Evaluating the Effectiveness of Regulatory Actions from the Source-to-Outcome Perspective (3.3)

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A core objective of the Clean Air Act is to "protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population." To achieve this goal, billions of dollars are spent annually by the regulated community and federal and state agencies on promulgating and implementing regulations intended to reduce air pollution and improve human and ecological health. Historically, the impact of air pollution regulations has been measured by tracking trends in emissions and ambient air concentrations. Now, however, the EPA is exploring the potential of extending the concept of measuring impact to a more complete understanding of the relationships along the entire source-to-outcome continuum. Assessing whether air quality management activities are achieving the originally anticipated results from sources through outcomes requires (1) the development of indicators that capture changes in source emissions, ambient air concentrations, exposures, and health outcomes; and (2) the ability to characterize the processes that impact the relationships among these indicators. The NO_x SIP Call was recently implemented by EPA to reduce the emissions of nitrogen oxides (NO_x) and the secondarily formed ozone, in order to decrease the formation and transport of ozone across state boundaries. Over the past three years, AMAD's research has demonstrated reductions in observed and modeled ozone concentrations resulting from the NO_x SIP Call. The Community Multiscale Air Quality (CMAQ) model was used to characterize air quality before and after the implementation of the NO_x SIP Call and to evaluate correlations between changes in emissions and pollutant concentrations. Model simulations were used to estimate the anthropogenic contribution to total ambient concentrations and the impact of not implementing the regulation. Methods were developed to differentiate changes attributable to emission reductions from those resulting from other factors, such as weather and annual and seasonal variations. Trajectory models were used to investigate the transport of primary and secondary pollutants from their sources to downwind regions.

We will continue to develop ways to systematically track and periodically assess progress in attaining national, state, and local air quality goals—particularly those related to criteria pollutants regulated under the NAAQS and related rules. Current research is focused on relating NO_x emissions and ambient ozone concentrations to human exposure and health endpoints. Improved air quality surfaces that combine observed and modeled data are being generated for use in exposure models, epidemiological health studies, and risk assessments. These studies will examine the benefits of using improved air quality surfaces versus central monitoring approaches, and of using exposure probability factors versus ambient ozone concentrations in health studies. In addition, these studies will evaluate changes in predicted exposure and risk assessments and actual changes in health endpoints (e.g., respiratory diseases) between the pre- and post-NO_x SIP Call time periods. Finally, research is moving beyond the NO_x SIP Call to assess upcoming regulations. An approach for evaluating the Clean Air Interstate Rule (CAIR) is being investigated to establish and integrate "metrics" (predictions of changes associated with the promulgation of CAIR) and "indicators" (actual levels of the same or closely related parameters observed during the implementation of CAIR).