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BUILDING A SCIENTIFIC FOUNDATION FOR SOUND ENVIRONMENTAL DECISIONS

CLEAN AIR RESEARCH PROGRAM

MODELING IMPROVES UNDERSTANDING OF HUMAN EXPOSURE TO AIR POLLUTANTS

Issue:

Knowing how and where people are exposed to air pollution is important both for identifying people at risk of health impacts from air pollution and for reducing that risk. However, understanding human exposure to air pollution is not as simple as taking a measurement of outside air at a given location.

For example, people spend the majority of their time indoors at home, work, and school, where levels of air pollutants may differ from those measured outdoors. In addition, many different factors influence human exposure to air pollution, including where a person lives or works, and how much time is spent there.

Human exposure models that estimate exposure to air pollution are valuable decision-making tools for the U.S. Environmental Protection Agency and for air quality managers and risk assessors. The models are used to better understand how exposures vary between people (e.g. children vs. adults), as well as over time. While air monitoring can provide actual real-world data, the information is limited to a particular time and location. Models, on the other hand, offer a way of predicting exposures under different conditions.

With human exposure models, investigators can examine a variety of scenarios to find out what the impact might be on actual exposures, such as lower air pollutant concentrations from emission reductions or more time spent in places with high pollutant concentrations (e.g. commuting).

Scientific Objective:

The Clean Air Research Program in EPA's Office of Research and Development is dedicated to advancing exposure modeling to improve exposure estimates for air pollution risk assessments.

Key scientific questions being addressed include:

- What are the most important factors that influence human exposures to air pollutants?
- Can air quality and exposure models be used together to improve estimates of exposure?
- How do exposures compare across different types of air pollutants?
- Can associations between air pollutants and health effects found in epidemiology studies be improved by accounting for exposure differences?

A major research effort is the development of the Stochastic

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Human Exposure and Dose Simulation (SHEDS) model and the databases needed for applying human exposure models for air pollutants. The SHEDS model accounts for variations in the demographics of the population, the time people spend in different locations during their daily activities, and the pollutant concentrations for these locations, among other factors.

The primary databases include demographic data from the U.S. Census, human activity pattern data from diary records, and data from human exposure measurement studies.

Application and Impact:

Exposure modeling research by the Clean Air Research Program is improving our understanding of the relationships between air pollutant sources, outside concentrations of the pollutants, and human exposures.

The SHEDS model is an important decision-making tool used by air quality regulators and planners to implement air quality standards.

As a result of the model, researchers have learned more about particulate matter (PM). Studies using the model have shown that exposure to outdoor PM while indoors is an important contributor to a person's total PM exposure. However, the amount of exposure varies across age groups due to differences in people's activities.

Case studies which have applied the SHEDS model in combination with air quality models have demonstrated how these modeling tools can be used together to improve estimates of exposure to air pollutants, especially those that vary within an urban area due to the location and type of sources.

The model is also an important research tool for advancing our knowledge of personal air pollutant exposure. Currently, researchers are refining the SHEDS model to apply to exposures of air pollutant mixtures, such as PM, air toxics and regulated gases that come from vehicle exhaust.

The model is also being used as part of a study to track the effectiveness of air quality control measures in New Haven, Conn. In addition, the model provides exposure information for EPA health studies on air pollution, including studies of associations between mortality, asthma, and birth outcomes with particulate matter.

REFERENCES

Georgopoulos, P., Wang, S., Vyas, V., Sun, Q., Burke, J., Vedantham, R., McCurdy, T., Özkaynak, H. 2005. A source-to-dose assessment of population exposures to fine PM and ozone in Philadelphia, PA, during a summer 1999 episode. *Journal of Exposure Analysis and Environmental Epidemiology*, 15: 439-457.

Isakov, V., Graham, S., Burke, J., Özkaynak, H. 2006. Linking air quality and exposure models. *EM*, Sept. 2006, 26-29.

CONTACT

Janet Burke, National Exposure Research Laboratory, EPA's Office of Research and Development, 919-541-0820, burke.janet@epa.gov.

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