PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Environmental and Water Resources

11/2006

DEVELOPMENT OF A SET OF INHERENT PARTICULATE AND GAS TRACERS FOR APPORTIONING EMISSIONS OF INDIVIDUAL POWER PLANTS AND STATIONARY SOURCES USING HIGHLY TIME-RESOLVED MEASUREMENTS AND ADVANCED RECEPTOR MODELING

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Background

The scientific community and public frequently wonder about the exact sources of air pollutants. A method to identify the point sources of specific air emissions, particularly in communities with multiple fossil fuel combustion sources (such as coal-fired and oil-fired power plants) and various industrial operations (such as steel works and incinerators), is a current challenge in the United States and other parts of the world.

Advanced analytical techniques are being pursued to "map" pollutants sampled in ambient air to specific emission sources. Typically, air emission streams from particular source types are associated with a unique ratio of elements, such as metals and heavy metals in trace amounts. These trace elements, present in the form of fine particulate matter ($PM_{2.5}$, with a mean aerodynamic diameter less than 2.5 μm), can be utilized to develop a chemical signature for each source type.

Reliable analytical techniques to determine ambient contributions and emission rates from individual sources are necessary to determine the relative contribution of $PM_{2.5}$ from each source. This information can aid in the development of air quality source receptor models for estimating potential air quality impacts of new sources, as well as benefits from advanced technologies and air pollution control devices.

Primary Project Goal

The primary goal of this project is to develop a set of particulate and gas tracers that can be used to apportion emissions to individual power plants and stationary sources.

Advanced measurement and modeling techniques will be used to determine primary and secondary $PM_{2.5}$ mass (and other) contributions for resolving individual power plant pollution emission rates (e.g., power plants equipped with different types of air pollution control equipment) and their effect on nearby receptor sites.

PARTNER

University of Maryland

PERIOD OF PERFORMANCE

12/29/2005 to 12/31/2006

COST

Total Project Value
$62,499

DOE/Non-DOE Share
$49,999 / $12,500

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Objectives

- *Develop analytical testing procedures* for up to 30 trace elements at the part per billion (ppb) and sub ppb level for use with a Thermo-Electron X-series II, inductively coupled plasma mass spectrometer (ICP-MS).
- *Analyze archived 30-minute air samples* from specific known sources that approximate power plant plumes to determine trace element concentrations using the developed analytical test procedures for ICP-MS. Archived samples previously collected in the St. Louis, Baltimore, Pittsburgh, and Tampa areas have been selected for analysis within this project.
- *Validate the ICP-MS results* using receptor modeling with nitrogen oxide (NO_X) and sulfur dioxide (SO_2) data from each archived sample to determine the sensitivity of results to the number and quality of tracer elements and if new (interfering) sources are detected.
- *Determine primary and secondary $PM_{2.5}$ contributions* from power plant sources (representative of the archived samples successfully tested) in terms of trace elements and secondary sulfates.

Accomplishments

This project is still in its early stages, although the analytical testing procedures have been developed and analysis of archived 30-minute air samples from the St. Louis area has begun.

Benefits

Improved source receptor modeling capability using 30-minute ambient air samples will enable researchers to better characterize power plant emission source types.

ICP-MS analytical capabilities will provide the ability to accurately determine concentrations of more than 21 trace elements, twice as many as determined routinely by conventional Atomic Absorption Spectroscopy. These include calcium, potassium, and other trace elements that may be useful in separating the emissions signatures of power plants equipped with scrubbers from non-scrubber equipped plants and other sources.

Planned Activities

Activities will continue throughout the project to analyze archived samples, validate ICP-MS results, and improve receptor modeling capabilities for specific power plant types based on fuel source and types of operating air pollution control equipment.