In-State/Out-of-State Sources of Semivolatile Pollutants and Hg in NYS

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INTRODUCTION

The objectives of this project include the development of a database of ambient atmospheric measurements and the application of appropriate receptor models to these data to permit the determination of the contributions of electricity generation to the observed concentrations of nitrate, sulfate, total gaseous mercury (TGM), reactive gaseous mercury (RGM) and fine airborne particulate matter. The contributions of in-state and out-of-state emissions will be separated and transboundary sources will be emphasized. The current schedule was implemented in September 2001, and consists of the sampling and analysis of the samples every third day throughout the year.

EXPERIMENTAL SECTION

Samples were collected on multiple filters at Potsdam and Stockton, NY (Figure 1), every third day for a 24- hour interval in an Andersen RAAS speciation network sampler. Samples collected to measure the concentrations of chemical constituents from November 2002 to June 2004, at both sites have been used for this report. The Teflo filters were measured for $PM_{2.5}$ mass by gravimetry, black carbon by light transmission, and elemental composition by XRF. Quartz fiber filters were analyzed as follows: Punches for OC and EC using Sunset OC/EC analyzer and the remaining filter was leached and analyzed for WSSC organic acids using an ion-chromatographic method developed as part of this project.

In addition total gaseous mercury (TGM) and reactive gaseous mercury (RGM) were sampled and analyzed over this period. TGM was collected using gold wires and the mercury determined by thermal desorption into a cold vapor atomic fluorescence spectrometer (CVAFS). The RGM was collected using KCl-coated denuders and was analyzed by thermal desorption, uptake on gold wires and CVAFS. Sampling was terminated at the end of August 2005. Currently sample analyses are being completed and the complete set of data will be available at the end of the calendar year.

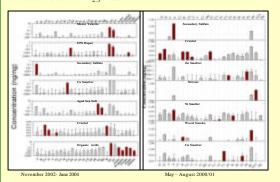Figure 1. Map showing the location of the sampling sites and major instate power plants.

PRELIMINARY RESULTS

An initial study was conducted of the data from the summers (May through August) of 2000, 2001 at both sites (Liu *et al., Atmospheric Environ.* 37: 4997-5007 (2003). $PM_{2.5}$, anions, cations, black carbon and trace elements were used for source identification in a PMF analysis.

Based on the data that were available as of the end of 2004, an analysis using positive matrix factorization to derive the source profiles. A comparison of the source profiles from the initial summer study and the more recent analysis of the Potsdam data is provided in Figure 2 and the average source apportionments are given in Table 1. Figure 3 shows the average contributions to the $PM_{2.5}$ mass.
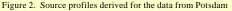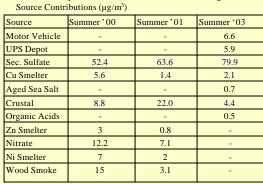

November 2002- June 2004   May – August 2000/01

Figure 2. Source profiles derived for the data from Potsdam

Table 1. Comparison of Potsdam – Summer Percentage Source Contributions (µg/m³)

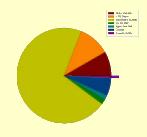| Source	Summer '00	Summer '01	Summer '03
Motor Vehicle	-	-	6.6
UPS Depot	-	-	5.9
Sec. Sulfate	52.4	63.6	79.9
Cu Smelter	5.6	1.4	2.1
Aged Sea Salt	-	-	0.7
Crustal	8.8	22.0	4.4
Organic Acids	-	-	0.5
Zn Smelter	3	0.8	-
Nitrate	12.2	7.1	-
Ni Smelter	7	2	-
Wood Smoke	15	3.1	-

Figure 3. Source contributions to the $PM_{2.5}$ mass at Potsdam.

Seven sources were resolved using PMF. Secondary sulfate is the highest contributor to PM2.5 mass. Inclusion of WSSC organic acids led to the identification of an organic acids source, but mono-carboxylic acids could not be separated from the di-acids. No co-variance between sulfate and organic acids was observed.

A comparison of the source profiles from the initial summer study and the more recent analysis of the Stockton data is provided in Figure 4 and the average source apportionments are given in Table 2. Figure 5 shows the average contributions to the PM2.5 mass.
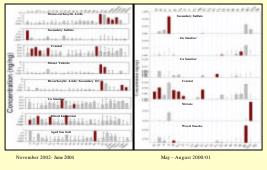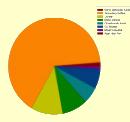

November 2002- June 2004   May – August 2000/01

Figure 4. Source profiles derived for the data from Stockton.

Table 2. Comparison of Stockton – Summer Percentage Source Contributions (µg/m3)

Source	Summer '00	Summer '01	Summer '03
Mono-acids	-	-	0.7
Sec. Sulfate	46.7	65.1	73.4
Crustal	29.1	19.2	8.5
Motor Vehicle	-	-	6.0
Di-acids	-	-	6.1
Cu Smelter	16.6	8.0	4.7
Mixed Industrial	-	-	0.6
Aged Sea Salt	-	-	negligible
Zn Smelter	4.5	3.2	-
Nitrate	2.3	2.2	-
Wood Smoke	0.8	2.3	-

Figure 5. Source contributions to the $PM_{2.5}$ mass at Potsdam.

Eight sources resolved from the Stockton data. Secondary sulfate was again the highest contributor to PM2.5 mass. Inclusion of WSSC organic acids led to the identification of a mono-carboxylic acid source and a di- carboxylic source that could represent secondary OC. No co-variance between sulfate and organic acids was observed.

NEXT STEPS

The complete data set along with appropriate back trajectories for each sampling day will be used in a variety of analyses including PMF, potential source contribution function (PSCF) and other trajectory ensemble methods. These analyses will help us identify the relative contributions of in-state and out-of-state sources to the particulate matter at these two sites.

ACKNOWLEDGMENTS