

2006-07 Measurements of Atmospheric Mercury Species in Halifax, Nova Scotia

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Abstract

Environment Canada's Atlantic Region began a sampling program in January 2006 to measure atmospheric mercury species from a site in Halifax, Nova Scotia (Canada). This program involves the analysis of gaseous mercury species - elemental mercury (Hg^0), reactive gaseous mercury (RGM), and the particulate (Hg_p) fine fraction ($<2.5 \mu m$). Sampling is conducted using the Tekran integrated sampling system - 2537A analyser, the 1130 RGM sampler and the 1135 particulate Hg sampler. This poster will illustrate the trends observed in gaseous Hg species from January 2006 to July 1, 2007. The data set - show Hg^0 having a median of 1.67 ng/m^3 and a range from 0.716 to 46.5 ng/m^3 ; for RGM a median of 2.43 pg/m^3 with a range from the detection limit (dl) to 140 pg/m^3 and for Hg_p a median of 1.75 pg/m^3 and a range from dl to 30.8 pg/m^3 . The median levels of RGM and Hg_p were only a very small percentage ($\approx 0.1\%$) of the Total Gaseous Elemental Mercury.

Methods

Sampling for atmospheric Hg species in air of the Halifax Regional Municipality was established from the third floor roof of Environment Canada's Queens Square office building. This site is located in an urban area with a population base of $\sim 360,000$ within half a km from an active commercial harbour.

The analysis of the Hg^0 , RGM, and fine fraction ($<2.5 \mu m$) Hg_p is being carried out using a Tekran integrated sampling and analysis system. This system incorporates analysis of Hg^0 with the Tekran 2537A, RGM sampled with the Tekran 1130 and Hg_p sampled with the Tekran 1135 unit. A Tekran air dryer unit (Model 1102) was connected to the 1130 zero air supply to eliminate artifacts from the zero air canisters affecting the gold traps in the 2537A analyser unit. The sampling programmed was set for a composite 3 hour sample for RGM and Hg_p . During this sampling mode, air is drawn through the system at 10 l/min . for a total volume of 1800 litres of air sampled. During this 3 hour sampling period, RGM was collected on a KCl-coated quartz denuder and the Hg_p was collected on the quartz filter. During the 3 hour sampling period, 5 minute integrated samples of Hg^0 were continuously measured with the 2537A analyser unit.

The 3 hour sample period was followed by a desorption cycle of one hour for sequential transfer of the collected Hg_p and RGM to the 2537A analyser. During the first step, a pyrolyzer oven was heated to 850°C , to ensure complete decomposition of Hg compounds eluted from the Hg_p filter and RGM denuder. First the Hg_p filter was heated to 850° followed by the denuder (RGM) heated to 500° , each sequentially desorbed for 15 minutes. The Hg from the Hg_p and RGM samplers were quantified as Hg^0 by the 2537A unit. After this desorption step, the 1130/1135 sampling units were cooled for 10 minutes before the beginning of the next sampling cycle. The denuder, quartz filter unit (Quartz Regenerable Particulate Filter assembly RPF) and impact disk were changed out biweekly. Prior to the first analysis cycle after this change out, both the denuder and RPF units were conditioned with a heating cycle (500°C denuder; 850°C RPF) of 20 minutes with zero air flow, followed by 15 minutes of cooling. The in-line sample filter ($1 \mu m$ glass fibre) was changed weekly.

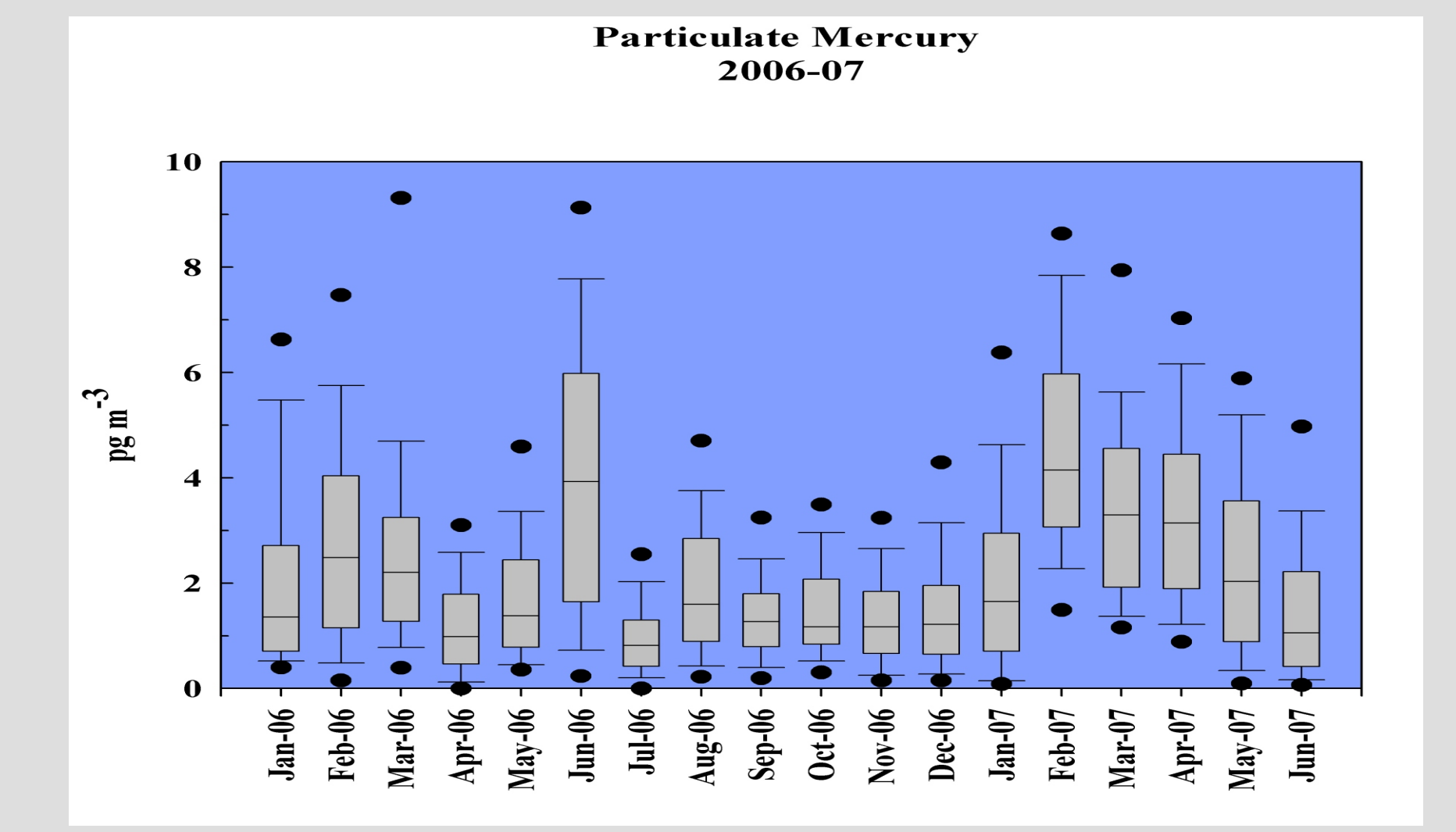
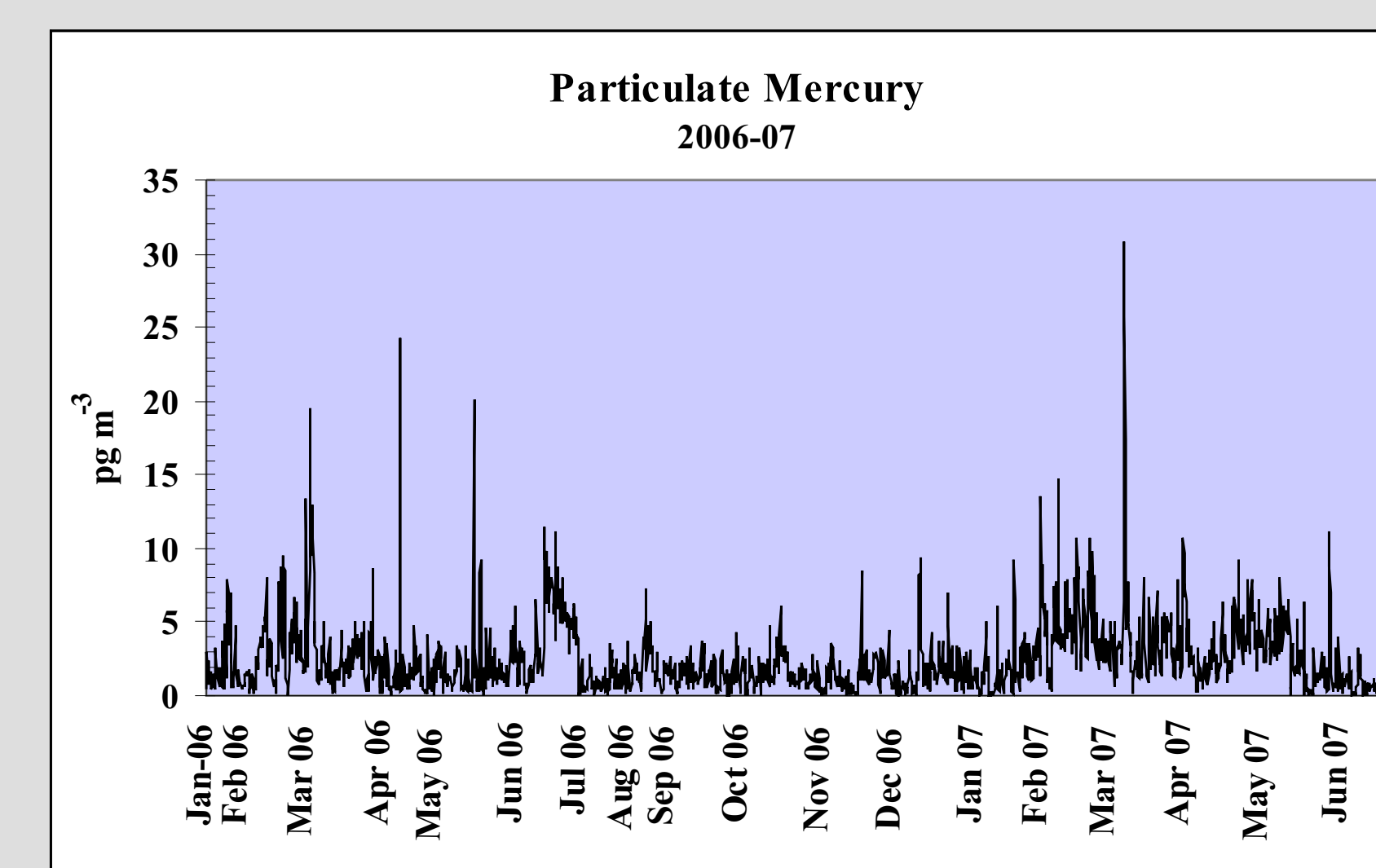
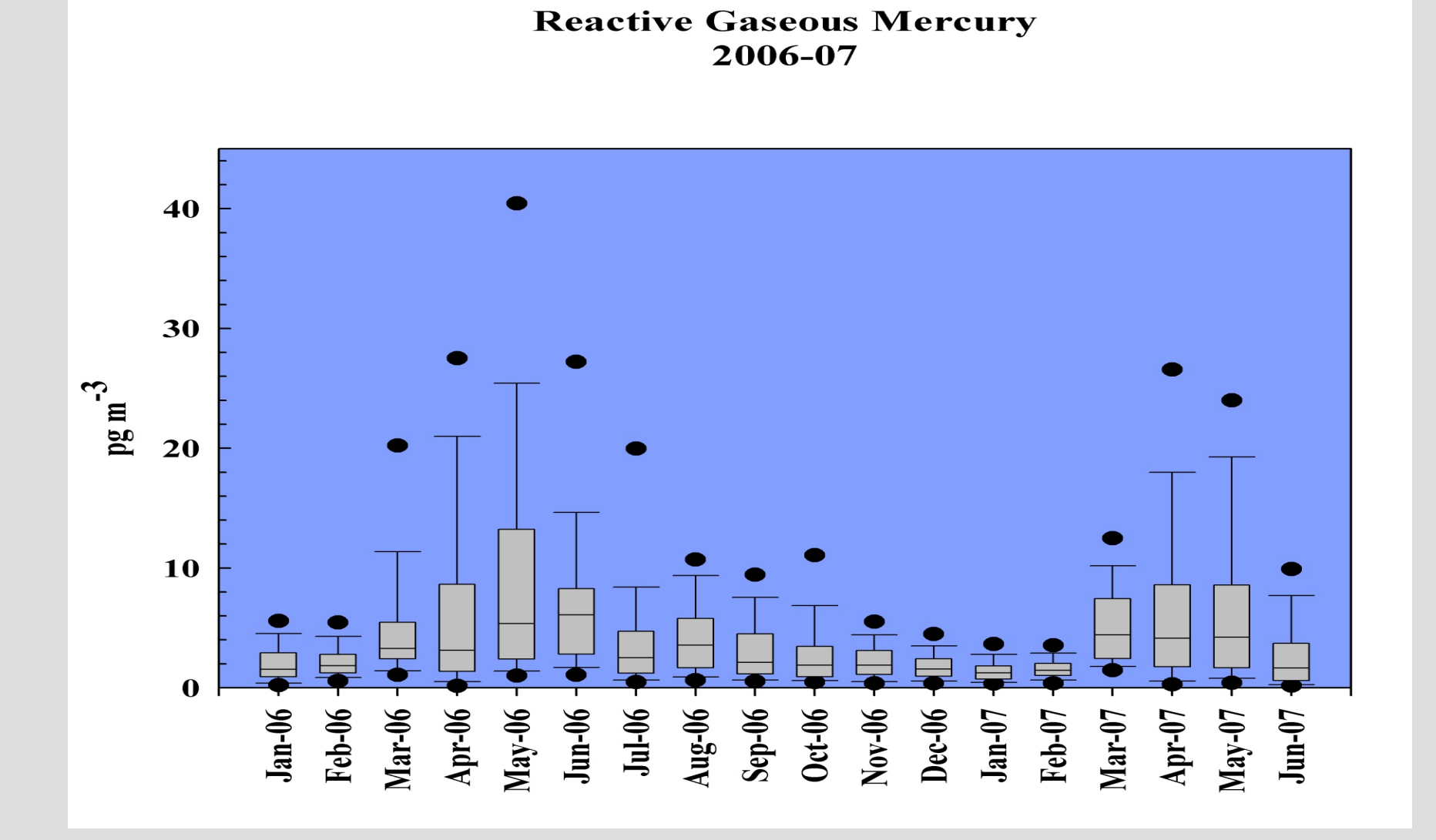
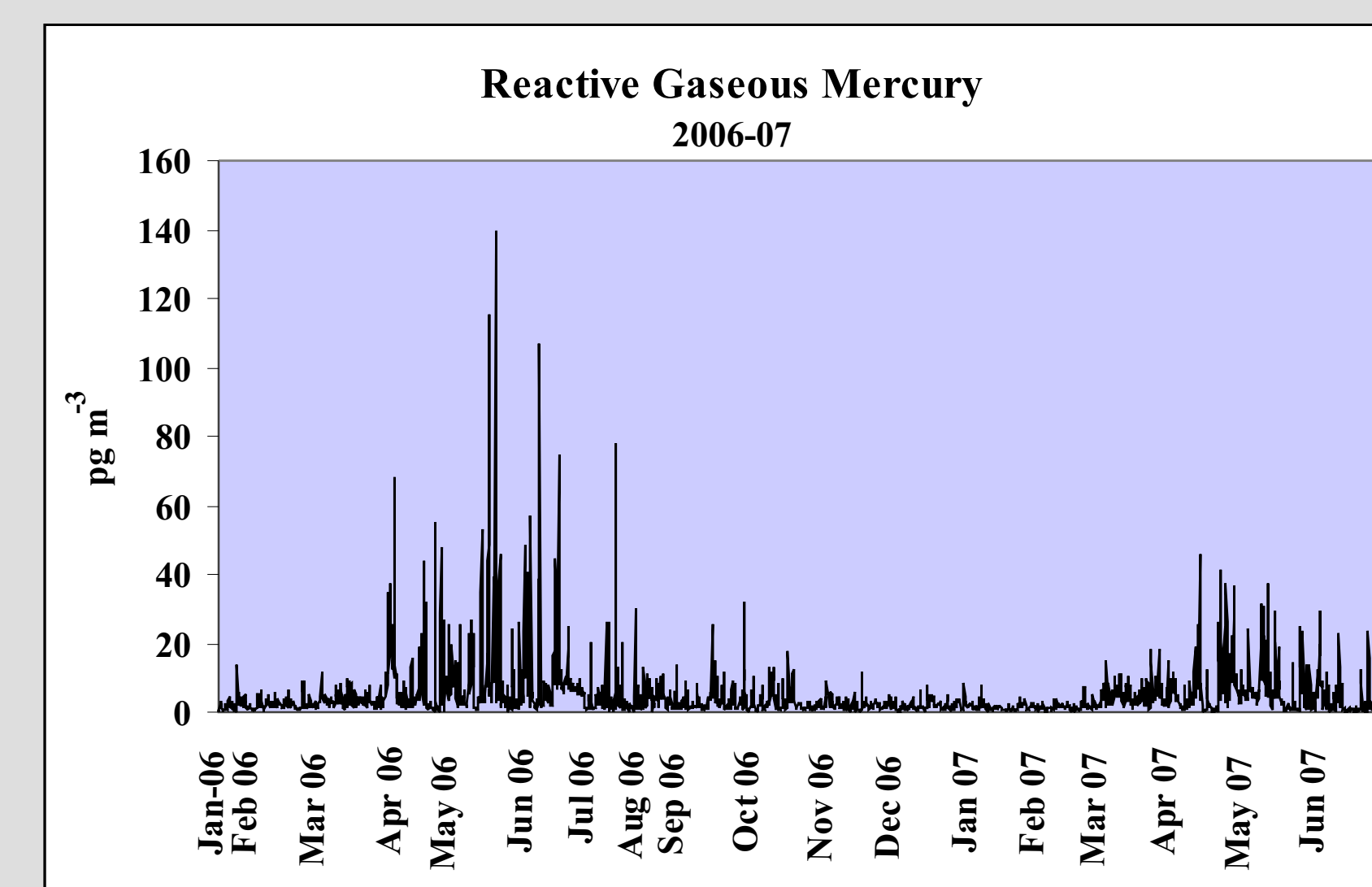
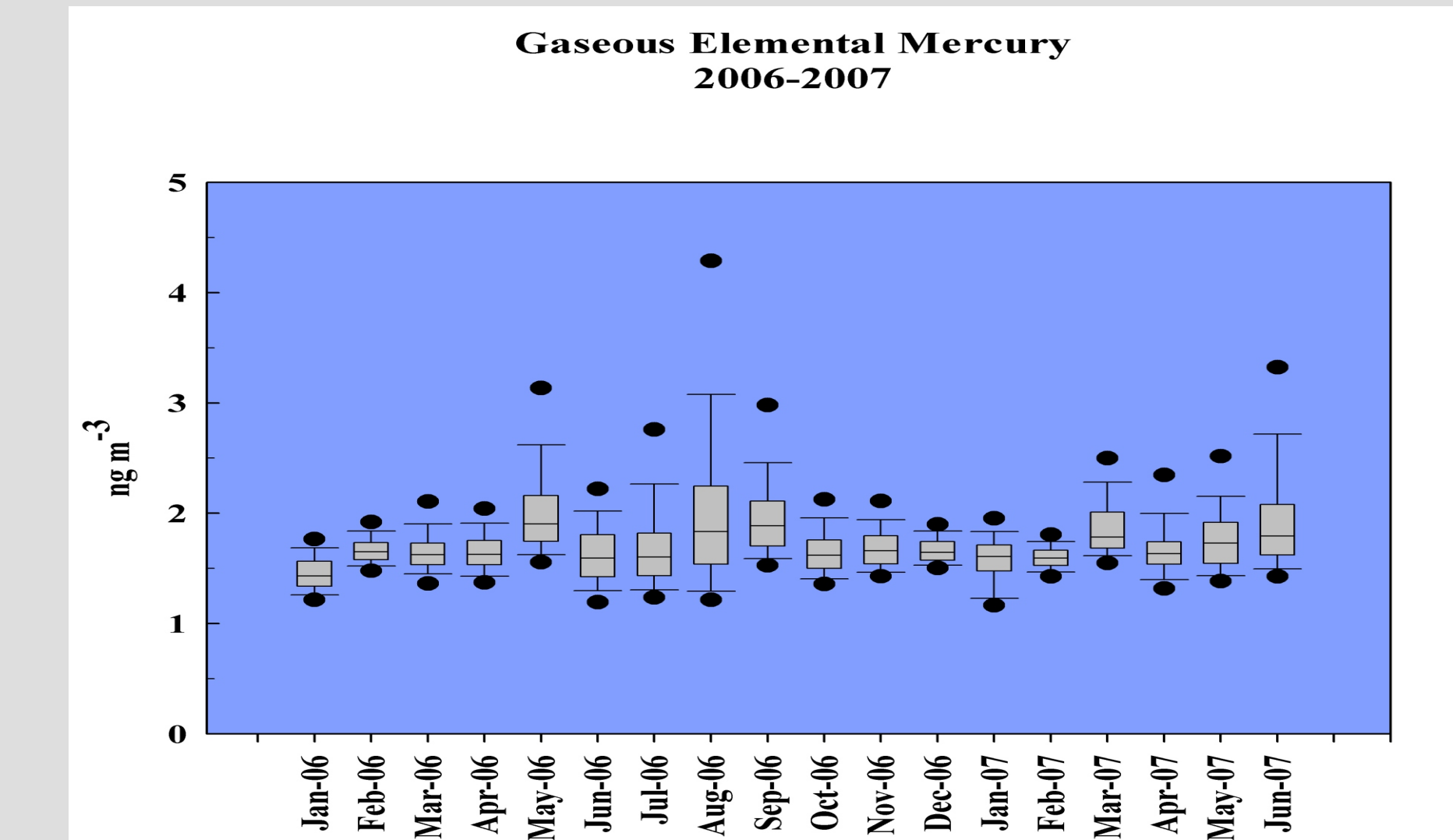
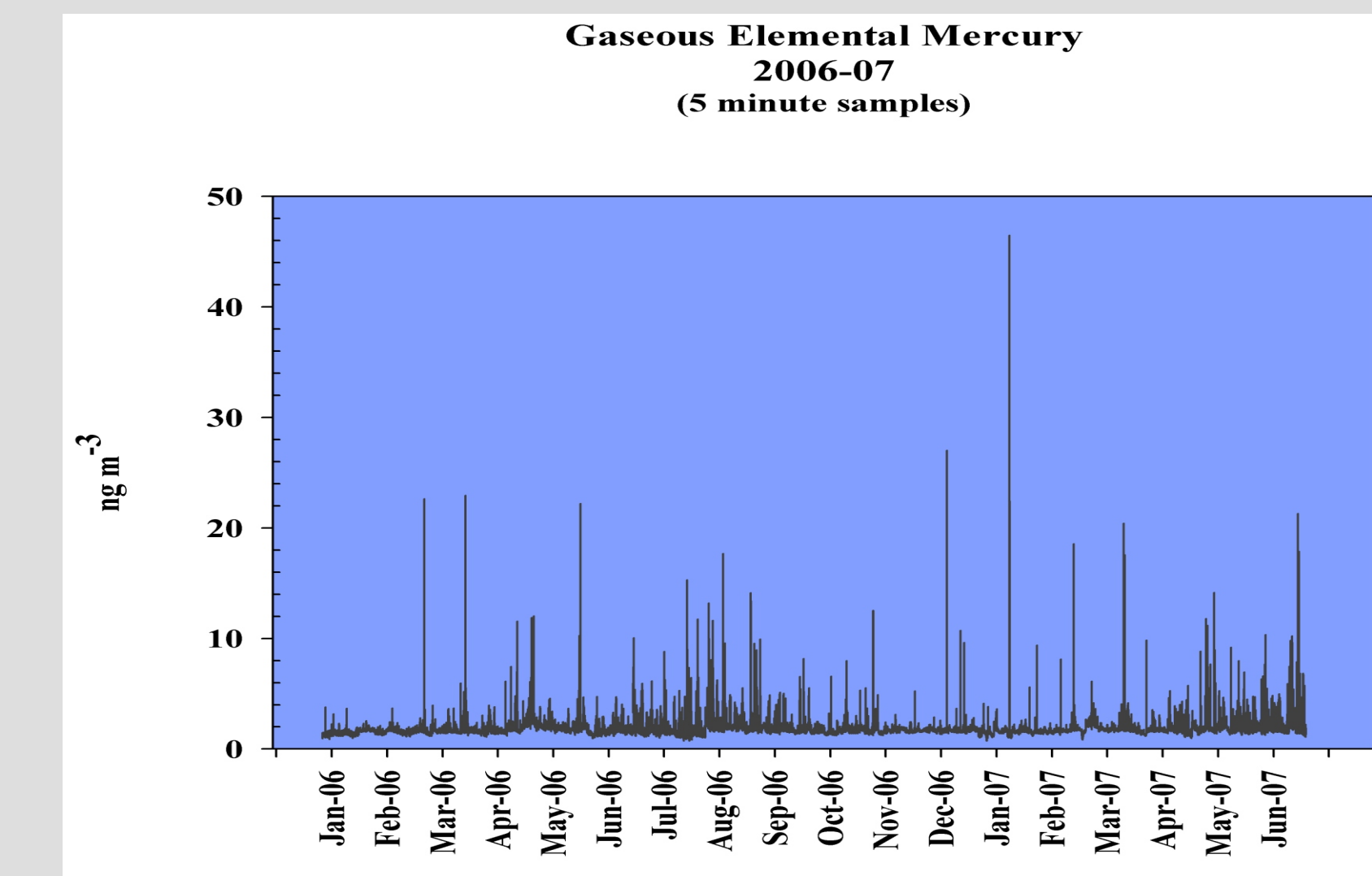
Results

The data from January 2006 to July 1, 2007 for Hg^0 , Hg_p and RGM are illustrated in the plots to the right. The plot illustrating Hg^0 (5 minute samples) show a median value of 1.67 ng/m^3 and a range of 0.716 to 46.5 ng/m^3 ; for Hg_p a median value of 1.75 pg/m^3 and a range from detection limit (dl) to 30.8 pg/m^3 and for RGM a median value of 2.43 pg/m^3 with a range from the dl to 140 pg/m^3 . Along with the data plots there are also box plots of the monthly data illustrated at the far right.

These data plots show:

- median level of RGM and Hg_p are only a very small percentage ($\approx 0.1\%$) of the Total Gaseous Mercury
- GEM, generally higher levels are seen in the late spring and summer
- RGM the highest monthly trend occurs in the spring April to May
- Hg_p generally (ignoring June 06) higher values were observed in the winter months

Although not illustrated in this poster, meteorological measurements (MET) were collected concurrently with the atmospheric mercury sampling from May 2006. The MET data (air temperature, relative humidity (Campbell Scientific™ CS-500 temperature/RH sensor), solar radiation (LiCor LI200S solar pyranometer 400-1100 nm) and wind speed-direction (RM Young 05103) was collected with 5 minute resolution. In May 2007, a Davis weather system replaced this older Campbell Scientific weather system. This Davis system included measurements of leaf wetness required by modellers for the determination of the levels of mercury dry deposition at this urban coastal site.



The above box plots illustrate monthly data. The boundaries of the box are the 25th and 75th percentile, the line within the box marks the median and the "whisker" lines are the 10th to 90th percentile. The upper and lower data points outside the box are the 5th to 95th percentile.

Future Work

□ continue the sampling program at this site along with hopes of future involvement in a proposed NADP dry deposition network

□ mercury species data will be compared to collected MET data and the province of Nova Scotia's air quality measurements (NO , NO_x , SO_2 , $PM_{2.5}$, O_3)

□ work with Environment Canada modellers to begin to quantify the level of mercury dry deposition in our coastal urban area



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