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Title: PM2.5 Technology Assessment and Characterization Study in New York State (PMTACS-NY)
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Institution: Atmospheric Sciences Research Center, University at Albany
Research Category: Particulate Matter EPA "Supersites" Program
Sorting Code: 99-NCERQA-X1
Project Period: October - December 2001

Objective of Research:

As a result of recent clinical and epidemiological studies (NRC, 1998) associating adverse health effects in humans and fine particle mass, a new National Ambient Air Quality Standard for $PM_{2.5}$ mass (15 $\mu g/m^3$ annual and 65 $\mu g/m^3$ 24-hr average) has been promulgated in the United States (Federal Register, 1997). Significant scientific and technical issues surrounding the mitigation of the warm season PM2.5 /co-pollutant complex and its interdependence with O_3 air quality through coupled photochemical pathways, common precursors, and similar dependencies upon meteorology must be addressed if effective control strategies are to be implemented.

The long-term monitoring of the PM2.5/co-pollutant complex and its precursors at urban and regional representative sites provides the opportunity to track the impact of emission controls and their effectiveness on air quality. These data can to be used to verify that implemented PM2.5 primary and secondary precursor (including ozone precursor) emission controls are performing according to specifications and verify that PM2.5 and ozone air quality has responded to the emission changes achieved as expected. Without adequate monitoring systems to track the progress and effectiveness of implemented control programs, the air quality management approach remains unaccountable.

The PMTACS-NY Supersite program provides a unique and unparalleled opportunity to enhance our understanding of ozone/$PM_{2.5}$-precursor relationships and track progress in current precursor emission control programs and assess their effectiveness in achieving expected air quality responses. The impact of this research is highly significant, providing a sound scientific basis for informed effective decisions in the management of air quality in New York and will benefit its citizens both environmentally and economically.

The PMTACS-NY is designed around three major objectives and addresses a series of science policy relevant questions related to hypotheses to be tested using measurement data collected under the program. The subject quarterly reports provide highlights on the overall program status, the progress made in the context of the specific tasks associated with the three program

objectives, identification of outstanding issues, project schedule and completion status by task, and a budget analysis.

Progress Summary/Accomplishments:

Much of this quarter was dedicated to data reduction and preliminary analysis of findings from the PMTACS-NY 2001 Summer Field Intensive performed during June 30 – August 6, 2001 in Queens, New York. The initial results from this Summer's Supersite Activities were presented at a PI's Workshop held at EPA, Research Triangle Park, NC in November 13-14, 2001. In addition, PMTACS-NY held its first data workshop in Albany on November 27-28, 2001. The main purpose of that data workshop was to provide the following basic information for each measurement system deployed: 1) data completeness - (i.e. during the period June 30 - August 3, what percentage of the total possible data reported, based on your systems measurement cycle; 2) the status data reduction, level of QA assurance and any quality assurance experiments performed; 3) a time series plot of the data and summary statistics (mean, median, diurnal boxplots if applicable, frequency distribution, etc.); 4) report any major glitches in the operation/performance of the system or outstanding issues that must be addressed before data could be released (examples might include calibration problems, operational inconsistencies with SOP, inlet or sampling problems or in-field operation failures; and 5) any other valuable information about the measurement data set and its application that should be shared with the user community. Several examples of preliminary findings from the Summer Field Intensive are discussed in the sections below.

Objective I. Measure the temporal and spatial distribution of the PM2.5/co-Pollutant complex including: SO_2, CO, VOCs/Air Toxics, NO, NO_2, O_3, NOy, H_2CO, HNO_3, HONO, PM2.5 (mass, $SO4^{=}$, NO_3^-, OC, EC, Trace Elements), single particle aerosol composition, CN, OH and HO_2 to support regulatory requirements to develop cost effective mitigation strategies PM2.5 and its co-pollutants and to establish trends in the relevant precursor concentrations to assess the impact of recent and future emission reductions in terms of emission control effectiveness and air quality response.

Measurements at our two rural sites Whiteface Mountain and Pinnacle State Park operated during the quarter as outlined in Table 1 of the QAPP. IS 52 in the South Bronx which had to be taken off line, as a result of an asbestos abatement project that involved the floors containing our monitoring equipment last quarter, came back online on September 6.

Objective II. Monitor the effectiveness of new emission control technologies [i.e. Compressed Natural Gas (CNG) bus deployment and Continuously Regenerating Technology (CRT)] introduced in New York City and its impact on ambient air quality, thorough remote open path roadside, mobile platform, and fixed site measurements of CO_2, CO, NO, H_2CO, HONO, CN and aerosol chemical composition.

Some preliminary findings from vehicle chase studies performed as part of the CEPEX Summer 2001 Intensive are summarized figures 1 and 2 below. The CRT carbon particle trap control technology uses catalytic surfaces in the presence of NO_2 to oxidize the particulate carbon to CO_2. It is very effective in reducing diesel particulate emissions, but as figure 1 confirms, can

have NO_2 emissions slip. Figure 1 shows a comparison of on-road vehicle chase emissions of a CRT and non-CRT equipped diesel bus where NO_2 emissions make-up ~ 40% of the NOx emission from the CRT equipped vehicle.

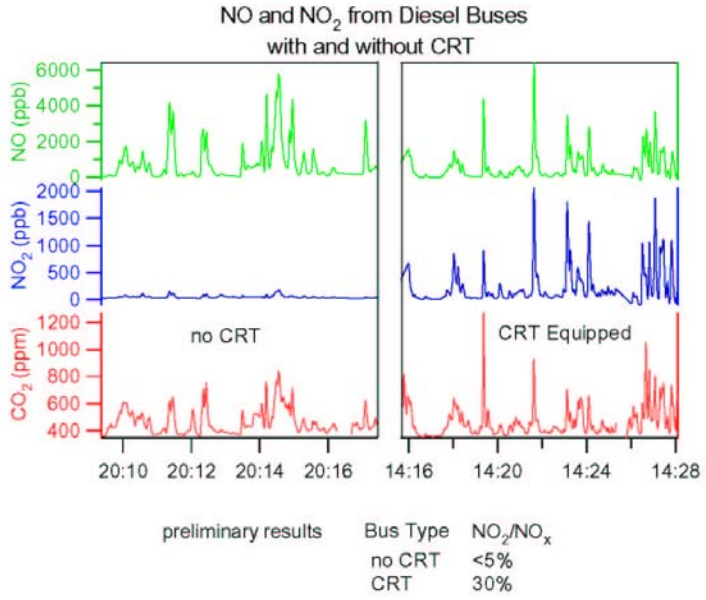

Figure 1. Comparison of NO, NO2 and CO2 concentration in CRT and non-CRT equipped buses

In another series of vehicle chase studies involving the exhaust plumes of CNG buses, we looked for the presence of formaldehyde, which is a potential product of the incomplete combustion of methane. Figure 2 shows significant emissions of methane and formaldehyde from CNG buses as compared to standard diesel buses and other diesel equipped vehicles.

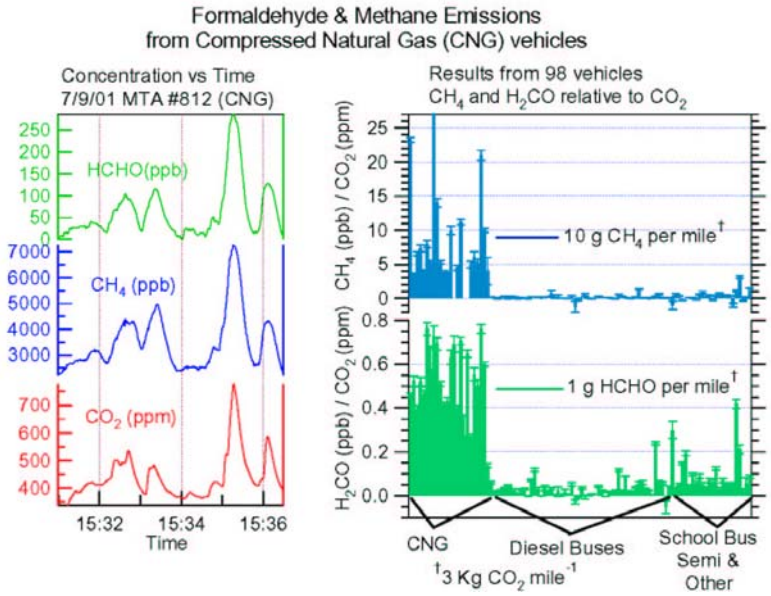

Figure 2. H2CO and CH4 emissions from CNG vs. diesel equipped vehicles

Objective III. Test and evaluate new measurement technologies and provide tech-transfer of demonstrated operationally robust technologies for network operation in support of the development of process science and observation based analysis tools and health based exposure assessments.

A variety of instrument intercomparison studies were performed as part of the Summer 2001 Field Intensive. For example, four approaches for the measurement of semi-continuous particulate sulfate instruments were operated during the summer intensive. Preliminary comparison results of the R&P 8400S PM sulfate, the Harvard catalytic continuous PM sulfate, the Aerosol Mass Spectrometer and Particle in-liquid-sampler instrumental systems are presented in figure 3. Time integrated comparisons of the semi-continuous PM sulfate measurements with 6-hr averaged and 24-hr averaged filter measurements are presented in figures 4 and 5.

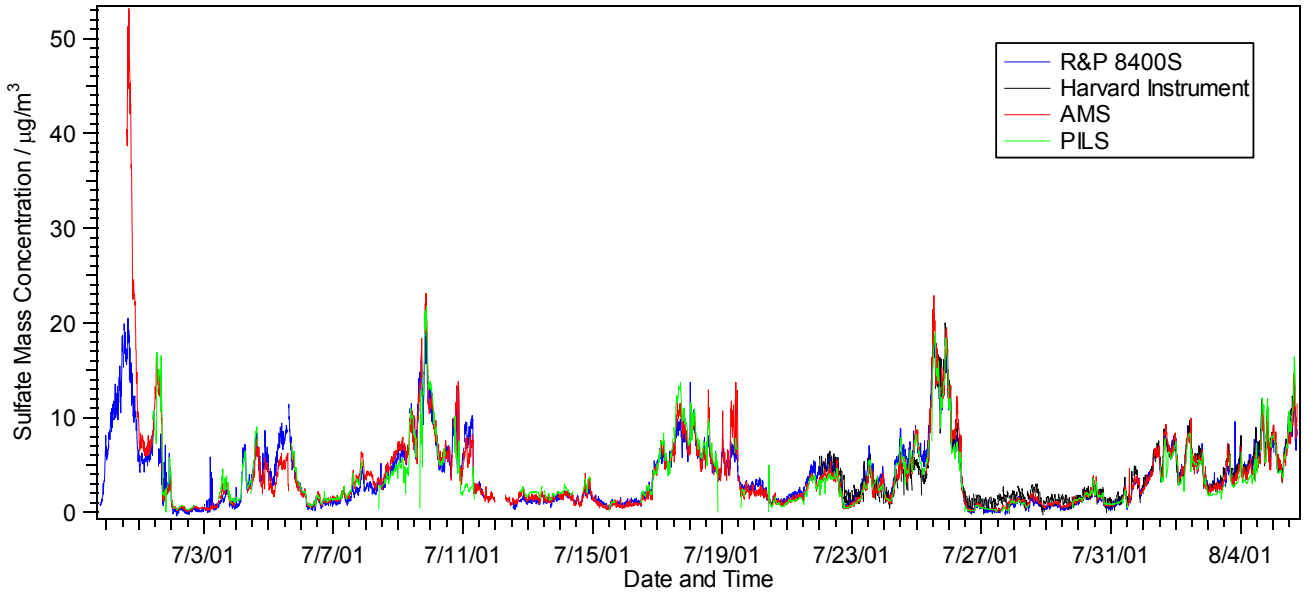

Figure 3. Semi-continuous PM sulfate measurements in Queens, NY

The correlations for the 6-hr integrated semi-continuous measurement systems and filter data have slopes ranging from 0.67 – 0.73; with intercepts from 0.16 - 0.67 µg/m^3 and correlation coefficients ranging from R = 0.956 – 0.980. (The large intercept is due to the HSPH instrument, where only few measurements are available.)

In the case of the 24-hour filter data, the correlations have slopes ranging from 0.73 – 0.84; with intercepts from -0.036 - +0.63 µg/m^3 and correlation coefficients ranging from R = 0.945 – 0.989.

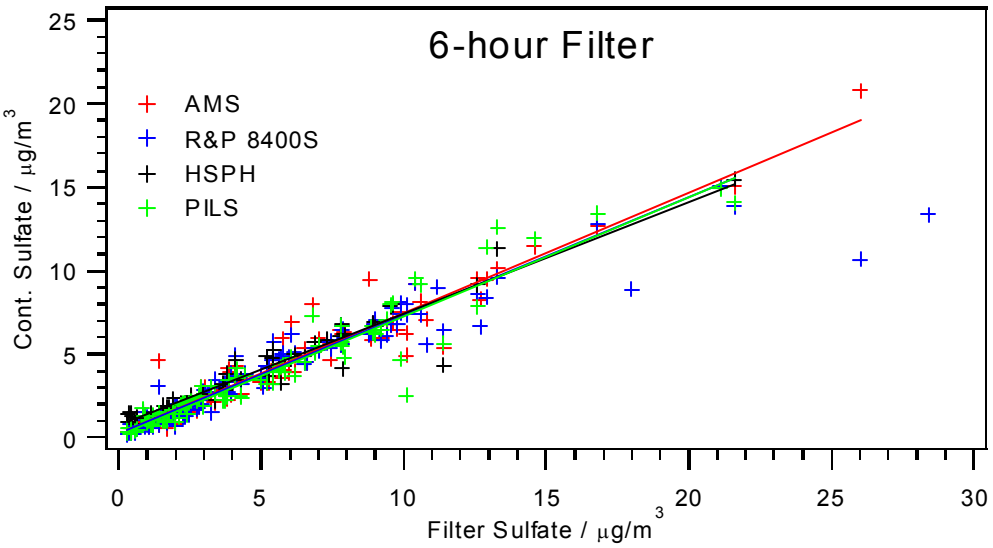

Figure 4. Integrated semi-continuous PM sulfate comparisions with 6-hr filter data

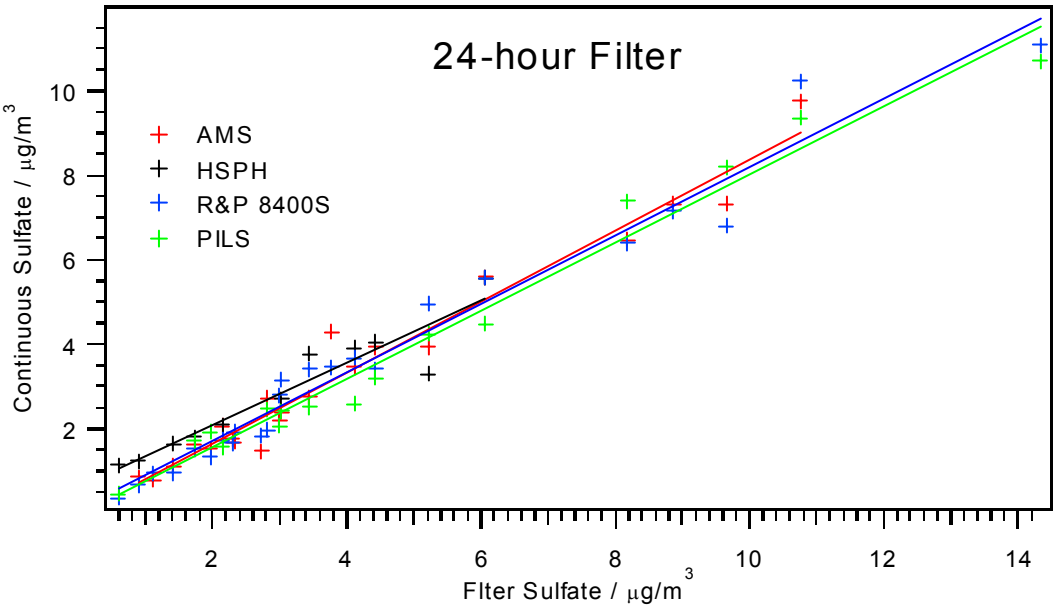

Figure 5. Integrated semi-continuous PM sulfate comparisions with 24-hr filter data

The comparisons indicate that the integrated semi-continuous measurements systematically report only about 80% of the filter sulfate, but show a very good linear correlation with the filter data. A probable explanation for this behavior is artifact formation on the filter surface, via the accumulation of gas phase species. We are currently exploring this possibility in the laboratory and via comparisons with chemical speciation filter samples collected as part of the PM chemical speciation network.

Publications/Presentations: Demerjian, K.L., PM2.5 Air Quality Issues and the U.S. EPA Supersites Program, Symposium on Indoor and Urban Environmental Systems, October 31, 2001, Syracuse University; Drewnick, F., J.J. Schwab, O.V. Hogrefe, and K.L. Demerjian, Preliminary Results of the Measurement of Ambient Aerosol Composition During the PMTACS-NY 2001 Using an Aerosol Mass Spectrometer, 2001 Fall Meeting American Geophysical Union; Jayne, J.T., M. Canagaratna, S. Herndon, J. Shorter, M. Zahniser, Q. Shi, C. Kolb, D. Worsnop, J. Jimenez, F. Drewnick, K. Demerjian, and T. Lanni, Mobile Gas and Particulate Emission Studies of the New York City Transit Bus Fleet, 2001 Fall Meeting American Geophysical Union; Presentations and session leaders at the EPA PM Supersites Program Meeting: Data Analysis Workshop & Planning for ESPO2, RTP, NC on November 13-14, 2001 and the PMTACS-NY data workshop on November 26-27 in Albany.

Future Activities and Outstanding Issues:
During the next quarter planned activities include: 1) continuation of data reduction and analysis of the Summer 2001 Field Intensive measurements; 2) preparation of the annual quality assurance report; 3) NARSTO format data archive preparation; and 4) preparation of draft manuscripts highlighting the Summer 2001 results.

Supplemental Keywords: ambient air, atmospheric aerosols, ozone, particulate matter, metals, nitrogen oxides, sulfates, organics, atmospheric chemistry, monitoring, measurement methods, northeast air quality.

Relevant Web Sites: http://www.asrc.cestm.albany.edu/pmtacsny/