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CLEAN **AIR** RESEARCH PROGRAM

ACCOUNTABILITY RESEARCH: ASSESSING THE IMPACT OF AIR QUALITY REGULATIONS

Issue:

Air quality has substantially improved in the United States since the enactment of the Clean Air Act in 1970. Under the law, reductions in major pollutants, including ozone and particulate matter (PM), have been achieved as a result of air regulations implemented by the U.S. Environmental Protection Agency.

Measuring the impact of these regulations has been conducted historically by tracking changes in the amount of total annual emissions and outdoor concentrations of air pollutants. While the data have provided important information, there is growing recognition that new measurement tools are needed to better determine if air quality regulations and control measures are effective in protecting ecosystem and public health.

EPA and other organizations such as the Health Effects Institute (HEI) are studying ways to develop approaches to assess the impact of regulatory decision making. This effort is often referred to as "accountability research" because of its goal to produce new tools and information that can be used to provide evidence of regulatory effectiveness, or "accountability."

Accountability research in air science is inherently multidisciplinary. There is a need to better understand the relationship between the source of an air pollutant and its related health impacts. This source-to-outcome continuum involves a series of steps across the various air pollution sciences that link sources to air quality as well as air quality to health and environmental impacts. These steps are:

- Identifying source emissions
- Characterizing outdoor air concentrations
- Identifying human and/or ecosystem exposures
- Relating exposure to dose
- Determining health and environmental outcomes

Research is needed to develop indicators for each of these steps. Indicators can be used to identify and track changes in emissions, outdoor pollutant concentrations, exposures, dose, and outcomes. This will assist with evaluating progress towards the desired environmental policy objectives.

In addition, process models are needed that "connect" the steps described above. These models are essential to accountability because they can be used to estimate changes that will result from step to step in the

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continuum. They can also be used to understand why changes in indicators occur or do not occur as anticipated. As a result, process models are critical in the initial design and implementation of environmental policies.

Scientific Objective:

The Clean Air Research Program in EPA's Office of Research and Development is providing the science to assess the impact of air quality regulations. The objectives are to:

- Provide methods and models to enhance the understanding of relationships between changes in source emissions, ambient air concentrations, human exposure, and health outcomes.
- Inform the development of potential air quality and human exposure indicators that could contribute to a broader set of "linked" indicators along the entire source-to-outcome continuum that could be used to assess progress toward air quality management objectives.
- Conduct targeted feasibility studies that quantify relationships between available indicators or that provide plausible evidence of relationships between indicators.

Key underlying questions are:

- How do changes in source emissions impact outdoor air concentration?
- How do changes in outdoor air concentrations impact human and ecosystem exposures?
- How do changes in human and ecosystem exposures impact human and ecosystem health?

Application and Impact

Accountability is contributing to the development and implementation by EPA of a new national air quality management system, recommended by the National Research Council, that can track health and ecosystem exposures and outcomes as well as document air quality improvements.

To date, research has resulted in many science products related to the development of indicators and process models needed for accountability. These include but are not limited to:

- Emission factors to develop inventories, which serve as indicators of changed emission outputs.
- Air quality methods to measure air pollutants, including the federal reference and equivalency methods, which serve as indicators for changes in ambient air concentrations.
- Air Quality and exposure models, such as CMAQ, AERMOD, and SHEDS, which provide state-of-the-art capabilities to understand relationships between emissions sources and air concentrations, and exposures.
- Health effects data linked to accurate exposure and dose information to quantitatively link outcomes to air pollutants and sources.

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