PROJECT UPDATE

December 2005

New York State Energy Research and Development Authority

Environmental Monitoring, Evaluation, and Protection Program

Physical and Chemical Characterization of Laboratory-generated Secondary Semi-Volatile Organic Particles

Principal Researcher

KENNETH L. DEMERJIAN

Atmospheric Sciences Research Center, University at Albany, SUNY

Albany, NY

Project Location

Credit: Kenneth Demerjian

A view of the ASRC Aerosol Laboratory.

Contact Information

For more information on this project see:

http://www.nyserda.org/programs/environment/emep

or contact Ellen Burkhard at: egb@nyserda.org

Keywords

- Aerosol
- PMTACS-NY Supersite
- Primary $PM_{2.5}$
- Secondary $PM_{2.5}$
- Semi-volatile organic compound

PROJECT FOCUS

This project aims to improve our current understanding of the physical and chemical characteristics of secondary organic particulate matter (PM) through laboratory studies of organic aerosols and the application of findings to available data. The main components of the research are

- ♦ Generation of primary and secondary organic aerosols in SUNY-Albany's Atmospheric Science Research Center (ASRC) Aerosol Generation and Calibration Facility;
- ♦ Characterization of generated aerosols and investigation of their photochemical aging; and
- ♦ Application of findings to the New York City Supersite's database of ambient aerosol measurements, allowing improved estimates of the contribution of anthropogenic and biogenic secondary organic PM to ambient air in New York State.

CONTEXT

Airborne PM is a broad class of materials that are emitted from a variety of natural processes and human activities and are transported in the air as solid particles or liquid droplets. Some of these particles are emitted directly into the atmosphere from primary sources, e.g., motor-vehicle exhaust, home fireplaces and heating appliances, manufacturing plants, commercial and domestic food preparation, tar application, forest fires, wind erosion, and natural and cultivated vegetation. Other “secondary” particles are formed in the atmosphere through photochemical reaction and oxidation processes involving ozone and other gas-phase oxidants.

Credit: http://airnow.gov/

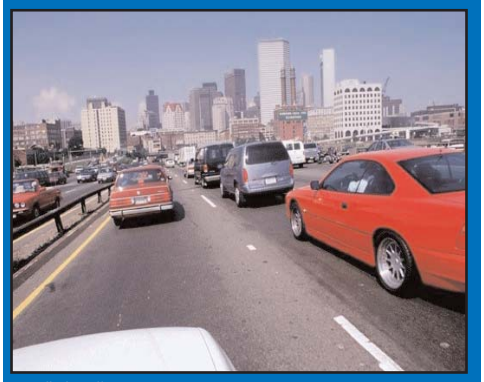
Particles contribute to haze

In July 1997, motivated by concerns about the adverse health effects of particulate pollution, the U.S. Environmental Protection Agency proposed a new National Ambient Air Quality Standard (NAAQS) for particulate matter of less than 2.5 microns in diameter ($PM_{2.5}$), including daily maximum (65 micrograms per cubic meter [$\mu g/m^3$] and annual maximum ($15 \mu g/m^3$) average concentrations. Approximately 65 million people in the United States live in areas with annual average $PM_{2.5}$ levels in excess of 15 $\mu g/m^3$.

Recent $PM_{2.5}$ measurements through the $PM_{2.5}$ Technology Assessment and Characterization Study-New York (PMTACS-NY) Supersite program have shown that 45%–50% of PM mass can be attributed to carbon-bearing aerosols. However, standard filter-based aerosol measurements, which provide no compound-specific data, offer extremely limited information for distinguishing primary and secondary contributions to carbon PM or for identifying the principal sources that contribute to observed levels of pollutants.

PROJECT UPDATE

December 2005



Credit: http://www.epa.gov

Project Status

- Initiated January 2005
- Project ongoing

New York Energy Smart℠
Public Service Commission — NYSERDA

Since 1975, the New York State Energy Research and Development Authority (NYSERDA) has developed and implemented innovative products and processes to enhance the State's energy efficiency, economic growth, and environmental protection. One of NYSERDA's key efforts, the Environmental Monitoring, Evaluation Protection (EMEP) Program, supports energy-related environmental research. The EMEP Program is funded by a System Benefits Charge (SBC) collected by the State's investor-owned utilities. NYSERDA administers the SBC program under an agreement with the Public Service Commission.

In the Supersite program, an Aerosol Mass Spectrometer (AMS) was used to characterize PM organic carbon by the mass spectral patterns in urban (Queens College, NYC) and rural (Whiteface Mountain, NY) ambient air. The data collected suggest that the secondary production of organics under summertime conditions contributes significantly to carbon PM levels at both sites. Additional data collected suggest that natural hydrocarbons are an important contributor to the organic fraction of PM in both environments.

METHODOLOGY

These studies, which will take place at the ASRC Aerosol Generation and Calibration Facility, are designed to provide basic knowledge about the production of organic PM from both anthropogenic and biogenic precursors. The results will be used to develop characteristic mass spectra for compound-specific primary and secondary PM production. The information gathered will subsequently be applied to the database of ambient aerosol mass-spectrometric measurements, allowing further quantification of the organic mass fraction of PM measurements made at urban and rural sites by the PMTACS-NY Supersite program and providing better estimates of the attribution of anthropogenic and biogenic sources to these measurements. Specifically, the project team will

- ♦ Modify the ASRC Slow Flow Aerosol Reactor, adding radical generation sources for the production of secondary semi-volatile organic aerosols;
- ♦ Generate and characterize known concentrations of primary semi-volatile organic aerosol species (organic acids, steranes, and polycyclic aromatic hydrocarbons);
- ♦ Develop techniques for generating secondary semi-volatile organic aerosol species through chemical reactions;
- ♦ Characterize semi-volatile organic aerosols generated by secondary reactions of known anthropogenic and biogenic precursor species; and
- ♦ Study the photochemical aging of organic aerosols generated from primary and secondary sources.

PROJECT FINDINGS

This project has just gotten underway. The project team has conducted an evaluation of the optimal combination of aerosol sizing instrumentation with well established operational protocols.

PROJECT IMPLICATIONS

Currently, 208 counties (September 2005) in the United States are in nonattainment of federal $PM_{2.5}$ standards, affecting ~88 million people. This number accounts for both annual and daily standards. In addition, more stringent $PM_{2.5}$ standards are expected to take effect next year. Better knowledge of secondary organic PM is an important component of an integrated plan to reduce PM emissions in New York. This project is designed to provide fundamental information currently not gathered by the national monitoring network concerning the production of organic PM species in aerosols and to develop characteristic mass spectra for compound-specific primary and secondary PM. This much-needed information will allow identification of the sources of organic PM species in ambient air, a crucial step in developing an effective State Implementation Plan (SIP) for controlling PM concentrations.

Credit:http://www.asrc.cestm.albany.edu/
Atmospheric Sciences Research Center