



How Are Ambient Monitoring, Personal Exposure, and Health Related?

Presenter: Alan Vette

U.S. Environmental Protection Agency, Office of Research and Development

research
and
development

Science Questions

- How does community-level ambient monitoring represent personal exposures of PM components and air toxics attributed to specific sources?
- Are ambient pollutant exposures reflected in clinical / biological markers of exposure?
- Are neighborhood differences in urban air pollutant levels related to the development of allergies and asthma?
- What is the role of specific ambient pollution sources upon human health and the ability of community-based monitors to represent potential human exposures

Background

Ambient air pollution data collected in communities are typically used in epidemiology studies to determine relationships between air pollution and human health effects. Previous research has shown that concentrations of PM_{2.5} mass measured at community sites are often a reasonable surrogate for personal component exposures. Presently, it is not known if PM and related air toxic pollutants from specific ambient sources behave similarly.



A community monitoring site at Allen Park, Michigan. Sites like these are used around the U.S. as a surrogate for human exposure measurements

Research Goals

EPA and its collaborators have a series of ongoing or planned research studies targeting the Detroit Metropolitan area. These include:

- Detroit Exposure and Aerosol Research Study (DEARS),
- Detroit Children's Health Study (DCHS),
- Healthy Heart Study,
- Detroit PM Toxicology Study, and
- Windsor Air Quality Study

The overarching goal of these related efforts are to use community, residential indoor, residential outdoor, and in some cases personal exposure monitoring data to assess the impact of ambient-based PM and air toxic sources upon human populations and the neighborhoods in which they live. Assessing ambient source impacts in local neighborhoods and observed health effects will provide invaluable information on the current uncertainty of using ambient-based monitors as a surrogate for human exposures.

The **DEARS** will collect ambient, personal, residential indoor and residential outdoor data for a total of 120 residents of Wayne County, Michigan over a 3-year period. The ambient source impact of PM constituents and select air toxics will be identified. This source information will be leveraged in the parallel or linked health and exposure studies.



Personal



Home indoors

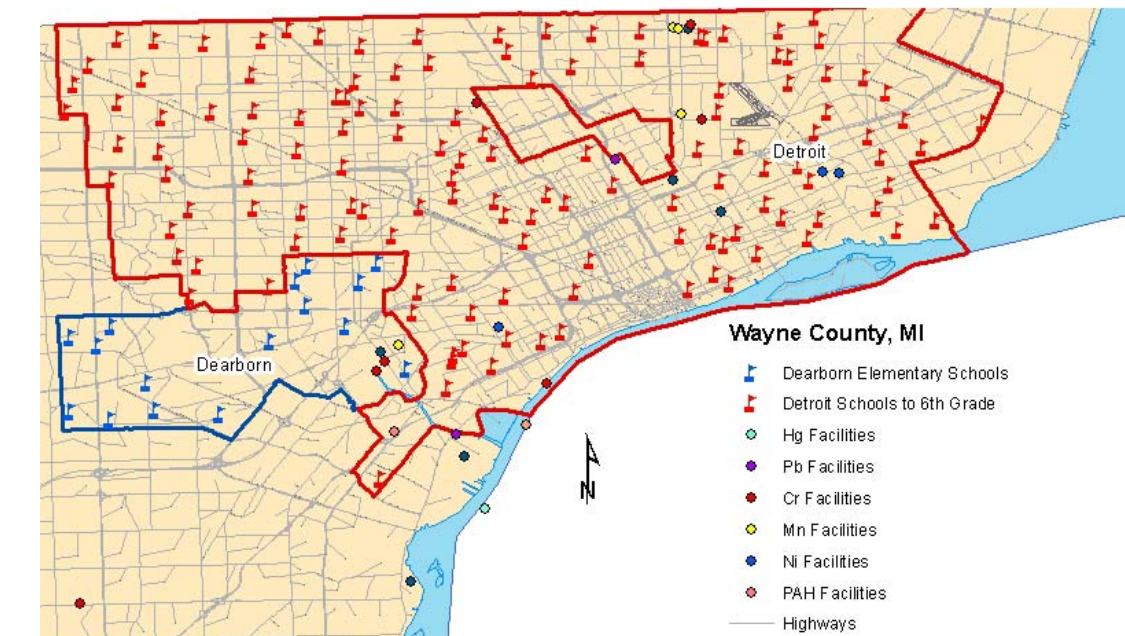


Home outdoors

The Studies

The **DCHS** will use exposure modeling data for PM and select criteria pollutant gases from school-based exposure monitoring and DEARS to assess the impact of ambient-based pollutants upon the health status of students in the Detroit and Dearborn areas. The Study will apply questionnaires, lung function testing, inflammatory and other biological markers and measurements combined with neighborhood differences in air pollutant concentrations to help EPA understand whether long-term, early-life exposures to mobile-source emissions, particularly diesel exhaust particles, play a key role in the initiation of allergic asthma in schoolchildren.

Fourth- and fifth-grade children enrolled in 50 to 60 elementary schools



The **Healthy Heart Study** is being conducted by the University of Michigan as a parallel study to the DEARS. Personal exposure data from the DEARS will be integrated with cardiovascular endpoints including brachial artery dilation. Clinical findings have shown this to be a sensitive marker of potential exposures to some pollutant classes, like PM using ambient-based monitoring. Use of personal exposure data will potentially provide a more sensitive analysis

The collection of sensitive ultrasound measurements in the home environment is a key component of the Healthy Heart Study



The Detroit PM Toxicology Study

will collect coarse, fine and ultrafine PM for toxicological assessment. When combined with source apportionment data from the DEARS these studies will provide insight as to the toxicological properties of PM attributed to specific ambient sources. Size fractions will be collected using a Harvard-designed cascade impactor hi-volume sampler that is portable and can be taken to the DEARS and other study sites.



The 4-stage Cascade Impactor positioned in Detroit

The Canadian Windsor Air Quality Study

is being conducted simultaneously with the DEARS and uses a similar study design. Data collected in this study may extend the exposure model development making it applicable to a geographical beyond DEARS. This holds the potential for being of benefit to the DCHS and spatial modeling of pollutant concentrations

Future Directions

- The DEARS has completed its first summer season and has initiated its first winter monitoring. Two additional years of monitoring will be performed. Source apportionment and modeling applications will soon begin using data collected from the first seasons.
- The DCHS is expected to begin in summer 2005. School-based exposure will be monitored and linked to the collection of approximately 60,000 health surveys from grade school children.
- The Healthy Heart Study is currently being piloted. Information gained from the real-world collection of circulatory vessel constriction as a function of pollutant exposure will be used to more fully design follow up seasons.
- The Detroit PM Toxicology Study has been initiated. Data and operational information gained from its first siting will be used to refine the prototype impactor and trailer operations for additional collection of large mass quantities of PM for toxicology studies.
- The Windsor Air Quality Studies will coincide with the DEARS. Data analysis and potential integration of modeling efforts could begin as early as 2006.

Impact and Outcomes

The Detroit studies reveal the impact of collaborative inter-and intra-laboratory efforts across ORD to fully leverage resources on the complex issue of PM, air toxics, and observed toxicological and human health effects. The outcome of these efforts will be a database useful for understanding PM and air toxics source impacts upon the local population and the reduction of the uncertainty of using ambient-based monitors to assess source impacts for epidemiological studies. This will be used to form future National Ambient Air Quality Standards.

Source to Health Outcome