Air Quality Assessment of Ozone, Particulate Matter, Visibility and Deposition - Program 91

Program Overview

Program Description

Implementation of regulatory programs under the Clean Air Act requires the development and application of rigorous air quality models, accurate ambient measurements, and the use of assessment tools based on credible science. Improved techniques are needed for estimating emissions from various sources and for determining the impact of interstate pollution. Previously these tools and techniques have been used to enable informed rulemaking processes for attainment of National Ambient Air Quality Standards (NAAQS), to develop state implementation plans (SIPs), and to make determinations of Prevention of Significant Deterioration during permitting of power plants. However, over the past few years the use of these models has been extended to essentially every part of the air quality regulatory process. In addition to their use in the implementation of standards, air quality models will be applied in the following ways:

- Three-dimensional air quality models, as well as other environmental models, are being used to determine levels of the ambient concentrations of nitrogen oxides (NOx) and sulfur oxides (SOx) to meet a given aquatic acidification standard as part of the Secondary NAAQS for NOx and SOx. This application of these air quality models is unprecedented within the NAAQS process, and thus requires a greater degree of scrutiny on the adequacy of the models.
- With the promulgation of the Primary NAAQS for NO\textsubscript{2} and SO\textsubscript{2}, the U.S. Environmental Protection Agency (EPA) has introduced a new “hybrid” methodology for determining attainment designations of these NAAQS. In addition to deploying monitors to assess whether specific areas exceed the level of the standards, EPA is also requiring major point sources to demonstrate attainment via the use of air dispersion models as part of the designation process. These models have been developed for permitting applications, and as such are quite conservative. The use of models to demonstrate future attainment of standards as part of the SIP process is routine. However, the application of models to define current attainment designations is unprecedented.
- Finally, EPA is continuing to use models to determine the levels of significant contributions to interstate transport of air pollution. As primary and secondary standards for ozone and particulate matter (PM) become more stringent and secondary standards for NOx and SOx are introduced, EPA is expected to continue to develop “Transport Rules” with increasingly smaller thresholds of significance for these pollutants. EPA is likely to continue to use three-dimensional air quality models to establish the upwind/downwind state relations for significant contributions.

Given the already significant use of models and their proposed expansion in the air quality regulatory and management process, it is becoming more important to improve the overall process and thus increase the confidence in their use. This can be accomplished through a three-pronged approach of improving models, emissions inventories, and measurements. It is clear that improving different air quality models (through better representation of chemistry and transport) is essential to informing decisions at different steps of the regulatory process. For the models to provide accurate results, the emissions used as the input to the models should be developed with the best-available science and methods. Finally, only accurate air quality measurements can provide the “ground truthing” to determine if the models are adequate for these proposed uses.

In summary, the electric power industry needs an enhanced understanding of how atmospheric chemical reactions—especially those involving power plant emissions—influence the formation, composition, and health effects of air pollutants. Developing and improving air quality models, improving emissions inventories, and ensuring accurate measurements of air quality, visibility, and deposition are the focus of the Electric Power Research Institute’s (EPRI’s) air quality assessment program.
Research Value

Air quality rulemaking continues to be a key issue for power plant owners and operators. Through this program, EPRI advances the science supporting air quality models used for policy development, regulatory decision making, and implementation planning. Timely communication materials facilitate industry’s ability to respond to questions raised by policymakers, regulators, and other stakeholders. Program research also informs environmental compliance activities, asset management, and long-term strategic planning by power companies. With this research,

- policymakers, regulators and the public will benefit from EPRI’s scientific data, modeling tools, and analytical resources to fully evaluate air quality impacts from all emissions and sources, thereby enabling informed, science-based decision making;
- analysis of additional regulatory options and evaluations of the effectiveness of proposed policies will be performed;
- detailed scientific perspectives on environmental policy and regulatory deliberations of power plant emissions will be provided; and
- collaborations on multimedia environmental issues (such as water quality and ecosystem impacts from atmospheric deposition) and assessment of new technologies (such as electric transportation and distributed energy resources) will increase.

Approach

Research products include air quality models and ambient measurements that clarify how emissions from different sources contribute to the formation of ozone, PM, regional haze, and atmospheric deposition. Additional products include research on atmospheric chemistry and ambient measurement methods essential to allowing health scientists to identify the most harmful air pollution components. These tools are provided to the research and regulatory communities, and their use is encouraged. This program delivers

- independent, objective technical experts who can effectively work with regulatory agencies and the environmental science community;
- the most advanced air quality models, offering the most accurate representation of power plant emissions, chemistry, and transport in the atmosphere;
- multimedia research on the interactions between air quality and climate change, as well as between air quality and watershed management;
- improved techniques for estimating point and nonpoint emission sources; and
- atmospheric measurements that identify air pollution components associated with adverse health impacts, to inform development and application of modeling tools and source-receptor analysis techniques.

Accomplishments

Advanced air quality models and assessment tools based on atmospheric science are critical to informing state and federal air quality management actions in response to more-stringent air pollution standards. This program has

- assessed environmental impacts of plug-in hybrid electric vehicles;
- developed and received regulatory acceptance of a new algorithm for more-realistic accounting of contributions to regional haze;
- evaluated changes in nitrogen deposition due to power plant emissions controls;
- clarified the role of acids in the formation of secondary organic aerosol, and improved representation of the process in air quality models;
- ensured that the Southeastern Atmospheric Research and Characterization (SEARCH) Network continues to yield valuable information for evaluating poorly represented sources, understanding trends, evaluating models, and providing information for health studies;
Electric Power Research Institute 2012 Research Portfolio

- implemented an advanced plume-in-grid module to better characterize specific impacts of power plant emissions on ozone, particulate matter, and atmospheric deposition; and
- highlighted the importance of transboundary pollution in regional haze considerations.

Current Year Activities
The program’s R&D for 2012 will continue to focus on the development and application of air quality assessment tools during a significant time in U.S. environmental rulemaking. Key collaborations with EPRI programs on ecosystem/watershed management, energy storage, electric transportation, and coal combustion products management will be crucial in order to inform policymakers, regulators, and other stakeholders. In 2012, program research will

- enhance air quality models and apply those models in regulatory case studies to clarify the contribution of power plants to ozone, PM, haze, and atmospheric deposition;
- evaluate and improve air permitting models;
- conduct additional experiments to enhance understanding of contributions to regional haze from various emission sources;
- continue providing comprehensive information on PM sources, chemistry, and composition essential to understanding air quality health effects;
- improve emissions inventories for highly uncertain categories;
- continue developing improved modules to represent organic PM in air quality models; and
- develop new linkages between air quality and watershed models to assess the contribution of atmospheric deposition from different sources to sensitive ecosystems and waterways.

Estimated 2012 Program Funding
$2.0M

Program Manager
Eladio Knipping, 202-293-6343, eknippin@epri.com
Summary of Projects

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<tr>
<th>Project Number</th>
<th>Project Title</th>
<th>Description</th>
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<tbody>
<tr>
<td>P91.001</td>
<td>Air Quality Model Development, Evaluation and Application</td>
<td>This project enhances the development and application of comprehensive atmospheric models to better inform air quality policies or implementation plans for compliance with air quality regulations.</td>
</tr>
<tr>
<td>P91.002</td>
<td>Regional Haze Studies</td>
<td>This project provides critical information for improving the implementation of the Regional Haze Rule, focusing on rigorous and realistic assessments of the contributions of various emission sources to visibility degradation.</td>
</tr>
<tr>
<td>P91.003</td>
<td>Improving Emission Inventories</td>
<td>This project will improve the modeling tools, techniques, and emission factor data used to create emission inventories, focusing on ozone and PM precursors from the most uncertain emission sources.</td>
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<tr>
<td>P91.004</td>
<td>Air Quality Measurements and Analysis</td>
<td>This project will improve the detail, spatial resolution, and temporal resolution of atmospheric measurements and related analyses through small-scale field sampling events or as part of larger collaborative field studies.</td>
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<tr>
<td>P91.005</td>
<td>Atmospheric Deposition and Ecosystem Impacts</td>
<td>This project will address the major knowledge gaps on sources contributing to atmospheric deposition, as well as the impacts of acid and nutrient deposition to ecosystems.</td>
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<tr>
<td>P91.006</td>
<td>Air Dispersion Models</td>
<td>This project will evaluate and improve modeling tools used in the permitting of facilities and in attainment demonstrations for the primary SO2 and NO2 NAAQS.</td>
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<tr>
<td>P91.007</td>
<td>Communications</td>
<td>This project will enhance the value of EPRI research by actively communicating results to members and other key stakeholders, particularly federal and state government policymakers and regulators.</td>
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**P91.001 Air Quality Model Development, Evaluation and Application (P21294)**

**Key Research Question**

In response to increasingly stringent environmental regulations, there is a continuing need to enhance three-dimensional air quality models in their representation of the atmospheric chemistry and transport of ozone, particulate matter, regional haze, and atmospheric deposition. Traditional research to improve three-dimensional air quality models has focused on their application in the development of state implementation plans (in other words, control strategies) for compliance with air quality regulations. However, over the past few years the use of these models has been extended to essentially every part of the air quality regulatory process. Models are now also being proposed to determine the levels of ambient standards. For example, the air concentrations of NOx and SOx needed to satisfy the level of an aquatic acidification standard developed as part of the Secondary NAAQS for NOx and SOx require the use of several atmospheric and aquatic models due to absence of necessary ambient data for the calculations. This application of air quality models within the NAAQS process is unprecedented, and thus requires a greater degree of scrutiny on model adequacy.

EPA is also continuing to use air quality models to determine the levels of significant contributions to interstate transport of air pollution. As primary and secondary standards for ozone and PM become more stringent, and as secondary standards for NOx and SOx are introduced, “Transport Rules” with increasingly smaller thresholds of significance for these pollutants will likely result. In addition, models will continue to be used to establish the upwind/downwind state relations for significant contributions.
One of the major research needs is to improve representation of organic particulate matter in current air quality models, which continue to lack in that respect. Organic particulate matter can be as prevalent as sulfate particles in urban areas and can contribute significantly to regional particle levels. Pertinent to health-oriented studies, these models also do not simulate ultrafine particles well. There is also a critical need to improve the simulation of near-field emissions in urban landscapes by developing new methods to capture sub-grid-scale impacts, which may dominate air quality at a particular site. Many air quality models still lack an embedded plume-in-grid module, a feature that is needed for accurate simulation of the chemistry and transport of power plant emissions.

Enhanced models developed in this project will provide the best available tools to stakeholders for developing plans in order to attain increasingly stringent ozone and particulate matter standards and meet regional haze goals. For example, these models can be used to assess different control technology and control strategy options.

**Approach**

This project develops and evaluates computational air quality models. It enhances model capability and reliability for air quality management applications. Advancing the science and thoroughly evaluating the models will increase confidence in their use for environmental policy and regulation development. In addition, this project applies the models to regulatory case studies and helps regulators understand which sources contribute to ozone, PM, regional haze, and atmospheric deposition. Major project activities in 2012 will include:

- developing enhanced modules for accurately simulating the different components of PM, especially organic particles, in air quality models;
- enhancing EPRI’s advanced plume-in-grid module in order to better characterize the impact of power plant emissions on ozone, PM, and atmospheric deposition;
- improving modules simulating cloud chemistry and processing of gases and PM;
- using superior air quality modeling systems for simulating the chemistry, transport, and deposition of atmospheric gases and particles in the environment; and
- examining transboundary contributions to ozone, PM, regional haze, and atmospheric deposition in the United States that define policy-relevant "background" levels of these substances.

**Impact**

- EPRI’s advanced plume-in-grid modules will help electric companies—as well as decision makers and other stakeholders—to better characterize the impact of power plant emissions on ozone and PM formation and atmospheric deposition.
- Advancing the science within these models and evaluating them thoroughly will increase confidence in their use for developing future environmental policies and regulations.
- Planned model applications will help regulators understand the policy-relevant background levels of ozone, PM, regional haze, and atmospheric deposition (the contribution from natural and international emissions to these pollutants and air quality indicators). This information is particularly important in view of more-stringent ozone and PM standards being promulgated by EPA.

**How to Apply Results**

EPRI members and other stakeholders can apply and use enhancements in air quality models in several ways:

- Air quality models can be used by members or their consultants for applications pertinent to the operation of their facilities.
- Air quality models can be used by federal and state agencies when developing environmental policies and regulations.
- Air quality models can be used by regulatory agencies in development of state implementation plans to meet air quality goals.
- Modules developed by EPRI in other modeling systems can be adopted into air quality models.
EPRI will facilitate regulatory approval of models and their enhancement by working in collaboration with federal regulatory agencies and submitting the model enhancements for formal review and adoption. Members can increase the probability of use of EPRI models by working cooperatively with state regulators and encouraging the use of those models. EPRI will also work with members in developing cooperative projects that enhance application and use of these models. In addition, EPRI staff will facilitate broader use and awareness of the EPRI modeling results by providing timely communication materials, including content available through EPRI’s public website, and through continuing service on various advisory panels.

### 2012 Products

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<th>Product Title &amp; Description</th>
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<tbody>
<tr>
<td><strong>Comparison of Different Configurations of the New Community Multiscale Air Quality Model, Version 5:</strong> Different configurations of EPA’s new CMAQ5.0 model will be compared, including model configurations including EPRI-supported modules such as the Advanced Plume Treatment and different modules for organic PM.</td>
<td>12/31/12</td>
<td>Peer Literature</td>
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### P91.002 Regional Haze Studies (103321)

#### Key Research Question

EPA's Regional Haze Rule (RHR) is a long-term regulation that requires visibility in Class I areas to return to natural levels by 2064. In attributing haze to emissions from a specific source, an important step is calculating the relationship between fine particle composition and haze by estimating how much light is scattered or absorbed by sulfate, nitrate, organic materials, black carbon, and other PM components.

EPRI's research developed a new algorithm, which has been accepted by EPA, for calculating haze indices and attributing haze levels to specific components. Many outstanding issues still remain in understanding the relationship between particle composition and haze, and further research is needed. These issues will be addressed by collection of new particle and visibility data at Class I areas and by focused laboratory studies.

Another key challenge with the RHR is how to define or determine the levels of natural visibility that each Class I area that must achieve by 2064. EPA’s definition of this endpoint does not include transboundary anthropogenic pollutants, as well as new science pertinent to understanding naturally occurring levels of particles contributing to haze. Although EPRI research has demonstrated that states need to recognize the importance of transboundary pollution when developing plans for meeting regional haze progress goals, significant uncertainty remains in estimating the transboundary contribution of organic aerosol concentrations.

#### Approach

EPRI research has played a crucial role in developing a new approach to implementing the RHR and its adoption by EPA. However, many outstanding issues still remain in understanding regional haze impacts from different sources, and further research is needed. This project will address these issues by collection of new particle and visibility data at Class I areas and by focused laboratory studies. The experiments need to be completed by 2012 so that the collective data can inform the regional haze rule implementation methodology. EPRI research on these issues will provide a more rigorous and realistic assessment of the contributions of various emission sources to visibility degradation in Class I areas. Specific tasks in 2012 include:

- completion of analyses of the final advanced experimental study at Acadia National Park, and
- synthesis of all the data from all four experimental studies conducted at various national parks and development of a plan for future analysis.
Impact

- Improves decision making by developing advanced methods for attributing haze to specific sources
- Provides a more rigorous and realistic assessment of contributions from various emission sources to visibility degradation in Class I areas
- Informs state agencies about haze in general—and the contribution of power plants to haze in particular—as the agencies prepare state implementation plans aimed at defining the most cost-effective measures to address local and regional air quality concerns

How to Apply Results

Members are encouraged to communicate project results widely. Members should be proactive in sending results to key stakeholders, making sure that stakeholders understand the results, and suggesting that these results be considered in development of environmental policies, including standards, state implementation policies, and other regulatory decisions. EPRI staff will work with members to these ends. In addition to member efforts, EPRI staff will facilitate broader use and awareness of the results by briefing key stakeholders, including regulatory and other government agencies; developing materials for the trade press/media; keeping EPRI’s public website current; and continuing service on various advisory panels.

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<tr>
<td>Characterization of Visibility Conditions at National Parks: Data collected from a series of experiments conducted at three Class I areas will be analyzed in order to improve the characterization of visibility and the contributions to regional haze from different components of PM.</td>
<td>12/31/12</td>
<td>Peer Literature</td>
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P91.003 Improving Emission Inventories (052314)

Key Research Question

Accurate emission inventories are essential to designing sound control strategies to mitigate air pollution. Power plant stack emissions of SO₂ and NOₓ are currently measured with continuous emission monitors (CEMs). However, emissions from many source categories—particularly those associated with on-road and nonroad mobile sources and with agriculture—are estimated using computational emissions models based on limited and often obsolete data. Emissions from other categories, such as local industrial sources, are not regularly monitored or modeled and are often missing from inventories at this time. Power plant stack emissions during plant startup and shutdown periods are currently not characterized; moreover, fugitive emissions from materials piles are estimated using idealized factors in emissions models that may not adequately represent actual conditions. These issues can allow for large uncertainties in emissions estimates used in air quality models, which rely on emissions inventory data as inputs. These uncertainties can in turn lead to incorrect allocation of the relative contributions of various sources to pollutant concentrations in the atmosphere. Since air quality management practices rely on use of the air quality models, these issues can affect permitting, policymaking, and regulatory processes.

In early 2011, EPA released a partial National Emissions Inventory (NEI) for the base year 2008; additional updates are expected throughout the remainder of the year. The 2008 NEI used a new process for collating and performing quality control on the data, which will be under review throughout most of 2011. Careful review of the new inventory is needed to ensure that the best science has been applied to determination of emissions from the various sources and to identify areas where EPRI research may contribute to further improvements.
Approach

Current methods for estimating (rather than measuring) emissions can impact air quality assessments based on emissions inventory data, and thus dramatically affect subsequent policymaking and regulatory processes. This project will improve the modeling tools and other techniques used to create emission inventories, as well as the emission factor data used as inputs to these calculations. Emissions of ozone precursors (volatile organics and nitrogen oxides) as well as PM precursors (such as sulfate, nitrate, and ammonia) are of interest. The focus will be on sources or processes with the most uncertain or limited amount of available emissions data; research could include both modeling and measurement studies. In 2012, improvements to on-road and nonroad mobile emission source models will continue, with a focus on organic carbon. Investigations of sources of nitrogen-containing chemicals (such as ammonia) through improved measurement techniques or inverse modeling studies in 2012 will help clarify PM concentrations and transformations.

Impact

- Expands knowledge of emissions sources of uncertain magnitude that contribute to ozone and PM levels
- Investigates options for potential emissions offsets for electric utilities resulting from vehicle/engine replacement or other actions
- Improves decision making by helping to determine the extent to which different sources are contributing to air pollution, enabling electric utilities, other industries, regulators, policymakers, and other stakeholders to determine the most efficient, cost-effective measures for addressing local and regional air quality concerns

How to Apply Results

Members are encouraged to communicate project results widely. Members should be proactive in sending results to key stakeholders, making sure that stakeholders understand the results, and suggesting that these results be considered in development of environmental policies, state implementation plans, and other regulatory decisions. EPRI staff will work with members to these ends. In addition to member efforts, EPRI staff will facilitate broader use and awareness of the results by briefing key stakeholders, including regulatory and other government agencies; developing materials for the trade press/media; keeping EPRI’s public website current; and continuing service on various advisory panels.

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<tr>
<td>Updated Emissions Estimates for Use in Inventories: Updated measurements and modeling approaches are used to better estimate direct or fugitive emissions from sources.</td>
<td>12/31/12</td>
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Future Year Products

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P91.004 Air Quality Measurements and Analysis (069212)

Key Research Question

Improving the detail and resolution of atmospheric measurements is essential for understanding the various transformation processes of emissions in the atmosphere and best representing those processes in atmospheric models. It is also crucial for studying the human health and ecosystem effects of air pollution. High quality, highly time-resolved measurements are required for evaluation of three-dimensional air quality modeling tools.
Such measurements also provide the necessary input to source-receptor models, which are used in weight-of-evidence analyses to determine sources contributing to pollution at a receptor site. However, most modeling studies rely only on ambient measurements from national monitoring networks, which for PM and its constituents are often taken only as 24-hour average or cumulative measurements. These measurements can obscure or miss rapid changes in atmospheric composition and processing. In addition, these networks typically use instruments designed first and foremost to be easy to operate and maintain, and many of these instruments are becoming increasingly outdated. Often, these methods may not provide the highest quality data in terms of chemical specificity, detection limits, or number of chemicals measured. Finally, static networks cannot cover all spatial and temporal locations of interest. Lack of high-resolution measurement data implies that air quality models are not subject to rigorous evaluation, and use of those models can result in misinterpretation of model results, with subsequent impacts to air quality management strategies.

**Approach**

EPRI research on atmospheric measurements, their interpretation, and relevant instrumentation has played a key role in conducting health studies, developing and validating air quality modeling tools, and determining applicability of source attribution and receptor modeling analyses. This project will continue to improve the detail and the spatial and temporal resolution of atmospheric measurements through both planned projects and projects of opportunity. In 2012, this work will include a small-scale field sampling event coordinated with university researchers to investigate effects of biogenic and anthropogenic emissions on air quality and to improve air quality chemical models. This study will supplement and leverage the work performed at the heavily instrumented SEARCH network sites. In addition, EPRI will participate in organizing a large-scale field study in 2013 in collaboration with government agencies and research institutions. This work will complement and extend the existing suite of atmospheric measurements, allow for critical evaluation of measurement techniques and data analysis/interpretation, allow flexibility to address unanticipated questions by nature of the collaborative efforts, and take advantage of large multiresearcher datasets.

**Impact**

- Improves the detail and resolution of atmospheric measurements, enabling health researchers to determine how the various components of air pollution contribute to observed health effects in the environment and informing the development and application of air quality modeling tools and source-receptor analysis techniques.
- Provides comprehensive data from state-of-the-art measurement techniques to complement or improve upon those that are available in current national monitoring networks and databases and that are used for determining air quality and management strategies.
- Enhances knowledge about the various sources contributing to air pollution, enabling electric utilities, other industries, regulators, policymakers, and other stakeholders to determine the most efficient, cost-effective measures to address local and regional air quality concerns.

**How to Apply Results**

Members are encouraged to communicate project results widely. Members should be proactive in sending results to key stakeholders, making sure that stakeholders understand the results, and suggesting that these results be considered in development of environmental policies, including standards, state implementation plans, and other regulatory decisions. EPRI staff will work with members to these ends. In addition to member efforts, EPRI staff will facilitate broader use and awareness of the results by briefing key stakeholders, including regulatory and other government agencies; developing materials for the trade press/media; keeping EPRI’s public website current; and continuing service on various advisory panels.
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<tr>
<td>Ambient Measurements of Power Plant Plume Impacts: Measurements collected under different atmospheric conditions, including conditions representative of influences by power plant plumes, will be compared to determine to what extent power plant plumes may affect the amount and composition of particulate matter in the atmosphere.</td>
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Future Year Products

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<tr>
<td>Ambient Measurements of Particulate Matter Composition: Ambient measurements using state-of-the-art instrumentation will be analyzed to determine how different components of particulate matter vary in the atmosphere.</td>
<td>12/31/13</td>
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P91.005 Atmospheric Deposition and Ecosystem Impacts (069213)

Key Research Question

Atmospheric deposition of acids and nutrients can influence the biogeochemistry of ecosystems. Deposition of several atmospheric pollutants can lead to acidification, which has been associated with a decline in forest tree species and loss of biodiversity in aquatic ecosystems. Nutrient deposition has been associated with disruption in the biodiversity of ecosystems and eutrophication of water bodies, which can contribute to toxic algal blooms and fish hypoxia.

In the past several years, there has been increasing focus by the regulatory and scientific communities on atmospheric deposition as it relates to acid and nutrient loading in ecosystems. EPA is considering proposing a new Secondary NAAQS based on an aquatic acidification standard. EPA has also indicated that it will continue to explore how other ecological impacts (terrestrial acidification and aquatic/terrestrial nutrient enrichment) may also be incorporated into future Secondary NAAQS for SOx and NOx. In addition, EPA has assembled an Integrated Nitrogen Committee under its Scientific Advisory Board to assess the fate and impacts of reactive nitrogen species throughout different environmental media.

Despite the renewed interest in these ecological impacts, the tools used to evaluate atmospheric deposition are inadequate to inform current decisions and policies. The policies and standards being proposed rely on the concept of critical loads as a means to protect sensitive ecosystems from the impact of atmospheric deposition. However, the critical load methodologies are overly simplistic, and the ecological indicators employed may not accurately represent the true state of ecosystem health.

Approach

This project will conduct a detailed review and analysis of different methods for assessing the impact of deposition on the various terrestrial indicators. In addition, this research is being complemented with a supplemental project on acidification and nutrient enrichment to address two key issues: reliance on overly simplistic aquatic models, and reliance on wet deposition networks with no consideration for dry deposition. The latter topic is of particular concern since EPA is pursuing the use of models, with various adjustments and “bias corrections,” to determine depositional loads without a means to determine the adequacy of the models to represent deposition.
This project will address the major gaps in the understanding of the sources contributing to atmospheric deposition, as well as the impacts of acid and nutrient deposition to ecosystems, by carrying out a suite of focused projects over several years. In 2012, one or both of the following projects will be undertaken depending on priorities:

- A critical review and evaluation of different methods used to address atmospheric deposition to sensitive ecosystems, such as critical loads, regional TMDLs, and secondary NAAQS standards for SOx and NOx
- Continued enhancement of the linkage between air quality and watershed models, thereby providing a dynamic tool to inform policymakers and support exploration of emerging issues, such as the inclusion of atmospheric deposition reduction credits in water quality trading schemes

**Impact**

- Improves decision making by determining the extent to which different sources are contributing to atmospheric deposition
- Enhances the linkages between air quality and watershed models, thereby enabling informed environmental policy
- Conducts analysis of the best methods for regulators and policymakers to address atmospheric deposition concerns

**How to Apply Results**

Members are encouraged to communicate project results widely. Members should be proactive in sending results to key stakeholders, making sure that stakeholders understand the results, and suggesting that these results be considered in development of environmental policies, state implementation plans, and other regulatory decisions. EPRI staff will work with members to these ends. In addition to member efforts, EPRI staff will facilitate broader use and awareness of the results by briefing key stakeholders, including regulatory and other government agencies; developing materials for the trade press/media; keeping EPRI’s public website current; and continuing service on various advisory panels.

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<tr>
<td>Assessment of Deposition Impacts on Aquatic and Terrestrial Ecosystems: National water quality and soil data will be used to assess the extent to which atmospheric deposition of different components from various sources contributes to aquatic and terrestrial acidification in key regions of the United States.</td>
<td>12/31/12</td>
<td>Peer Literature</td>
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**P91.006 Air Dispersion Models (070641)**

**Key Research Question**

The permitting process for power plants and other large industrial sources relies heavily on the application of air dispersion models. These are used to determine compliance with NAAQS and other regulatory requirements such as New Source Review (NSR) and Prevention of Significant Deterioration. In its Guideline on Air Quality Models, which was designed to provide consistency and equity in the use of modeling within the U.S. air quality management system, EPA has identified two preferred (recommended) “guideline” models: AERMOD, a steady-state plume dispersion model for near-source applications, and CALPUFF, a non-steady-state puff dispersion model for long-range transport applications.

EPA has recently promulgated new one-hour sulfur dioxide (SO2) and nitrogen dioxide (NO2) standards with a requirement that models be used to determine attainment compliance. As a result, the adequacy of EPA’s guidelines and accuracy of its preferred models are paramount. The AERMOD model has been shown in
several scientific forums to be too conservative for NO₂ due to simple assumptions on NO-to-NO₂ conversion rates. Furthermore, the modeling methodology required by EPA uses peak emission rates throughout a full annual simulation, resulting in unrealistically overestimated emissions for all pollutants, which will impact compliance with short-term ambient standards. Similarly, for long-range applications, the CALPUFF model is also considered too conservative in its estimates of PM formation from SO₂ and NO₂.

The process and modeling tools used for the NSR program and visibility analyses in the Regional Haze Rule may give overly conservative estimates of a source’s potential contribution to ambient pollutant concentrations and visibility impairment because of inherent assumptions built into these tools. There is a need to determine if either could be improved. Recent advances in computational speed suggest there may no longer be a need to restrict these analyses to the simplest form. Developments in three-dimensional atmospheric models could be transferred to improve air dispersion models or to create hybrid modeling systems.

Approach

This project will improve existing models to remove or minimize potential biases and explore whether better alternatives to existing models can be supported. Evaluations will be performed by comparing the newly developed methodology and models with their original counterparts. This will be accomplished by testing new methodologies for air dispersion model applications for the new short-term standards, improving existing dispersion models for both near-source and long-term application, and evaluating the adequacy of an alternate model within the EPA Guideline process.

Impact

- Improves the air permitting process and attainment demonstration process by developing better tools for determining contribution of a single industrial source to air quality
- Ensures a higher degree of confidence in use of dispersion models

How to Apply Results

EPRI members and other stakeholders can apply and use enhancements in air dispersion models in several ways:

- The improved air dispersion models can be used by members or their consultants for permit applications related to new construction or modifications in their facilities.
- The improved air dispersion models can be used by members or their consultants to determine compliance with primary SO₂ and NO₂ standards.
- The improvements in the models as a result of EPRI research can be adopted by EPA and other regulatory bodies.

EPRI will facilitate regulatory approval of the enhancement of the air permitting models by working in collaboration with federal regulatory agencies and submitting the model enhancements for formal review and adoption. Members can increase the probability of use of the enhanced models by working cooperatively with state regulators and encouraging the use of those models. EPRI will also work with members in developing cooperative projects that enhance application and use of these models. In addition, EPRI staff will facilitate broader use and awareness of these models by providing timely communication materials, including content available through EPRI’s public website, and through continuing service on various advisory panels.

2012 Products

<table>
<thead>
<tr>
<th>Product Title &amp; Description</th>
<th>Planned Completion Date</th>
<th>Product Type</th>
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<tbody>
<tr>
<td>Application of Improved Air Dispersion Models: An evaluation of EPA’s guideline models for air quality modeling (air dispersion modeling) will be performed to determine how different approaches, configurations, and improvements to science modules can improve their use for regulatory purposes.</td>
<td>12/31/12</td>
<td>Peer Literature</td>
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P91.007 Communications (060356)

Key Research Question

EPRI research on various air quality issues will have enhanced value to members and society if the results are actively communicated to and applied by key stakeholders, particularly federal and state government policymakers and regulators. EPRI's reputation for credible research results and its standing in the scientific community provide opportunities for informing key stakeholders of the latest scientific findings on air quality issues. EPRI members have recognized the critical nature of the communication materials provided to date and continue to underscore the importance of continuously updating these materials as new information becomes available.

Approach

Effective communication of EPRI research on air quality issues is essential for the results to be considered and applied by the policymaking and regulatory communities. Communications activities under this project inform decision making and support the development of scientifically sound environmental policy through effective dissemination of significant research results to EPRI members, policymakers, regulators, scientists, and the public at large.

These results are communicated via

- succinct descriptions of key EPRI research findings and their implications on a timely basis;
- presentations, briefings, and testimony to key stakeholders;
- detailed summary papers on EPRI research and analysis on major issues; and
- critical reviews of external studies published in technical reports or technical papers.

Impact

- Informs decision making and supports the development of scientifically sound environmental policy through effective dissemination of significant research results to EPRI members, policymakers, regulators, scientists, and the public at large
- Helps EPRI members stay current on the latest research findings from other groups through reviews of external studies (technical reports and scientific papers)
- Facilitates informed interaction between EPRI members and decision makers through succinct communications materials, targeted presentations, and detailed reports on a timely basis
- Ensures that costly air quality regulations are based on sound science and that investments in technology to reduce emissions provide maximum societal value

How to Apply Results

Members should review the communications materials for information that is relevant to their stakeholders, policymakers, and regulators. This information is useful to member company corporate communications departments and to local, state, and federal liaisons in creating messages and plans to proactively communicate the research findings to appropriate stakeholder groups. In addition, EPRI facilitates application of the results through briefings and testimony to key stakeholders, including state and federal government agencies, as pivotal studies appear or as state or federal actions dictate.

2012 Products

<table>
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<th>Product Title &amp; Description</th>
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<tr>
<td>Communication Products: This program releases a variety of products to help members communicate on a range of issues related to air quality modeling, contributions from different sources to pollutant levels, regional haze, emissions, ambient measurements, atmospheric deposition, and air dispersion models. These products consists of webcasts, issue briefs, critical reviews, and presentations to key stakeholders.</td>
<td>12/31/12</td>
<td>Technical Resource</td>
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</table>
Supplemental Projects

Acidification and Nutrient Enrichment (072064)

Background, Objectives, and New Learnings

Over the past several years, EPA has taken steps to propose a combined Secondary NAAQS for NOx and SOx. A proposed rule is expected in July 2011, with potential promulgation in early 2012. This proposal would be the first time that EPA addresses multiple criteria pollutants under one standard, and also the first time it uses air standards to address a concern in other environmental media (water and soils) due to the linkage through atmospheric deposition. EPA has developed a complex technical methodology to link atmospheric concentrations of SOx and NOx to atmospheric deposition in support of this unprecedented multipollutant, multimedia standard. This methodology relies heavily on the use of models to provide values for important parameters for which no data exist and no model evaluation can be performed. In addition, there are numerous simplified assumptions used in the proposed methodology without adequate validation that may show problems with the methodology itself.

The most critical aspect of the proposed methodology is the application of three-dimensional air quality models, as well as aquatic models, to develop linkages from ambient concentrations of NOx and SOx to atmospheric deposition and then ultimately to aquatic acidification, as part of the Secondary NAAQS for NOx and SOx. These models have not been evaluated adequately, and EPRI analysis has shown overlay conservative biases in the parameters of aquatic models and in their application. The approach proposed by EPA evaluates spatial variability in the air quality and aquatic data which could potential result in an overly conservative bias in the standard. Additionally, it is unprecedented that model simulations, rather than measured data, are being used to determine the level of the standards within the NAAQS process. Of the several reasons given by EPA for using models, the principal rationale is the lack of measurements of dry deposition fluxes of all atmospheric constituents. Since use of the models is being proposed for development of the standard (rather than only for implementation, when the models would be used in a relative sense), a greater degree of scrutiny of their adequacy is required.

By understanding the rationale for EPA’s methodology for the secondary SOx and NOx standards, there are many research issues that need to be addressed. There is aneed is for direct measurement of deposition rates and ambient concentrations, so that a linkage between deposition and concentrations can be evaluated and tested with empirical evidence rather than through the use of the models. If the deposition measurements can be made relatively inexpensively over a wide network, researchers could begin to explore whether a standard based on measurements alone could be supported. In the short term, these measurements can also provide the “ground truthing” to determine if the models are adequate for these proposed uses. Without this information, models will continue to be used without testing and evaluation of their ability to represent the flux of pollutants to ecosystems. Availability of measurements also would allow researchers to better understand any biases in EPA’s methodology and to develop means to reduce those biases.

Project Approach and Summary

The research in this supplemental project focuses on the following key topics:

- the development of inexpensive dry deposition measurements to test conceptual assumptions of the relationship between deposition and ambient concentrations, and to evaluate the ability of air quality models to accurately represent total depositional fluxes to ecosystems
- the collection of data in various aquatic systems in the United States to more accurately validate the aquatic models and terrestrial relationships
- the improvement of simple and complex aquatic models to represent the actual dynamic response of ecosystems to varying composition, meteorology, and other natural and anthropogenic environmental stressors
The work in this supplemental project complements the efforts within the Annual Research Portfolio on air quality model development (91.001), ambient air quality measurements (91.004), and source attribution of deposition via air quality models, linkages of air quality and water quality models, and atmospheric deposition policy analysis (91.005). The additional tasks of this supplemental project can also be extended to address other environmental issues related to atmospheric deposition, such as the determination of regional total maximum daily loads (TMDLs), inclusion of air deposition credits in water quality trading programs, vegetation impacts, and overall environmental sustainability.

**Benefits**

It is important to understand the impacts of secondary standards. State implementations plans for secondary standards do not have fixed timelines; states are expected to reach attainment “as expeditiously as practicable.” However, designation of nonattainment of secondary standards results in the same restrictions on new sources and modified sources as does nonattainment of primary standards: the sources must undergo the New Source Review process. Given the large extent of the potential nonattainment areas, such restrictions could severely affect the construction of new power plants or the cost-effectiveness of modifications to existing units over large regions of the United States. The public will potentially benefit by gaining a better understanding of how costs and timelines of any power plant modifications may affect electricity costs in the future. In addition, EPA could also enact a “Transport Rule” in order to limit the amount of interstate contributions to secondary SOx and NOx exceedances which may also affect costs of new or existing units. The public will benefit by understanding any potential variances which may impact rate payor increases or timelines for new construction of plants.

Results of the proposed research are expected to affect the implementation of any final proposed standard based on the current methodology being used by EPA, as the research will result in better data to ground-truth assumptions and parameter values as well as to test the adequacy of the models employed. Furthermore, this research will inform the next phase of scientific review of the NAAQS (as part of EPA’s five-year NAAQS review cycle) with availability of relatively inexpensive ways to measure dry deposition and a rich data set that can be used to evaluate and test current and future proposed methodologies related to the different environmental endpoints of concern.