PROJECT UPDATE

August 2005

New York State Energy Research and Development Authority

Environmental Monitoring, Evaluation, and Protection Program

Impact of Power Plants on Semivolatile Pollutants and Fine Particles in New York State

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Project Location

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Keywords

- Fine particles
- Polycyclic aromatic hydrocarbons (PAHs)
- Reactive gaseous mercury (RGM)
- Semivolatile organic compounds (SVOCs)
- Speciation

PROJECT FOCUS

This sampling and analysis program aims to measure the concentrations of different components of airborne particulate matter over several years and to develop a database of these measurements. In addition to fine particulate mass and chemical speciation, components being measured include black carbon, sulfates and nitrates, speciated polycyclic aromatic hydrocarbons (PAHs), reactive gaseous mercury (RGM), and total vapor-phase mercury (metallic mercury [Hg°] + RGM). The collected data will allow:

- Identification of seasonal concentration values and patterns of source contributions;
- Application of models to locate sources or source areas of pollutants within and outside New York State (e.g., Canada);
- Determination of the relative importance of electricity generation as a source of ambient atmospheric pollution in New York State; and
- Establishment of a baseline against which the impact of future emissions controls may be assessed.

While there has been considerable research on the contribution of New York sources to SO_2 and particulate sulfate concentrations measured in the State, this project represents the only effort to date to determine the amount of elemental mercury, RGM, and PAH compounds for which New York electric utilities could be partially responsible. Completion of the project is anticipated in February 2006.

CONTEXT

Epidemiological studies have shown a correlation between increased concentrations of fine particles and increased morbidity and mortality. These pollutants can directly and indirectly affect public health, both by inhalation and by potential uptake into the food chain, and contribute to stress on ecosystems through interaction with vegetation, deposition into lakes and streams, and accumulation in the soil.

In 1997 the U.S. Environmental Protection Agency (US EPA) set new ambient air quality standards for particulate matter of less than 2.5 microns ($PM_{2.5}$) in diameter. There are several multi-pollutant bills pending in Congress, as well as the Clear Skies Initiative, that would reduce sulfur dioxide, nitrogen oxide, and mercury emissions from the electricity generation sector. Such changes will likely affect the operations and operating costs of power plants and other combustion sources of $PM_{2.5}$.

It is important to acquire a set of baseline data for these pollutants in New York State, so that the effectiveness of future regulatory actions can be assessed. In addition, as is the case with ozone and its precursors, fine particles are transported regionally. Prevailing southwesterly winds can carry material emitted in the Midwest into the air shed of New York State. As this project aims to locate out-of-state sources of New York fine particles and mercury air pollution, the findings may be useful in future efforts to hold these sources accountable.

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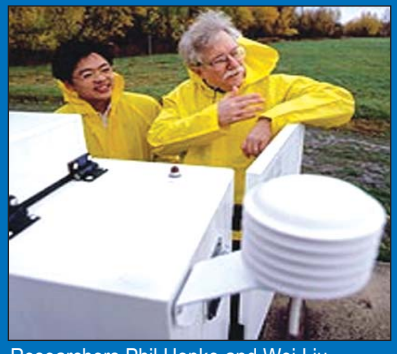

Researchers Phil Hopke and Wei Liu examining particle sampler.

Project Status

- Initiated 1999
- Project ongoing

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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, and 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.

METHODOLOGY

While in the summers of 2000 and 2001 daily samples were taken, in September 2001 the program was extended from summer to year-round measurements. Researchers monitor $PM_{2.5}$ through sampling every third day, in synchronicity with the schedule at the regulatory monitoring sites in New York and Vermont. The sampling sites - Stockton, Chautauqua County and Potsdam, St. Lawrence County - are located near the borders with Pennsylvania and Canada, respectively, along a common southwesterly wind trajectory. This allows the collection of samples as air enters and exits New York, both before and after it has been affected by in-state sources. Data are also acquired from US EPA/NYS Department of Environmental Conservation (NYS DEC) sites in Rochester, New York City, and Burlington, Vermont.

The project will also measure mercury in wet deposition at Potsdam and evaluate two instruments: the Tekron automated sampler (for mercury, reactive mercury, and particulate mercury) and the mercury sampler currently in use. The automated sampler will then be deployed at an urban site. Measurements of pollutant concentrations will be used in various statistical models in conjunction with meteorological data to identify trajectories and locate sources of emissions, to apportion aerosol mass and species concentrations to sources, and to assess relationships between pollutants. Time- and location-specific air pollution events and their effects will be considered. Maps are being generated to illustrate the likely sources and trajectories of emissions.

RECENT FINDINGS

- The greatest contributors to $PM_{2.5}$ mass in Stockton and Potsdam are sulfate, nitrate, ammonium, and black carbon, as expected from previous results.
- The probable source area for much of the sulfur measured at Stockton is the Midwest, including the Ohio River Valley and the southern border of the Great Lakes area.
- Likely sources of vapor-phase mercury at Potsdam include areas both in Canada (western Quebec and eastern Ontario) and in the eastern United States. At Stockton, US sources predominate.
- No clear relationship was found between ozone and RGM concentrations, although previous work has found significant correlation.
- Concentrations of $PM_{2.5}$ mass are higher during summer months.
- Nitrate levels increase and sulfate concentration levels decrease in the winter.
- There is no positive correlation found between RGM and total vapor phase mercury, possibly owing to different sources of emission or different removal mechanisms.

Clarkson University researchers taking air samples.

PROJECT IMPLICATIONS

The project will provide a baseline of information that can be used to identify trends and fluctuations in the concentrations of specific air pollutants and their likely sources of emission. The information from this study will be useful in developing state implementation plans for complying with $PM_{2.5}$ air quality standards and in identifying the regional contribution to fine particle concentrations in New York. The project will also provide mercury sampling data and technology transfer that the NYS DEC can use in evaluating monitoring network needs. Findings from this study may also increase understanding of transboundary pollution.