

CHEMICAL COMPOSITION OF FINE ORGANIC PARTICLES FROM URBAN AND REGIONAL BACKGROUND LOCATIONS IN NEW YORK STATE

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Project Locations



Project Cofunder

Northeast States for Coordinated Air Use
Management

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For more information on this
project see:

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Keywords

- Elemental carbon
- Molecular markers
- Organic carbon
- Organic particulate matter
- Primary emission sources
- Secondary emission sources

PROJECT FOCUS

The project is part of an ongoing research effort aimed at improving our understanding of the role of primary and secondary carbon particulate matter (PM) in New York State (NYS) air. While the broader research will identify molecular markers for different source types and determine the amount of organic PM from primary and secondary sources, this project will help improve understanding of the atmospheric abundances and sources of fine carbon PM in various urban and regional locations in the state, providing information that is essential for developing appropriate strategies to control pollutant concentrations in ambient air.

CONTEXT

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 [$\mu\text{g}/\text{m}^3$]) and annual maximum (15 $\mu\text{g}/\text{m}^3$) average concentrations. Approximately 65 million people in the United States live in areas with annual average PM_{2.5} levels in excess of 15 $\mu\text{g}/\text{m}^3$. Recent epidemiological and toxicological studies suggest that the health effects of particulate matter (PM) can vary by source category.

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. Secondary particles are formed in the atmosphere through photochemical reaction and oxidation processes involving ozone and other gas-phase oxidants. Each of the various emission source types has characteristic chemical and/or physical patterns and signatures. Organic molecular markers are individual compounds or groups of related compounds (homologous compounds such as n-alkanes, n-alkanoic acids, hopanes and steranes) that at a molecular level comprise the chemical profile or “fingerprint” for specific emission source types. Individual molecular markers and groups of marker compounds are linked quantitatively to major emission sources of urban fine particles and also to known chemical emission profiles.



Credit: www.photospin.com

Suites of common cooking oils, lard, and fats (e.g. from fast food frying operations) will be investigated in the laboratory



Credit: Monica Mazurek

Intermediate School 52, Bronx, NY, air quality monitoring site is operated by the NYSDEC

PROJECT UPDATE

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Credit: Monica Mazurek

Rutgers Tisch 2- and 4-Channel co-located samplers collect fine particle samples. Pinnacle is upwind of the NY metropolitan area and represents regional background.

Project Status

- Initiated October 2003
- Project Ongoing



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 NYSEDA'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. NYSEDA administers the SBC program under an agreement with the Public Service Commission.

METHODOLOGY

This project builds on existing NYSEDA research and a study funded by the Northeast States for Coordinated Air Use Management (NESCAUM) on Speciation of Organics for Apportionment of Particulate Matter (SOAP) in the New York City (NYC) area. The NESCAUM study sampled ambient air at several locations in order to identify organic compound concentrations within and upwind of the City. In collaboration with the NYS Department of Environmental Conservation (NYS DEC) Bureau of Air Quality Surveillance, this project will sample and analyze previously unmeasured concentrations of organic compounds in the organic fraction of PM. Specifically, the project team will

- ◆ Obtain elemental, organic, and total carbon filter mass measurements (m g/cm^2) from archived SOAP network filters (~470 filters) in order to determine ambient carbon mass-balance relationships at four metropolitan NYC sites; assist NYS DEC in comparing archived SOAP filters with U.S. Environmental Protection Agency (EPA) network filters by a second method (through Sunset Laboratories) to measure the organic components in aerosols;
- ◆ Measure and identify ambient concentrations of organic marker compounds and elemental, organic, and total carbon at a community-based urban receptor site (Bronx, NY) and at a regional background site (Pinnacle State Park, NY) in two years of samples; this will allow comparison between urban and rural ambient concentrations, improving understanding of emission sources and primary versus secondary formation of organic PM;
- ◆ Collaborate with NYS DEC Mobile Sources Bureau to measure organic molecular markers in vehicle emissions and motor oils in order to establish signatures for diesel and gasoline vehicles; and
- ◆ Investigate the sources of seed oil in SOAP samples to determine the relative contribution of commercial and domestic food preparation (e.g., fast food frying) to organic PM concentrations.

PRELIMINARY FINDINGS

Fine-particle ambient samples collected as part of the SOAP project have yielded important new results concerning the importance of vehicular emissions and food cooking operations (commercial fast-food restaurants, home cooking) for urban receptor sites in the metropolitan NYC area.



Credit: <http://www.tennessee.gov>

Professional kitchen

PROJECT IMPLICATIONS

Currently, 208 counties (September 2005) in the United States are in nonattainment of federal $\text{PM}_{2.5}$ standards, affecting ~88 million people. This number accounts for both annual and daily standards. In addition, more stringent $\text{PM}_{2.5}$ standards are expected to take effect next year, involving reductions in either daily or annual averages. Recent U.S. EPA proposals have suggested reducing the maximum daily average to $25\text{-}30 \mu\text{g/m}^3$, or alternatively, reducing the annual average to $12\text{-}15 \mu\text{g/m}^3$ while the daily average remains at $25\text{-}40 \mu\text{g/m}^3$. The U.S. EPA also is expected to issue new standards for toxic tailpipe emissions from cars, trucks, and buses by 2007 and for stationary diesel engines (e.g., electrical generators, compressors, and pumps) within two years, mandating reductions in their emissions to the level of their nonroad counterparts.

This project, closely coordinated with NYS DEC efforts, seeks to improve our current understanding of organic particles' chemical composition, ambient concentrations, sources (including unregulated primary sources, such as commercial and domestic cooking operations), and relative contributions of sources to aerosol mass. Its findings will provide the NYS DEC with fundamental information of much greater detail than data gathered by the national network on organic species in aerosols. The information, which will help identify the sources of organic PM in NYS ambient air, is vital for developing control strategies to reduce regional haze and PM and meeting federal standards for ambient air pollution through New York's State Implementation Plan (SIP).