PROJECT UPDATE

August 2005

New York State Energy Research and Development Authority

Environmental Monitoring, Evaluation, and Protection Program

Fine Particle Constituents and Acute Asthma in Urban Areas

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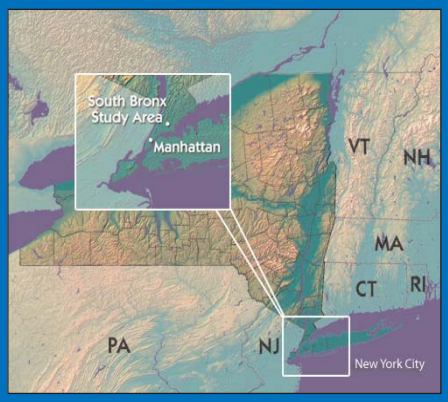
Project Location



Contact Information

For more information on this project see:
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Keywords

- Acute asthma
- Elemental carbon
- Emergency room visits
- National Ambient Air Quality Standards (NAAQS)
- $PM_{2.5}$, PM_{10}

PROJECT FOCUS

This project aims to improve understanding of the relationship between exposure to ambient air concentrations of a variety of pollutants and effects on respiratory health. Specifically, the research team is evaluating temporal associations between an array of air contaminants and acute asthma exacerbation, as measured by emergency room (ER) visits for asthma by residents in two communities in New York City (NYC): the South Bronx and Manhattan. In addition, ambient levels of various air pollutants in these two NYC communities are being compared. The air contaminants measured include gaseous compounds (ozone, sulfur dioxide, nitrogen oxides, aldehydes, nitrous acid, nitric acid, hydrochloric acid, and ammonia) and particulate components (metals, elemental and organic carbon, sulfate, hydrogen ion, pollen, mold spores, and particle mass and number).

The project objectives are to:

- Evaluate whether ambient levels of these pollutants differ in the two NYC neighborhoods, which have different rates of hospital admissions for asthma and different socio-economic characteristics;
- Compute the overall rates of asthma ER visits of residents of the two communities that are attributable to air contamination, and test whether the magnitude of the health effect from air pollution differs in the two communities; and
- Investigate which air pollutant or combination of pollutants is most associated with acute asthma exacerbation in each community.

CONTEXT

In 1997 the U.S. Environmental Protection Agency (EPA) set a new National Ambient Air Quality Standard (NAAQS) for fine airborne particles smaller than 2.5 microns in diameter, called $PM_{2.5}$. Currently, the New York State Department of Environmental Conservation (NYSDEC) is conducting a three-year monitoring program to identify areas in New York State that may or may not meet the mass-based $PM_{2.5}$ NAAQS. Reducing NYS ambient $PM_{2.5}$ concentrations to levels that are compliant with the NAAQS will likely require new emissions regulations.

Fine particles ($PM_{2.5}$), which may be both generated locally and transported over regional scales, have a variety of constituents, including carbon, metals, nitrates, sulfates, and semi-volatile organics. Combustion processes play a major role in the production of these particles, which can be emitted directly into the atmosphere (primary particles) or formed in the atmosphere from precursor gases (secondary particles). Important sources are stationary fossil-fuel; electric-power generation; industrial processes; industrial boilers; incinerators; and car and truck engines. While epidemiological studies have shown a correlation between increased concentrations of $PM_{2.5}$ very little is known about the relationship between ambient concentrations of the various components of $PM_{2.5}$ and human health.

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Using statistical tools, this study analyzes the relationship between air contamination and ER visits for asthma and other respiratory conditions in two NYC communities.

Project Status

- Initiated 2001
- Project ongoing

New York Energy Smart℠
Public Service Commission — NYSERDA

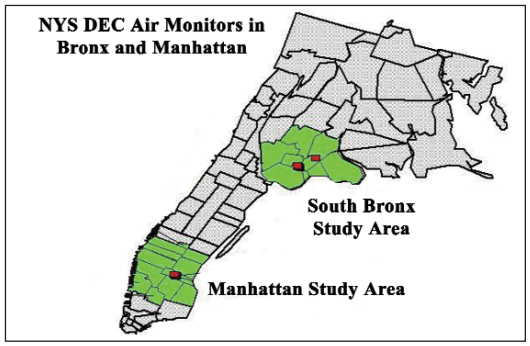
Since 1975, the New York State Energy Research and Development Authority (NYSERDA) has developed and implemented innovative products and processes to enhance the State's energy efficiency, economic growth, and environmental protection. One of NYSERDA's key efforts, the Environmental Monitoring, Evaluation, 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

AIR CONTAMINANT DATA: Nearly two years of meteorological data and daily measurements of air contaminents (January 1999–November 2000) have been collected at two neighborhood-based DEC monitoring sites in NYC for most of the air contaminants being investigated (see map). The hourly data were used for calculating daily averages, maximum concentrations, and, for ozone, an 8-hour moving average.

HOSPITAL DATA: Asthma ER visits for people who live within approximately 1.5 miles of each monitoring location were included in the analysis. Health data for the two communities were gathered from 22 area hospitals for the period in which ambient air contaminant data were collected. Health effects were measured by ER visits with a diagnosis of asthma or other respiratory condition. As a statistical control, the project team compiled the records of ER visits for a set of other health conditions thought to be unrelated to ambient air contaminants (e.g., non-infectious gastrointestinal disorders).

STATISTICAL ANALYSES: The air quality and hospital data are being analyzed to compare the two communities with respect to ambient air quality and ER visits. Using statistical tools, the project team will seek to determine the associations between various air contaminants and ER visits for asthma or other respiratory conditions.



RECENT FINDINGS

For most air contaminants, concentrations in Manhattan tended to be slightly higher than those in the Bronx, with the exceptions of ozone and pollen. In general, pollutant levels at the two sites were highly correlated.

- For both sites, PM_{10} and $PM_{2.5}$ levels varied throughout the day and peaked, along with elemental carbon, between approximately 7 and 9 AM. Low levels were observed in the middle of the night and in the mid-afternoon, and the highest levels were observed in the morning.
- Elemental carbon (soot) hourly averages varied throughout the day for both sites; the highest levels were observed in the morning.
- Organic carbon hourly averages (between peak concentrations and lowest concentrations) varied only in Manhattan; the highest levels were seen in the evening.

Analysis of air trajectories showed similar results for the two sites. In 1999, ~15% of sulfur dioxide, 45% of sulfate, and 30% of $PM_{2.5}$ mass were transported from the Midwest. The rest of the air contaminant mass can be attributed to sources within approximately 100 miles. In addition, there were seasonal variations in the composition of the $PM_{2.5}$ mass; the sulfate component (17–31%) was highest from June to September.

PROJECT IMPLICATIONS

The data and findings of this project will help fill a critical need to further clarify the complex relationship between different contaminants in ambient air and potential health effects. Distinguishing between $PM_{2.5}$ components in relation to reported health effects is desirable for the development of effective control strategies for reducing health risks. Speciation of $PM_{2.5}$ within the ambient air mixture is also useful in distinguishing source types and their relative contributions, and for the identification of potential source control opportunities.

Additionally, the data will offer greater insight into the health impacts of local sources of air contamination. The results of this study are likely to prove relevant to other large cities. Information about daily, weekly, and seasonal variations may also aid policy makers in formulating appropriate health advisories and creating successful preventive measures, as well as devising and implementing effective controls.