PROJECT UPDATE

December 2005

New York State Energy Research and Development Authority

Environmental Monitoring, Evaluation, and Protection Program

NYSERDA

AMBIENT GASEOUS AMMONIA: EVALUATION OF CONTINUOUS MEASUREMENT METHODS SUITABLE FOR ROUTINE DEPLOYMENT

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Project Locations

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For more information on this project see:

http://www.nyserda.org/programs/environment/emep

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Keywords

- Ammonia
- Ammonia Analyzers
- Fine Particulate Matter ($PM_{2.5}$)
- National Ambient Air Quality Standards (NAAQS)
- EPA NCORE Level 2 site

PROJECT FOCUS

A better understanding of the formation and transformation of particulate matter (PM) in the atmosphere requires advances in methods for measuring ambient gaseous ammonia and for quantifying the types and amounts of ammonia emitted to the atmosphere. This project aims to establish the viability of routine continuous measurements of gaseous ammonia and to begin conducting such measurements at one or more sites. The accumulated data will help clarify the formation and transformation of fine particulate matter ($PM_{2.5}$), and allow researchers to better quantify the types and contributions of ammonia sources while making measurements more reliable and routine.

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 µg/ m^3) and annual maximum (15 µg/ m^3) average concentrations.

Credit: www.ecy.wa.gov
Jersey cows

Ammonia (NH_3) is emitted into ambient air from a variety of sources. The major contributor to NH_3 concentrations is thought to be animal agriculture, which accounts for as much as 50%-85% of anthropogenic emissions in the United States. During the decomposition of animal manure, reduced nitrogen compounds are converted to ammonia, which enters the air. Gaseous ammonia can travel long distances and is therefore a global concern, playing an important role in a host of environmental effects such as the eutrophication of surface waters and the acidification of soils. In addition, through complex chemical reactions in the atmosphere, it combines with other compounds to form fine particles ($PM_{2.5}$). In fact, ammonium sulfate and ammonium nitrate combined contribute more than 50% of the $PM_{2.5}$ mass in the eastern United States. Although ammonia contributes a significant proportion of ambient air $PM_{2.5}$, however, emissions from animal agriculture are not at present specifically regulated.

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http://www-gte.larc.nasa.gov/
Aerosol multi-layers

Project Status

- Initiated January 2005
- Project ongoing

New York Energy Smart PUB

George E. Pataki, Governor

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

The first major task of the project will be to conduct a laboratory intercomparison of six different gas phase ammonia analyzers at SUNY Atmospheric Sciences Research Center (ASRC) in Albany. Two commercial continuous low-level ammonia analyzers, one based on chemiluminescence (Thermo Environmental Instruments Model 42C-TL) and one based on ion mobility spectrometry (Particle Measuring Systems AirSentry Pro IMS ammonia analyzer), will run alongside three research-grade ammonia measurements and a third commercial analyzer on loan from the Lake Michigan Air Director's Consortium. The three research analyzers will be used to determine a common baseline for the evaluation of the chemiluminescence and ion mobility spectrometer analyzers.

Credit: James J. Schwab
Research Station at Pinnacle State Park

In order to compare the performance of the six instruments and accommodate their different requirements for the laboratory intercomparison, the project team will design and build a robust, flexible sampling manifold from glass, and heat and insulate the manifold to minimize the surface interactions of ammonia with liquid or surface-bound water. The flow rate and fluimechanics flow regimes will optimize the distribution and uniformity of ammonia in the manifold while minimizing interactions with wall surfaces. The researchers will also design and implement a reliable system for delivering calibration gas into the system.

Following this comparison, one or both of the commercial instruments will be deployed for a minimum of three months at the air-quality monitoring site in Pinnacle State Park, NY in order to obtain ambient-air ammonia measurements. Subsequently, the performance of the ammonia analyzers will be assessed and the measurement data interpreted.

PROJECT IMPLICATIONS

Reliable measurements of gaseous ammonia are necessary for an improved understanding of the formation and transformation of particulate matter in ambient air, providing greater insight into the sources, ambient levels, and atmospheric chemistry of ammonia in the gas and particle phases. This project addresses current inadequacies in measurement technologies by evaluating novel methods that have not been deployed for ambient atmospheric measurements of ammonia concentrations. The improved measurement protocol and the data acquired are expected to significantly contribute to New York's effort to develop sound strategies to meet the NAAQS for $PM_{2.5}$.

Credit: Jason Smith, U.S. Geological Survey (http://pubs.usgs.gov)
Swine waste-retention basin

The EPA Office of Air Quality Planning and Standards (OAQPS) has recently proposed a new national monitoring strategy called NCORE. In the NCORE plan, air monitoring takes place at three types of sites, designated as Levels 1, 2, and 3. Level 1 will include only a handful of "research sites" nationwide, while Level 2 will be comprised of about 75 "backbone multi-pollutant sites" for the nationwide network. Level 3 will incorporate additional sites, including sites for monitoring single pollutants. The findings of this study will benefit efforts to establish the Pinnacle State Park site as an EPA NCORE Level 2 site.