotHg) which was made over a seven year period (2007-2013) using the results obtained during the rainy season (May – October). The most noteworthy result, however, is the strong correlation observed between GEM and the El-Nino Southern Oscillation (ENSO) signal, especially during the 1996 - 2004 period. These correlations (Figure 1b) suggest that the inter-annual variations of GEM (and also TotHg) concentrations are primarily influenced by large scale weather phenomena. Meteorological processes can affect mercury emissions directly, for example, by periodic changes of surface ocean temperatures during ENSO events, or indirectly via extended droughts leading to increased biomass burning which in many cases is also a source of GEM.

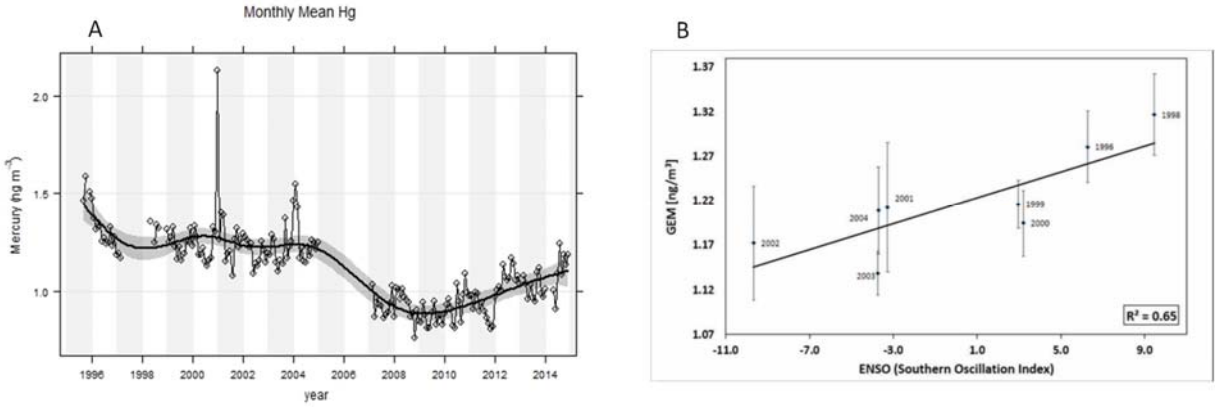


Fig.1a) Cape Point annual median GEM concentrations (all data) Sep 1995- Dec 2014 (b) Relationship between Cape Point GEM averages (May to October) and Southern Oscillation Index (SOI) 1996 - 2004.

## Conclusion

We thus conclude that meteorological influences on mercury emissions is the major reason for the positive GEM versus TotHg and GEM versus SOI correlations. Finally, an increasing trend for mercury concentrations at Cape Point for the period 2007–2014 was observed as was expected based on increasing worldwide anthropogenic emissions.

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