Baseline Measurements of Ambient Concentrations of Elemental, Reactive Gaseous and Particle-bound Mercury at Two Urban Locations in New York

Dirk Felton, Kevin Civerolo, Matt Hirsch, Sergio Fleishaker and Tom Everts

New York State DEC, Division of Air Resources, 625 Broadway, Albany, NY 12233-3256.

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Introduction

Mercury is a concern to public health and the natural resources in New York State. Due to the high levels of mercury in freshwater fish, the State Departments of Environmental Conservation and Health have issued specific warnings advising that pregnant women and children should not consume any servings of specific fish species that are caught in 93 lakes and more than 265 miles of rivers in the State. Much of the mercury deposited across the State results from human activities, including coal combustion, waste incineration, and other industrial applications. Once deposited, mercury can be converted to the highly toxic methyl form; methlymercury can bioaccumulate in the food chain and cause developmental and reproductive health issues with humans and piscivorous animals.

Over the past decade the largest reductions in anthropogenic mercury emissions have occurred from the municipal waste combustion and medical waste incineration sectors. During this same period, emissions of mercury from coal-fired utilities have not changed appreciably. However, mercury emissions from this sector are expected to decrease in the coming years as a result of Clean Air Mercury Rule legislation (CAMR). As these planned reductions are phased in, it is important to monitor ambient concentrations and deposition of mercury to establish baseline levels and to determine the effectiveness of mercury emission controls

NYSDEC Mercury Monitoring Program

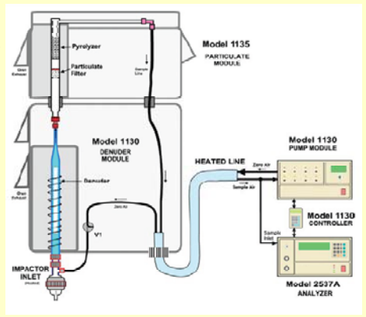
In 2005, the NYSDEC applied for an EPA Toxics Community Assessment Grant RFA: OAR-EMAD-05-16. This grant was awarded and provides funding for two years to monitor air concentrations of elemental (Hg0), reactive gaseous (RGM) and particle-bound mercury (PHg) as well as weekly wet deposition of total mercury at two urban locations in New York State: Bronx and Rochester. Ancillary measurements of co-pollutants such as SO_2, O_3, CO, $PM_{2.5}$, acid deposition, and meteorological parameters are currently made at these locations, which help in source attribution analyses. The wet deposition monitoring instrumentation was deployed in the field locations in January 2008. The ambient Hg instruments were installed in September 2008. The wet deposition instrumentation and data are described in another poster at this conference.

Ambient Mercury Monitoring Instrumentation

The Elemental Hg Vapor Analyzer is a Tekran 2537B Analyzer which utilizes CVAF (Cold Vapor Atomic Florescence) to detect Hg0 in 5 minute intervals. The analyzer is preceded by a Tekran 1130 and 1135 which collect RGM and PHg respectively over 2-hr intervals. The system in this configuration provides 5-minute Hg0 data for 2-hr periods separated by 1-hr without data. The RGM and PHg data are provided as 2 -hr averages once every 3 hours. The 1130 and 1135 require a high flow size-selective inlet which is provided by the 1130 pump module.

The Tekran 1130 houses a denuder coated with KCl to capture RGM at a 10 l/m flow. The denuder is thermally desorbed every 3 hours at 500ºC and the released Hg is quantified by the elemental Hg analyzer.

The Tekran 1135 houses a quartz filter and pyrolyzer glassware that collects PHg at a 10 l/m flow. The quartz filter is thermally desorbed every 3 hours at 800º C.

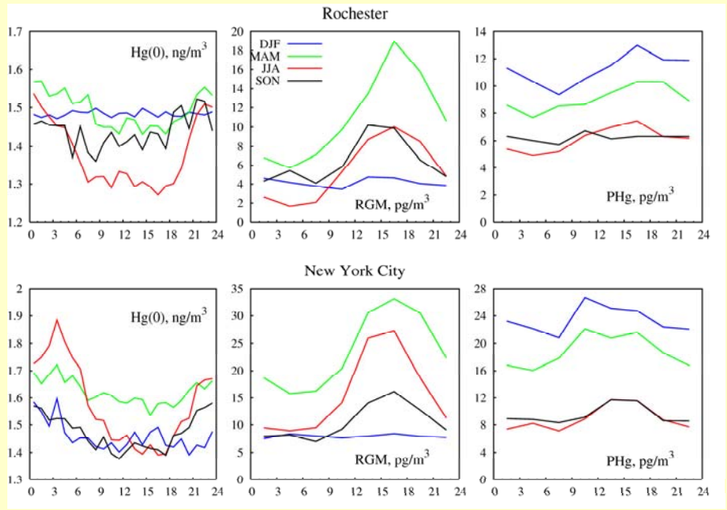


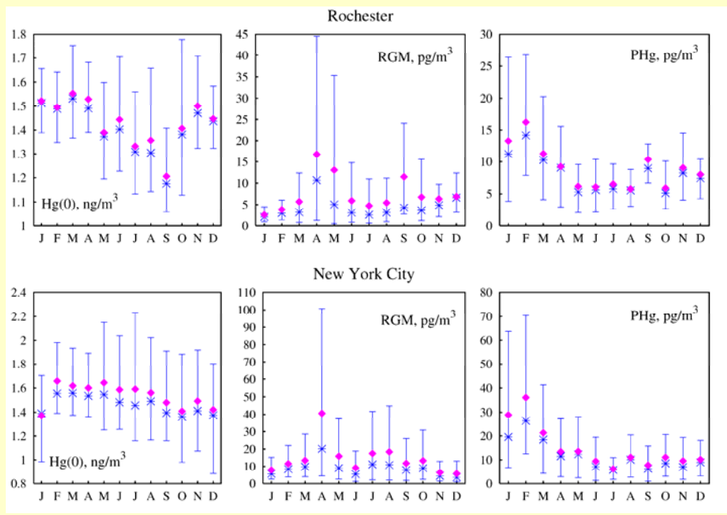
Preliminary look at first Year's Ambient Hg data

The data are presented in diurnal plots for both sites in the top six panels. The 3-month intervals are shown in different colors (DJF: Dec-Jan-Feb, MAM: Mar-Apr-May, JJA: Jun-Jul-Aug, SON: Sep-Oct-Nov) The six lower plots show the monthly averages (diamond markers) for both sites. The 10th, 90th and 50th percentiles are included on these plots in purple.

The diurnal plots indicate that Hg0 and RGM have significant variation over the course of a day while PHg remains relatively constant.

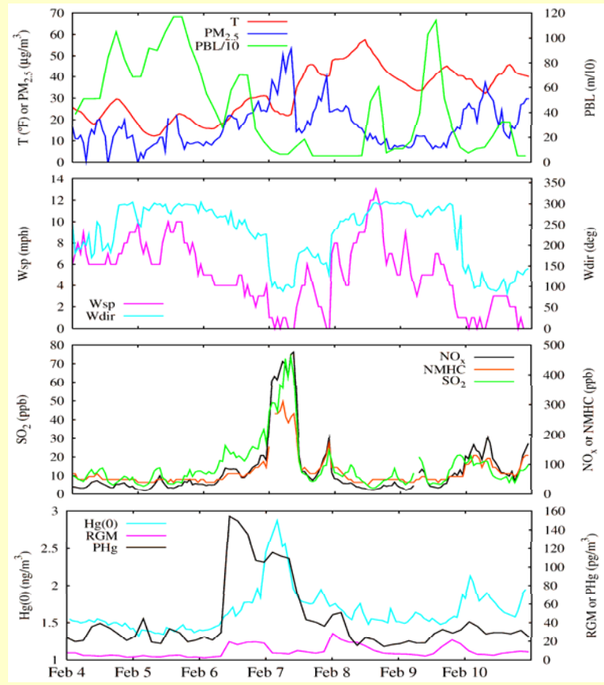
Both sites exhibited elevated PHg in the winter months and elevated RGM in the late spring and early summer months. The high RGM and PHg measurements collected in April occurred coincident with several days of unseasonably warm weather and the first significant Ozone episode of the season.





A Winter Stagnation Episode at the NYC Monitoring Site

The ambient Hg and ancillary data are presented from February 4-10, 2009. High pressure moved into the area on the morning of the 6th and moved slowly off the coast on the 7th. Overnight from the 6th to 7th, a strong low-level inversion formed and persisted through the day. The estimated boundary layer depths (PBL) were extremely low on the 7th and 8th. This period is marked by high NOx, NMHC, SO_2, Hg0 and PHg but only slightly elevated RGM.



Discussion

The ambient Hg and other pollutant data collected to date have demonstrated that urban Hg measurements are complex, variable and are significantly impacted by meteorology and local sources. The data have shown unexpected similarities between the two sites for periods such as the April high concentration events and an unusual early morning increase in Hg0 that only occurs at the NYC site. Comparisons with other pollutants not shown on this poster have shown strong correlations between RGM, Ozone and temperature. Further data collection is necessary to gain a better understanding of these pollutant interactions in urban areas.

Urban ambient Hg measurements will also allow for comparisons with ambient Hg data from other mostly rural sites in the MDN network. The extent of the urban pollutant interaction with specific species of Hg can only be determined by comparing rural and urban Hg and pollutant data sets over many years.

Many researchers have initiated Hg monitoring in rural areas to help determine Hg dry deposition rates. Urban speciated Hg data is necessary to determine if Hg dry deposition rates developed in rural areas are also applicable in urban areas. This is important in the Northeast where much of the source receptor areas are urban or suburban.

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