PROJECT UPDATE

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New York State Energy Research and Development Authority

Environmental Monitoring, Evaluation, and Protection Program

Workshop on Incorporation of Receptor Models into PM and Adverse Health Effects Study

Principal Researchers

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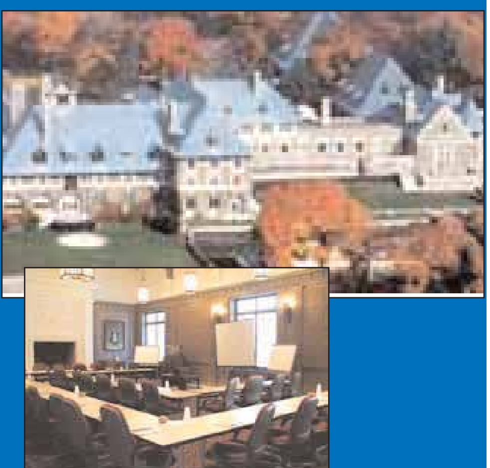

http://www.ardenhouse.com/
Arden House Conference Center.

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

- Factor analysis techniques
- Fine particulate matter ($PM_{2.5}$)
- Receptor modeling
- Source apportionment
- Time series analysis

PROJECT FOCUS

This project involved a workshop to examine the usefulness of PM source-apportionment methods for identifying source-related health effects. The workshop brought together researchers on particulate matter (PM) from Health Centers supported by the U.S. Environmental Protection Agency (EPA) and seven other organizations.

The goals of the workshop were to analyze particle composition and mortality data from two different cities, in order to:

- Determine whether quantitative relationships can be observed between apportioned source contributions and human mortality; and
- Ascertain whether the use of different receptor modeling methods significantly affects the relationships identified between source contributions and mortality.

The aim of these analyses is to provide a scientific basis for more cost-effective source control policies for New York and other states.

CONTEXT

Airborne PM is a broad class of materials, transported as solid particles or liquid droplets (aerosols). These particles are emitted from a variety of natural processes and human activities, including fossil-fuel combustion, forest fires, wind erosion, agricultural practices, industrial manufacturing, and construction. They can be emitted directly into the atmosphere (primary particles) or formed in the atmosphere from precursor gases such as sulfur dioxide, nitrogen oxides, ammonia, and volatile organic compounds (secondary particles). In July 1997, motivated by concerns about adverse health effects, 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 $\mu g/m^3$) and annual maximum (15 $\mu g/m^3$) average concentrations.

Although the current NAAQS uses $PM_{2.5}$ mass concentrations to gauge air quality, some particles that contribute to PM mass are expected to be more toxic than others, depending on their composition. Thus, focusing on all particles that contribute to PM mass may lead to less efficient and effective control strategies than focusing specifically on the particles that are more implicated in adverse health effects. As the number of possible chemical species associated with the particle mass is so great, it would potentially be more effective to consider airborne PM as a mixture of different combinations of particles arising from a variety of source categories. Each of the various source types, such as spark-ignition or diesel-powered vehicles; coal-, gas-, or oil-fired power plants; incinerators; and road dust, has characteristic chemical and/or physical patterns and signatures. These may be used in combination to match the composition found in ambient air.

Recent epidemiological and toxicological studies suggest that PM health effects can vary by source category. However, a variety of source-apportionment methods, used to attribute PM components to different source categories, are currently being used to assess PM impacts. Although these various methods are employed in epidemiological studies, the effect of variations in methods on the subsequent evaluation of PM health effects is not known. Thus, the studies may not be comparable.

Participating Research Groups	
Brigham Young University	Provo, UT
Clarkson University	Potsdam, NY
GSF Research-University of Rochester	Nuremberg, Germany-Rochester, NY
Harvard University School of Public Health	Boston, MA
New York University School of Medicine	Tuxedo, NY
University of Southern California	Los Angeles, CA
University of Washington	Seattle, WA
U.S. Environmental Protection Agency	Research Triangle Park, NC

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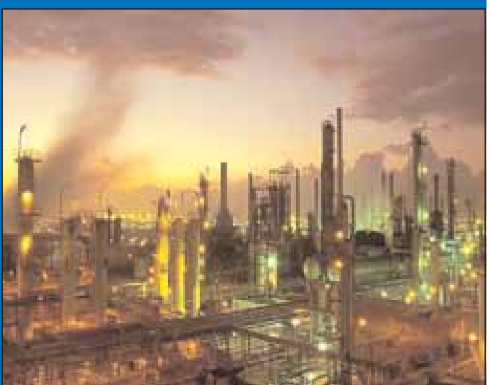

Credit: www.atwitsend.org/ rjnews.html

Oil refinery in Los Angeles.

Project Status

- Initiated 2003
- Project ongoing

New York Energy Smart[SM]

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.

METHODOLOGY

This project, managed by Clarkson University, involved a receptor modeling exercise and a workshop. The main components of the project were the following:

Modeling Exercise

- Data sets on $PM_{2.5}$ composition for samples collected over a minimum of three years in Washington, DC and Phoenix, AZ were prepared.
- Workshop participants were given these data sets to analyze and generate time-series source profiles, each group using a different factor analysis technique, including "UNMIX," chemical mass balance, and positive matrix factorization.
- The time-series source profiles generated by the workshop participants were compiled by New York University's EPA PM & Health Center. These data were then used in conjunction with mortality data to search for correlations between source profiles and health impacts in Phoenix, AZ and Washington, DC.

Workshop

The workshop brought together researchers from the various EPA Health Centers to characterize the status of work assessing attribution of sources and apportionment of PM to health effects, to present results, and to discuss correlations found between source profiles and health effects. The workshop goals were to:

- Discuss variations resulting from the separate teams' independent analyses of reference PM databases;
- Evaluate how source-specific effects would vary when the respective PM source apportionments of respective research teams were used in conjunction with a single standardized health effects model of mortality; and
- Identify key research needs for source-apportionment health effects evaluation.

PRELIMINARY FINDINGS

Despite the various investigating teams and methods employed in this study, many similar source categories were identified:

- Good agreement among investigators was evidenced on predicted concentrations by source class, when identified;
- Crustal (i.e., soil), secondary sulfate, oil, and salt were the most unambiguously identified sources, generally having the highest correlation across the sites; and
- Traffic and vegetative burning were the most difficult sources to identify unambiguously, having the poorest correlation across groups.

Visible car emissions during highway traffic congestion.

Phoenix, AZ

Mortality was most often associated with secondary aerosols/coal burning, motor/gas vehicles and traffic, diesel, metals, smelter, and sea salt (Cl-rich). Crustal/soil $PM_{2.5}$ as consistently insignificant.

Washington, DC

- Despite the variety of source attribution methods, data selection criteria, and other factors, the range of mortality risk estimates obtained for each source type was comparable between groups.
- Secondary sulfate appears to be most consistently associated with mortality outcomes in the Washington DC data set, followed by traffic and soil.
- The time lapse between exposure and mortality appears to vary depending on source types and was generally consistent across research groups.

Health Effects: General Conclusions

In both cities, mortality was most often associated with secondary sulfate aerosols and combustion particles from motor-vehicle traffic. Other sources were less consistently associated with mortality.

PROJECT IMPLICATIONS

The project's assessment of chemically analyzed ambient PM and mortality data sought to provide greater insight into the relationship between different $PM_{2.5}$ source types and adverse health effects, as well as to determine the effects of using different receptor models in source apportionment. Such studies are a vital component in the effort to formulate pollution controls aimed at minimizing adverse health effects.

The results of this workshop indicate that the use of different factor analysis methods does not make a major difference in the results obtained: good agreement was found between investigators on the source classes identified. In addition, the results obtained by the different groups of investigators show general agreement on which source classes constitute the most harmful components of $PM_{2.5}$ mass resulting in adverse health effects in both Phoenix, AZ and Washington, DC: secondary sulfate aerosols and traffic-related pollution.