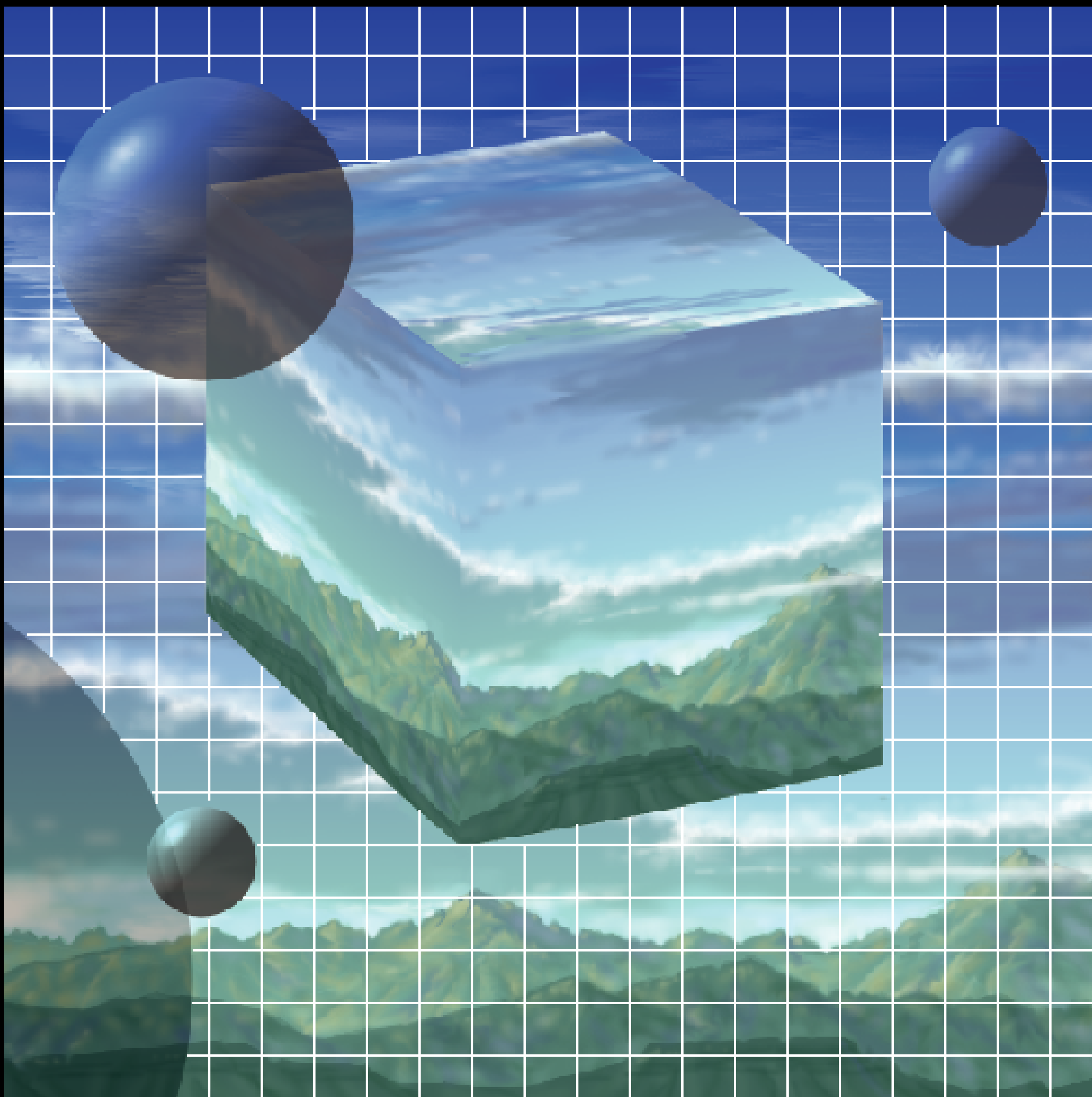
# The Role of Monitoring Networks in the Management of the Nation's Air Quality



National Science and Technology Council
Committee on Environment and Natural Resources
Air Quality Research Subcommittee

## *About the National Science and Technology Council*

President Clinton established the National Science and Technology Council (NSTC) by Executive Order on November 23, 1993. This cabinet-level council is the principal means for the President to coordinate science, space, and technology policies across the Federal Government. The NSTC acts as a "virtual" agency for science and technology to coordinate the diverse parts of the Federal research and development enterprise. The NSTC is chaired by the President. Membership consists of the Vice-President, the Assistant to the President for Science and Technology, Cabinet Secretaries and Agency Heads with significant science and technology responsibilities, and other White House officials.

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To obtain additional information about the CENR, contact the CENR Executive Secretary at (202) 482-5181.
On-line information is a http://www.nhic.noaa.gov/CENR/cenr.html

**Executive Office of the President**
**National Science and Technology Council**
**Committee on Environment and Natural Resources**
**Washington, D. C.**

March 1999

Dear Colleague,

We are pleased to transmit the report, "The Role of Monitoring Networks in the Management of the Nation's Air Quality," prepared by the Air Quality Research Subcommittee of the Committee on Environment and Natural Resources (CENR). Air quality and deposition monitoring networks are critical components in the Nation's air quality research strategy and in the management of air pollution. These networks provide the fundamental data needed to identify trends in levels of air pollution and deposition and determine the effectiveness of ongoing and planned control strategies. The Nation's air quality has steadily improved over the last three decades, and man-made emissions to the atmosphere continue to decrease. The Nation's long-term air quality monitoring networks have documented this improvement and allow us to relate changes in emissions to reductions in impacts on public health and terrestrial and aquatic ecosystems.

The report summarizes the Nation's current long-term capabilities in monitoring air quality and atmospheric deposition. The role of each network in providing the information for evaluating significant air quality scientific issues is highlighted, and examples of data applications, network coverage, and data availability are presented. Through the Subcommittee's outreach activities, the research community is also encouraged to increase its involvement in and review of new and existing monitoring programs. The CENR Air Quality Research Subcommittee is working to ensure that these monitoring networks, which are critical for accountability in air quality regulation, are sustained.

Sincerely,

Rosina Bierbaum
Co-Chair, CENR
Associate Director for Environment
Office of Science and Technology Policy

D. James Baker
Co-Chair, CENR
Administrator, National Oceanic
and Atmospheric Administration

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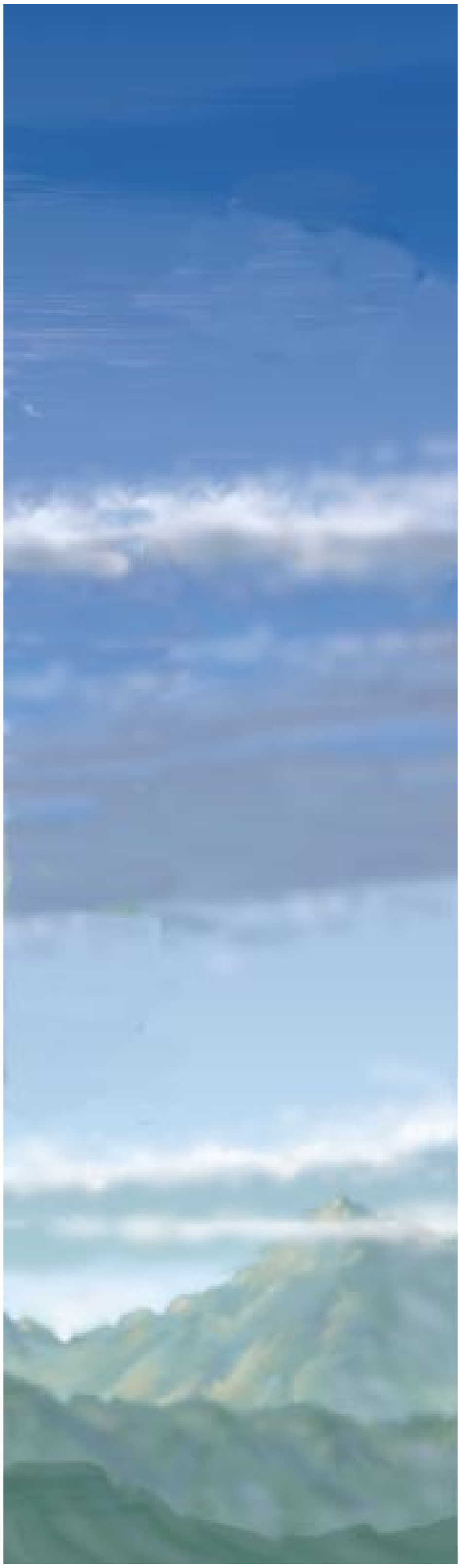


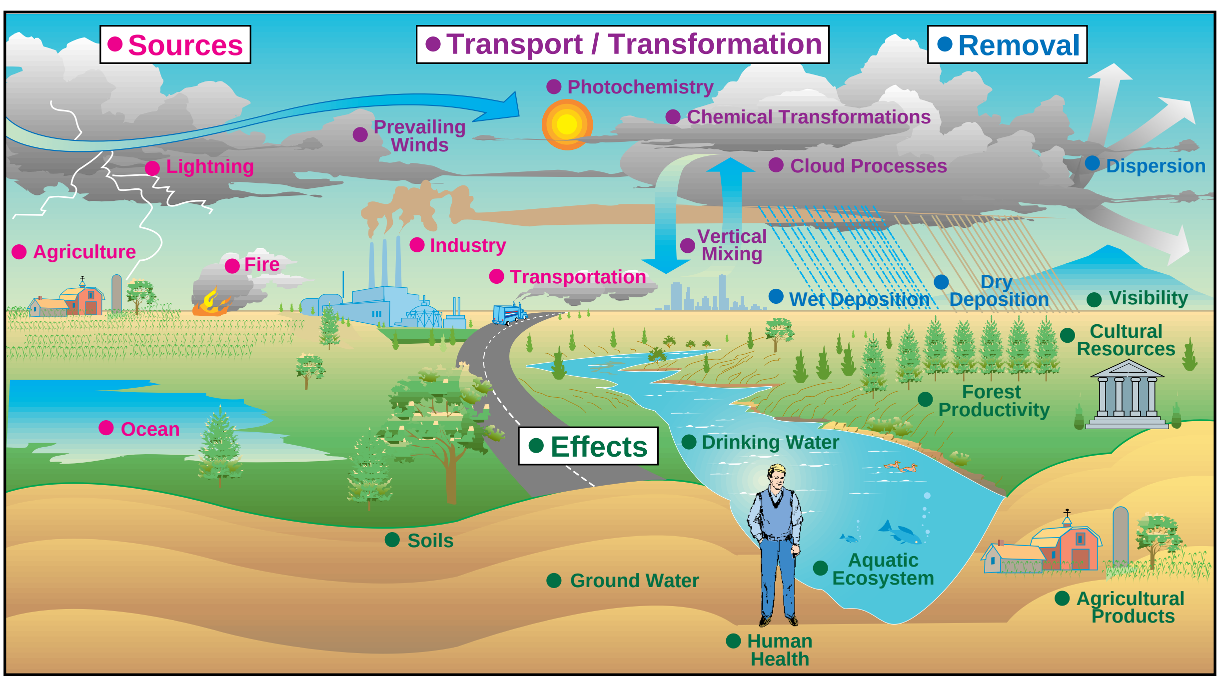
# The Role of Monitoring Networks in the Management of the Nation's Air Quality

*National Science and Technology Council*
*Committee on Environment and Natural Resources*
*Air Quality Research Subcommittee*

## INTRODUCTION

Nearly three decades ago, the country responded to growing concerns over the quality of the air in the United States by adopting the landmark Clean Air Act in 1970. This Act established two types of national air-quality standards. Primary standards set limits to protect public health, and secondary air quality standards were set to protect public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. In the mid-1970's, there was growing awareness in the United States of the linkages found in Europe between air quality and impacts to aquatic and forest ecosystems. This awareness led to concern that atmospheric emissions and subsequent atmospheric deposition could be causing similar problems in the United States. In the 1977 amendments to the Clean Air Act, Congress established as a national goal the remediation of any existing impairment in visibility resulting from air pollution in National Parks and Wilderness Areas and the prevention of any future degradation in these areas.

The Clean Air Act Amendments of 1990 (CAAA) built upon the original Act in initiating and expanding programs to address acid rain and urban air pollution, and identified 189 "toxic" air pollutants for regulation. Air toxics are those pollutants that are known or suspected to cause cancer, serious birth or developmental defects, or other adverse health impacts. The Amendments also established a national permits program to make the law more workable and an improved enforcement program to help ensure better compliance with the Act. The new law also encouraged the use of market-based principles and other innovative approaches, like performance-based standards and emission banking and trading.




*Air Pollution: Sources, Transport, Transformations, Removal, and Effects*

## Why monitor?

"Air quality is the best it's been in 30 years." "Air quality in our wilderness areas is declining." Conflicting headlines such as these and the often emotion-driven opinions that surround most environmental issues confound the emergence of a clear picture of what is happening to the quality of the air we breathe and depend on for a healthy environment. Long-term networks that monitor the levels of pollutants in the atmosphere provide important information to scientists and policymakers regarding the current status of the chemical composition of and deposition from the atmosphere and how levels of pollutants differ over time and space; these networks also provide needed "hard data" for policy decisions.

Long-term changes in air quality and atmospheric deposition can be obscured by the large day-to-day, season-to-season, and year-to-year variations in winds, temperature, precipitation, and atmospheric circulation patterns that in turn affect dispersion, transport, and deposition of pollution. In order to see the larger picture, beyond these shorter term variations, it is important to monitor for long periods of time, using consistent procedures and quality-assurance practices to observe long-term and significant changes in atmospheric composition.

Air-quality monitoring networks provide a vital performance measure to aid in determining and reporting how effective current regulations are in improving air quality as required under the Government Performance and Results Act (GPRA) and provide the data needed to revise existing or promulgate new regulations. For example, cumulative investments in environmental controls by major United States power utilities are estimated at $63 billion through 1994, representing 12% of electric utility plant investments. These costs are passed on to the public in the form of higher costs for energy, transportation, and other goods and services. The Nation's air-quality monitoring networks provide the only nationwide basis to determine if these actions are providing the desired benefits, namely an improvement in air quality and a reduction in the adverse environmental impacts to our land and water resources from atmospheric deposition. Market-based incentives provided in the CAAA, such as emission trading, banking of emission reductions, and allowing industry to select the most cost-effective means for reducing emissions, are revolutionary in nature. Proposals are under consideration that would extend the use of these mechanisms as an alternative approach to more traditional regulatory actions. The air-quality networks provide a mechanism for determining the effectiveness of these new regulatory approaches in protecting the environment.

## CURRENT AIR-QUALITY MONITORING NETWORKS AND THE POLLUTANTS MONITORED

Eight federally supported, national air-quality monitoring networks are operating currently in the United States. Other specialized regional and local research networks exist primarily to address local environmental issues. The following matrix relates the monitoring networks to the measured atmospheric chemical constituents or properties. As many as 10 chemical constituents in atmospheric deposition are measured by the deposition networks. Each of the existing networks described in this report utilizes extensive quality-assurance practices and procedures so that comparable data are available for detecting spatial and temporal trends in air quality.

| Network | Lead Federal agency | Number of sites | Estimated FY 99 Federal funding (millions $) | Nonfederal participation? | Initiated |
|---|---|---|---|---|---|
| IMPROVE | NPS | 108 | $2.9 | Yes | 1987 |
| SLAMS/NAMS | EPA | 3,200 | $114.0 | Yes | 1978 |
| PAMS | EPA | 83 | $12.1 | Yes | 1994 |
| NADP/NTN | USGS | 215 | $3.5 | Yes | 1978 |
| NADP/MDN | None | 36 | * | Yes | 1996 |
| CASTNet | EPA | 80 | $4.5 | No | 1988 |
| AIRMoN | NOAA | 23 | $0.6 | Yes | 1984 |
| GPMP | NPS | 33 | $1.5 | Yes | 1987 |

*Total funding approximately $0.6M, nearly all from State and local sources.

| Air-quality network | Visibility | Nitrogen species | Sulfur species | Lead | Particulate matter | Carbon monoxide | Ozone and/or precursors | Atmospheric deposition |
|---|---|---|---|---|---|---|---|---|
| IMPROVE | • | | | | • | | | |
| SLAMS/NAMS** | | • | • | • | • | • | • | |
| PAMS | | • | | | | | • | |
| NADP/NTN* | | | | | | | | • wet |
| NADP/MDN | | | | | | | | • wet mercury |
| CASTNet | • | • | • | | • | | • | • dry & wet |
| AIRMoN | | • | • | | | | | • dry & wet |
| GPMP | | | • | | | | • | |

*Atmospheric deposition constituents ($SO_4$, $NO_3$-N, $NH_4$-N, Ca, Mg, Na, K, pH, specific conductance, and $PO_4$).
**All pollutants are not monitored at each SLAMS/NAMS site.

## IMPROVE

The Interagency Monitoring of Protected Visual Environments (IMPROVE) is a collaborative monitoring program to establish present visibility levels and trends and to identify sources of anthropogenic impairment. The National Park Service and the U.S. Environmental Protection Agency (USEPA) are the lead funding agencies for the IMPROVE Network. IMPROVE began with 20 long-term monitoring sites in 1987, and currently is expanding to encompass 108 sites in parks and wilderness areas across the Nation. The instrumentation and monitoring protocols have been adopted by organizations with common interests in air quality and, as a result, additional sites are operated by individual Federal, State, and local government agencies. Numerous additional sites are operated in 17 countries around the world.

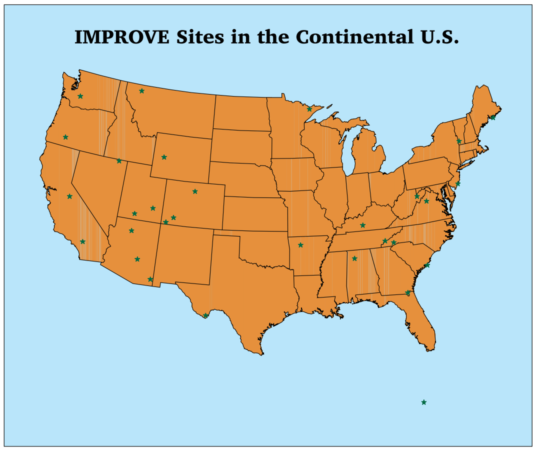



***Figure 1.*** *IMPROVE Network.*

Visibility is most often thought of in terms of visual range or the farthest distance a person can see a landscape feature. However, visibility is more than "how far" one can see; it also encompasses visual contrast—a measure of how well scenic landscape features can be seen and appreciated. Visibility cannot be fully defined by a single parameter via monitoring of only one atmospheric parameter. Rather, the objective of visibility monitoring is to understand the effect that various types of particles, lighting conditions, and humidity have on the appearance of a scene. Therefore, the IMPROVE Network: (1) photographically documents the appearance of the scene under various levels of visibility, (2) optically records the characteristics of the atmosphere, and (3) measures the composition of visibility-reducing aerosols to help identify the source type and source strength of particles and gaseous precursors to secondary particles. One of the principal purposes of the IMPROVE Network is to gather enough data in order to identify sources of impairment on individual site, regional, and national scales.

When recent visibility data from monitoring networks are compared to estimates of pre-industrial visibility, a picture emerges of "what we are missing" due to impaired visibility. While the estimated natural mean visibility in the Western United States is 110–115 miles, the best current mean visibility, at greater than 90 miles, is found only in the inner mountain West and Great Basin regions. Moving east or west from this area, the visibility decreases quite rapidly, to approximately 10–20 miles along the West Coast, and to less than 10 miles in much of the Eastern United States. The estimated natural mean visibility in the Eastern United States is 60–80 miles. Relative humidity does not, by itself, cause visibility to be degraded. Some particles, especially sulfates and aerosols with polar organic constituents, accumulate water and grow to the size (0.3-µm to 0.7-µm diameter) that is very efficient at scattering light. Poor visibility in the Eastern United States during the summer months is, in part, a result of the combination of high concentrations of these particles and high relative humidity.

Additional information on the IMPROVE Network is available via the Internet at http://www2.nature.nps.gov/ard/vis/vishp.html

### *AIR-QUALITY MONITORING AND HUMAN HEALTH*

*National Ambient Air Quality Standards (NAAQS) have been set for six air pollutants. Primary NAAQS are designed to protect public health, and secondary NAAQS are designed to protect the public welfare such as our crops, visibility, and materials. In addition, indexes have been established for NAAQS pollutants, at graduated levels above the NAAQS, which describe differing degrees of alert or emergency that warrant different levels of responses, depending on daily pollution levels. At the time NAAQS are set, Federal Reference Methods are established for measuring air concentrations of the pollutant to determine changes in air quality and compliance with the standard. A network of roughly 5,000 air-monitoring sites distributed throughout the country and located primarily in and around high population centers is maintained to monitor NAAQS attainment. This network consists of federally supported SLAMS (State and local air monitoring stations) and NAMS (National Air Monitoring Stations) as well as other State-supported Special Purpose Monitoring Stations (SPMS).*

## SLAMS/NAMS

Carbon monoxide (CO), lead, nitrogen dioxide ($NO_2$), ozone, particulate matter (PM-10 and PM-2.5), and sulfur dioxide ($SO_2$) are monitored through the State and Local Air Monitoring Stations (SLAMS) and National Air Monitoring Stations (NAMS). Although most air-quality samples at SLAMS/NAMS sites are collected in urban areas where air quality is influenced primarily by local sources, some sites are located away from urban areas in order to characterize regional air quality.

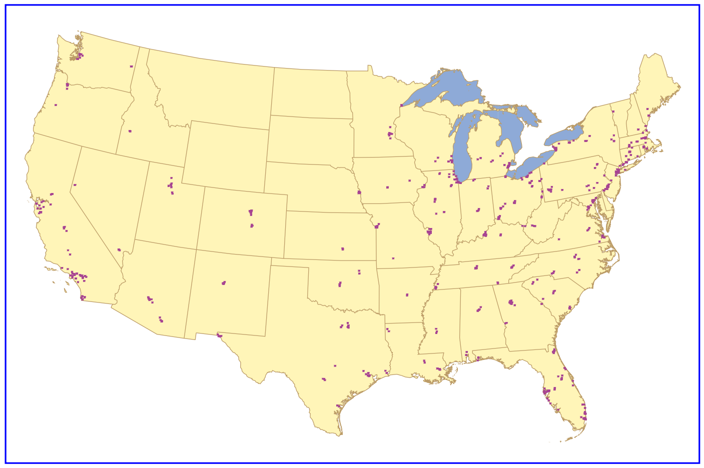


***Figure 3.*** *National Air Monitoring Network.*

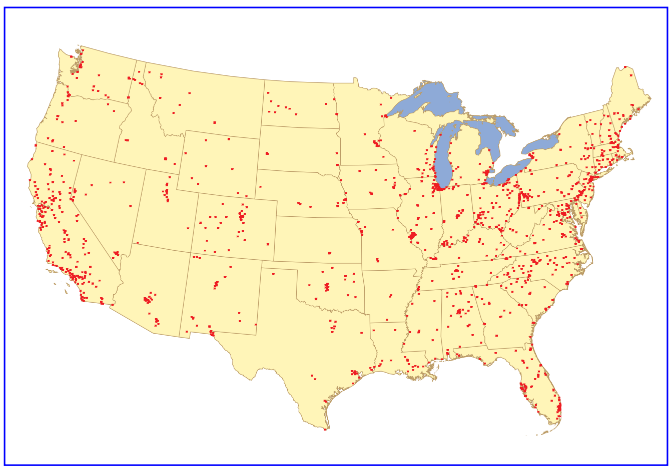


***Figure 2.*** *State and Local Air Monitoring Network.*

The primary objectives of the SLAMS/NAMS Network are to:

- Judge compliance with ambient air-quality standards.
- Activate emergency control procedures that prevent or alleviate air-pollution episodes.
- Observe pollution trends throughout the region, including nonurban areas.
- Provide a data base for research on urban, land-use, and transportation planning; development and evaluation of abatement strategies; and development and validation of dispersion models.

Data from SLAMS/NAMS indicate air concentrations of lead, CO, and $SO_2$ have decreased significantly in the past 10 years, and emissions of all criteria pollutants have shown improvement (decreased) as shown in the table below.

Percent decrease in emissions and air concentrations (1986–1995), U.S. Environmental Protection Agency National Air Quality Status and Trends Report, 1995

| Criteria pollutant | Percent decrease in emissions | Percent decrease in air concentrations |
|---|---|---|
| CO | 16 | 37 |
| Lead | 32 | 78 |
| $NO_x$ | 3 | 14 ($NO_2$) |
| Ozone | -- | 6 |
| PM-10* | 17 | 22 |
| $SO_2$ | 18 | 37 |

*PM-10 measurements began in 1988.

The USEPA administers the SLAMS/NAMS networks.

Additional information on the SLAMS/NAMS network is available via the Internet at http://www.epa.gov/oar/oaqps/qa/monprog.html Data for each site in the network and the annual trends report showing national and local air quality are publicly available via the Internet at http://www.epa.gov/airsdata/monitor.htm and http://www.epa.gov/oar/aqtrnd97/

## PAMS

Photochemical Assessment Monitoring Stations (PAMS) measure ozone precursors (approximately 60 volatile hydrocarbon and carbonyl compounds). The Clean Air Act requires a PAMS Network in each ozone nonattainment area that is designated serious, severe, or extreme. Each nonattainment area has from two to five sites, depending on its population. The current PAMS Network has over 80 sites. The chief objective of PAMS data collection is to provide an air-quality data base that will assist air-pollution control agencies in assessing and, if necessary, refining control strategies for attaining the National Ambient Air Quality Standard for ozone. Ambient concentrations of ozone and ozone precursors are measured to make attainment/nonattainment decisions, aid in tracking VOC and NOx emission inventory reductions, characterize the nature and extent of the ozone problem, and identify air-quality trends. In addition, data from PAMS provide an improved data base for evaluating photochemical model performance, especially for future control strategies as part of the continuing air-quality management process. The data are particularly useful to States so that the most cost-effective regulatory controls are implemented. The USEPA provides funding and oversight for the PAMS networks.

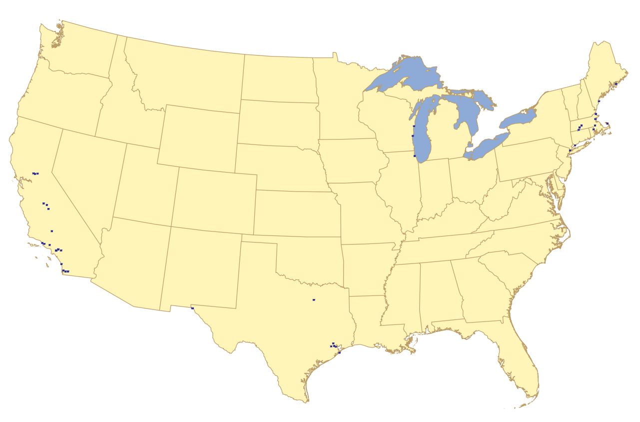


***Figure 4.*** *Photochemical Assessment Monitoring Network.*

Additional information on PAMS is available via the Internet at http://www.epa.gov/oar/oaqps/pams

### *ATMOSPHERIC DEPOSITION*

*The relation between air quality and the environmental impacts air pollutants have on land and water resources is well recognized. The monitoring of wet and dry atmospheric deposition focuses attention on the transfer of chemical substances from the atmosphere to terrestrial and aquatic ecosystems. Atmospheric deposition data furnish important information on chemical flux and are a performance measure for air-quality researchers and regulatory agencies. The same data provide essential information for environmental studies by ecologists, foresters, hydrologists, and agricultural scientists in assessing the influence of atmospheric inputs to the Earth's surface.*

## NADP/NTN

Since 1978, when 18 sites were placed into operation, the National Atmospheric Deposition Program/National Trends Network (NADP/NTN) has grown and evolved. The network now provides a long-term, high-quality data base that is useful for assessing the magnitude of the acid rain problem and for determining spatial and temporal trends in the chemical composition of the atmosphere and the removal of atmospheric compounds as deposition. The NADP/NTN Network is the only long-term deposition monitoring program in the United States with national coverage. Today the NADP/NTN consists of over 200 sites and is cooperatively funded and operated by over 100 organizations, including 8 Federal agencies, State and local agencies, universities, and private industries. The combined funding supports program management, site operation and maintenance, chemical analysis, data management, and quality assurance. The network has one of the longest multisite records of precipitation chemistry in the world and has maintained an effective quality-assurance program throughout the years.

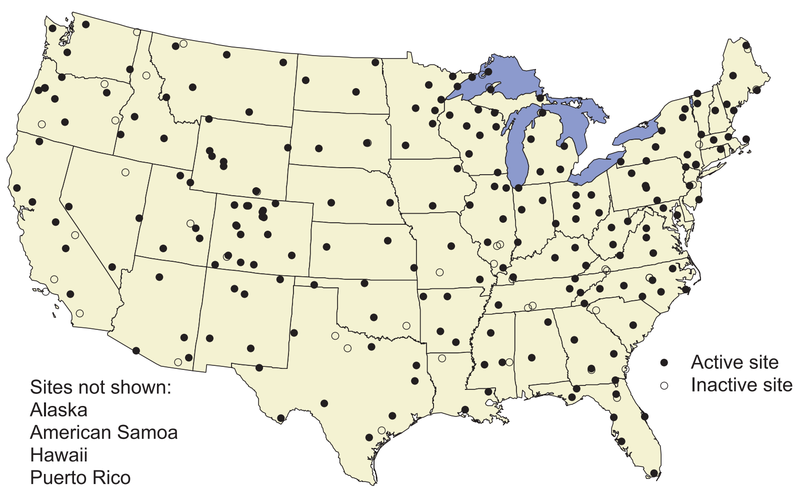



***Figure 5.*** *The NADP/NTN.*

Recently, an analysis of NADP/NTN data was undertaken to examine the effects in 1995 of Phase I, Title IV of the Clean Air Act Amendments of 1990. The results indicate that Phase I has reduced acid rain in the Eastern United States. Specifically, the analysis shows that, in the Northeastern United States, the dramatic reduction in $SO_2$ emissions that occurred in 1995 resulted in a significant reduction of the acidity and sulfate concentration of precipitation. The largest reductions of acidity and sulfate concentration precipitation occurred in the Ohio River Valley region, where many of the affected Title IV sources are located, as well as at sites to the east of where the primary reductions in emission occurred. Unlike sulfate, nitrate deposition has showed considerable variability. Deposition of ammonium, which along with nitrate is a significant contributor to nitrogen enrichment to ecosystems, has been increasing since the early 1980's.

As principal NADP/NTN coordinator for the Federal agencies, the U.S. Geological Survey provides a significant portion of the network's funding.

Data and additional information from the NADP/NTN are available via the Internet at http://nadp.sws.uiuc.edu/ and http://bqs.usgs.gov/acidrain/

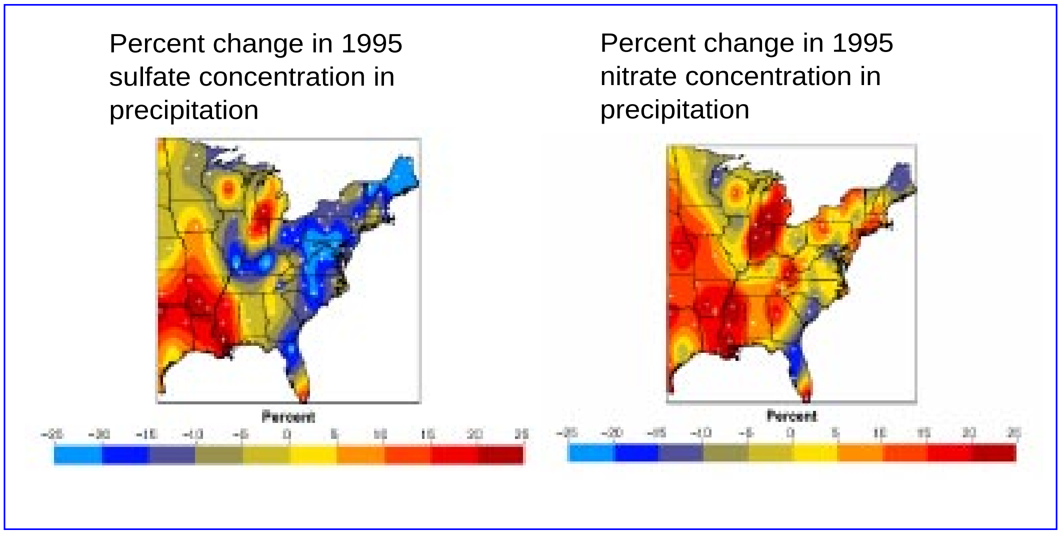



***Figure 6.*** *Changes in precipitation chemistry, 1995.*

## NADP/MDN

In 1996, the Mercury Deposition Network (MDN) of NADP was established to develop a regional data base on the weekly concentrations of total mercury in precipitation and the seasonal and annual flux of total mercury in wet deposition. Atmospheric deposition is the prevalent source of mercury to aquatic ecosystems. The data are used to develop an information data base on spatial and seasonal trends in mercury deposited to surface waters, forested watersheds, and other sensitive receptors. Mercury is of special concern to State and local governments because 37 States now post health advisories for the consumption of gamefish with excessive mercury levels. Most advisories are issued in areas lacking point sources of mercury. The MDN has grown to be the largest network in the United States measuring total mercury in precipitation. More than 35 sites are currently in operation. The MDN utilizes a specially designed collector, tested and proven for mercury and other trace metals.

Around 20 State, Federal, and private organizations support the NADP/MDN. The Minnesota Pollution Control Agency and the Wisconsin Department of Natural Resources are the two largest participants in the program.

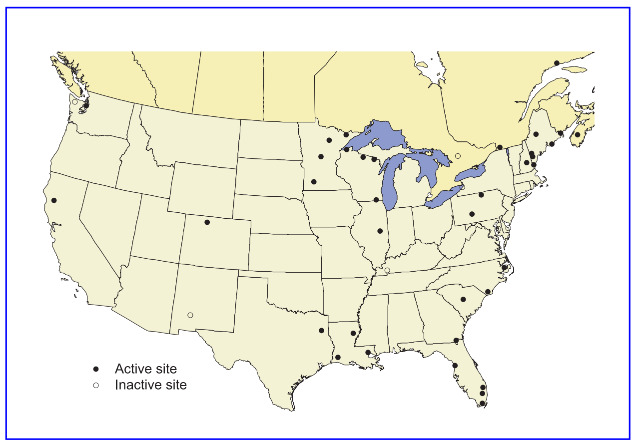



***Figure 7.*** *NADP/MDN.*

Data and additional information from the NADP/MDN are available via the Internet at http://nadp.sws.uiuc.edu/

## CASTNet

The Clean Air Status and Trends Network (CASTNet) was developed to establish an effective monitoring and assessment network to determine the status and trends of air-pollution levels, to define their spatial distribution, to assess their environmental effects, and to develop a scientific data base for effective evaluation of air-quality management. The network consists of approximately 80 monitoring stations across the United States. Unlike SLAMS/NAMS, most CASTNet sites are located away from local sources of pollution in order to assess broad regional air-quality trends. In contrast to the NADP, which measures wet atmospheric deposition, CASTNet focuses on dry deposition and, more recently, has an additional component to address fine particles and visibility. CASTNet measures ambient concentrations of gaseous phase pollutants and aerosols along with meteorological parameters needed to estimate deposition velocities and dry deposition fluxes of these constituents. Dry deposition fluxes generally cannot be measured directly; measurements are possible only under highly constrained conditions. A number of investigations, however, have shown that fluxes can be reasonably inferred by coupling air concentration data with meteorological measurements.

CASTNet is the only broad source of dry deposition data in the country. The data are used to determine relations among emissions, air quality, and deposition and to provide information necessary to understand the ecological effects of atmospheric deposition. With over a decade of data collected, CASTNet provides critical information necessary in bench marking and understanding the impact of pollution on the environment and the effectiveness of pollution management programs.

The USEPA administers the CASTNet program. The National Park Service, in cooperation with the USEPA, operates 19 of these sites.

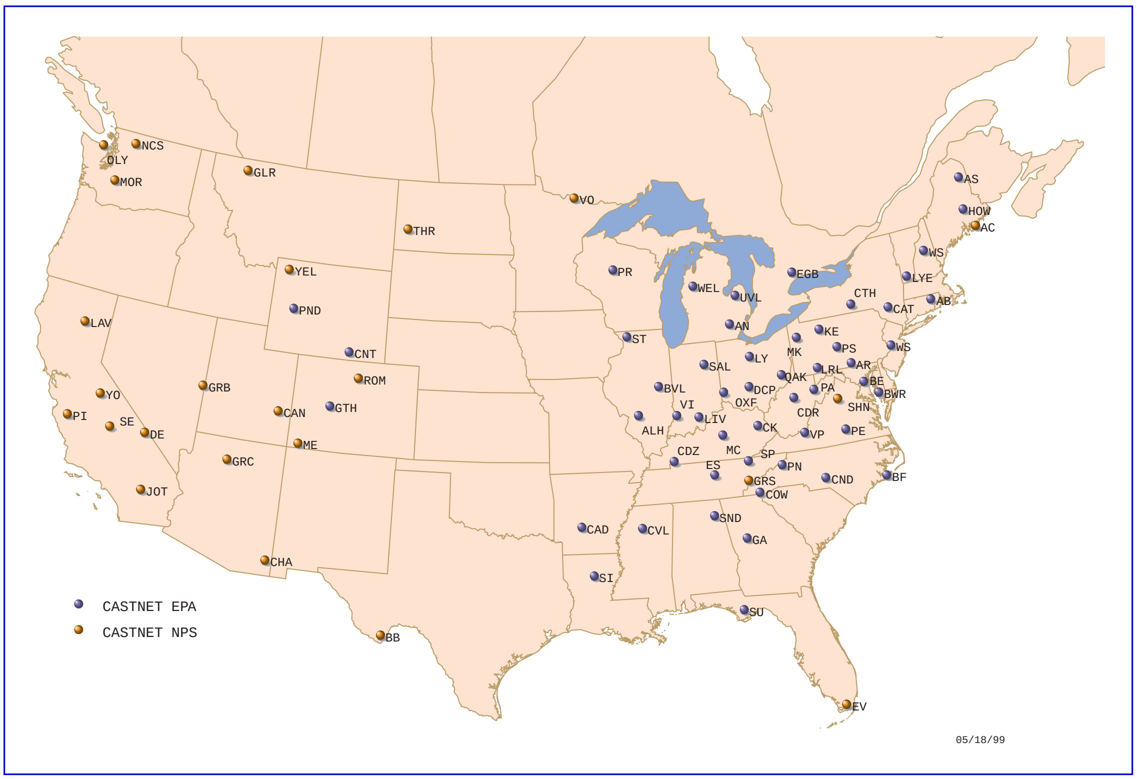



***Figure 8.*** *CASTNet sites.*

Data and additional information on CASTNet are available via the Internet at http://www.epa.gov/acidrain/castnet/

## AIRMoN

The Atmospheric Integrated Research Monitoring Network (AIRMoN) is an array of stations designed to provide an intensive, research-based foundation to support the routine operations of the Nation's deposition monitoring networks—the National Atmospheric Deposition Program (NADP) for wet deposition, and the Clean Air Status and Trends Network (CASTNet) for dry deposition. A subprogram is specifically designed to detect the benefits of emissions controls mandated by the Clean Air Act Amendments of 1990 and to quantify these benefits in terms of deposition to sensitive areas.

AIRMoN combines two previously existing deposition research networks with related measurement characteristics (previously known as the MAP3S precipitation chemistry network and the CORE/satellite Dry Deposition Inferential Method network). The combined sites operate in parallel, with consistent operational and data aggregation protocols, thus enabling wet and dry deposition data to be incorporated efficiently into on-line modeling and analysis applications.

AIRMoN operating principles are designed to quantify the extent to which changes in emissions affect air quality and deposition at selected locations. AIRMoN sites are chosen to optimize the probability for detecting projected changes and to serve related measurement needs of researchers studying the effects of atmospheric deposition. Specific sites are emphasized where operations of different observing arrays can be collocated. Such Collocated Operational Research Establishments ("CORE sites") serve two additional distinct purposes: (a) to provide linkages among network programs operating to address different needs with different protocols and (b) to provide the detailed measurements necessary to understand important processes. A strong linkage with the emerging National Environmental Monitoring Framework resulted.

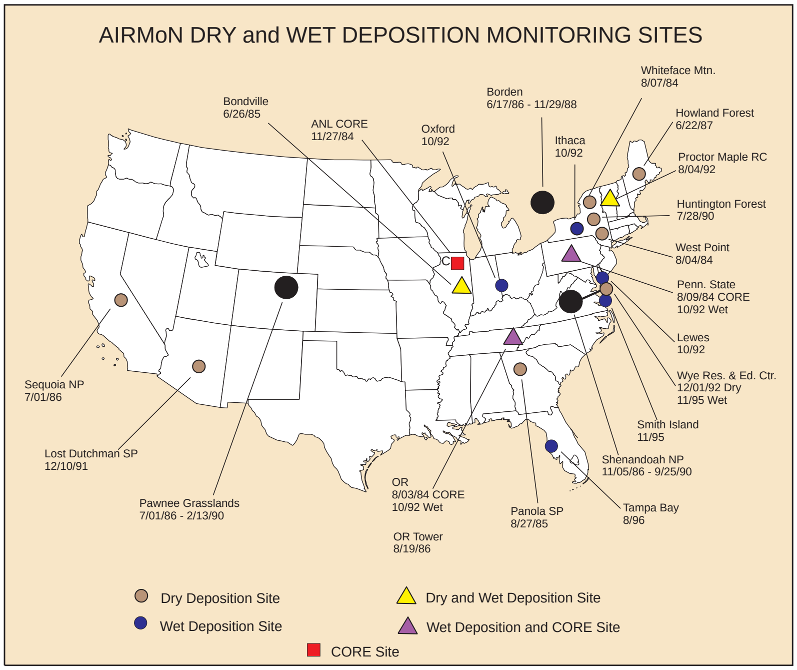



***Figure 9.*** *AIRMoN.*

The wet deposition component of the AIRMoN program (NADP/AIRMoN) was initiated in 1992 as a network of the National Atmospheric Deposition Program. NADP/AIRMoN provides precipitation chemistry data with a greater temporal resolution than what is available from the NADP/NTN. In 1999, the NADP/AIRMoN comprises 10 monitoring stations where precipitation samples are collected every 24 hours. The daily samples are analyzed for the same constituents as the NADP/NTN weekly network. Daily monitoring data are used to provide additional resolution to evaluate the effectiveness of air-quality regulations and emission trading practices. One of the primary applications of the daily data is identifying the source areas of atmospheric pollution via back-trajectory analyses. Also possible is the calibration of models, which are used in estimating changes in atmospheric deposition, as a result of changing emissions.

The AIRMoN program is coordinated and funded primarily through the National Oceanic and Atmospheric Administration (NOAA).

Additional information and data for AIRMoN
are available via the Internet at
http://www.arl.noaa.gov/research/programs/airmon.html
and http://nadp.sws.uiuc.edu/

## GASEOUS POLLUTANT MONITORING PROGRAM (GPMP)

To meet its general responsibilities with respect to air resource management, the National Park Service (NPS) has established a framework to protect, preserve, and enhance the air quality in units of the National Park system, particularly Class I areas. This framework is heavily dependent on comprehensive monitoring programs to determine the levels of gaseous pollutants, fine particles, and visual air quality occurring or affecting National Parks. The gaseous pollutant monitoring program (GPMP) has historically concentrated on determining the levels of two air pollutants—ozone and sulfur dioxide. These pollutants are particularly toxic to native vegetative species found in National Park Service units at levels at or below the National Ambient Air Quality Standards established by the USEPA for these two pollutants.

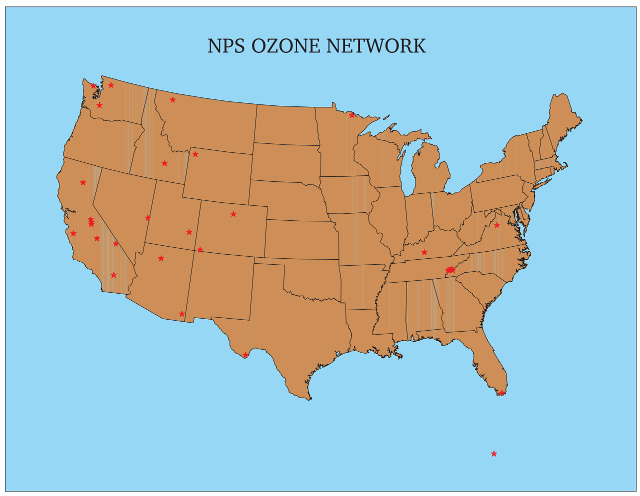



*Figure 10. Gaseous Pollutant Monitoring Program (GPMP).*

The primary monitoring objectives for the gaseous pollutant-monitoring program are to:

- Establish existing or baseline concentrations and assess trends in air quality in NPS units.
- Determine compliance with national air-quality standards.
- Assist in the development and revision of national and regional air-pollution control policies affecting park resources.
- Provide data for atmospheric model development and evaluation.
- Identify those air pollutants with the potential to injure or damage park natural resources, monitor these pollutants, and correlate observed effects on these resources to ambient levels of these pollutants.

All gaseous pollutant monitoring stations are equipped with continuous ozone monitors, with some also containing continuous sulfur dioxide monitors. Most stations also are equipped with meteorological towers for the measurement of wind speed and direction, temperature, dew point or relative humidity, solar radiation, and precipitation.

Currently, ozone monitoring is being conducted either by the NPS or State agencies in 26 of the 48 Class I areas. In addition, the NPS and States monitor ozone and other pollutants in seven other areas designated as “Class II.” Intensive, or enhanced, monitoring of ozone and its precursors is currently being conducted in three eastern parks—Great Smoky Mountains, Mammoth Cave, and Shenandoah—as a means of understanding the atmospheric and chemical processes causing high levels of ozone measured at these parks and the ways to reduce these levels. Much of the enhanced monitoring effort is a result of cooperative efforts with other agencies, universities, and industry. A new component of the program is its recent experimentation in the use of low-cost, passive samplers to measure ozone, sulfur dioxide, and nitrogen oxides as a way of supplementing the continuous monitoring program. These devices can be used to investigate the existence and the spatial extent of air- pollution problems in parks.

The NPS gaseous pollutant program is a highly leveraged program. Through effective partnerships with the USEPA, other Federal and State agencies, and industry, the NPS has been able to maintain a viable gaseous pollutant monitoring program for over 10 years. The NPS commitment to long-term monitoring of air pollutants in National Parks has attracted others to use parks as outdoor laboratories for the advancement of science and their own research interests. This synergism allows NPS managers to make more informed air-resource management decisions. The USEPA’s decision to use 12 National Parks as the backbone of a national UV-B monitoring network was heavily influenced by the availability of air-quality data in these parks. Thus, NPS data complement other scientific and research efforts in this country.

## HOW IMPORTANT IS THE CURRENT MONITORING INFRASTRUCTURE IN ADDRESSING EMERGING ISSUES?

The existing network of air-quality monitoring sites provides a low-cost infrastructure that is readily modified to include new atmospheric chemical species of interest. The ability of emerging monitoring programs to build on an established traditional infrastructure (e.g., trained site operators, secured and well-documented sites, and field laboratories) has resulted in lower start-up costs and quicker implementation schedules for new measurement objectives. Also important for new initiatives is the ability to access the substantial knowledge-based infrastructure associated with a monitoring network, such as trained data-management and quality-assurance specialists, sophisticated data- and site-management tools, and data dissemination (e.g., interactive Internet-based servers for supplying air-quality data to a worldwide user base).

One example of this synergy between new and existing air-quality monitoring activities was the recent initiation of a monitoring program to measure atmospheric deposition of mercury in the United States and Canada. In this effort, the existing infrastructure of the long-established NADP/NTN facilitated a quick and successful start-up for the new NADP Mercury Deposition Network (NADP/MDN). Although Federal agencies support only a few of the currently operated MDN sites, support via the specialized personnel, computer facilities, and network management tools enabled the MDN to come on line as a nearly 40-site operation in 3 years.

The importance of collocating air-quality monitoring equipment at key sites throughout the United States is increasingly recognized as critical to understanding the relation between atmospheric air-quality data and deposition-flux measurements. Recently, the National Park Service and the USEPA have designated 14 park monitoring locations as Prime Net (Park Research and Intensive Monitoring of Ecosystems Network) sites. The 14 sites have monitors for IMPROVE, CASTNet, NADP/NTN, ozone, and UV-B. Sites at Penn State University and Bondville, Illinois, have monitors from NADP/NTN, NADP/AIRMoN, AIRMoN Dry, and CASTNET.

In 1997, the USEPA issued final revisions to strengthen the particulate-matter standards by adding new standards that provide more stringent goals for fine particles in air (PM-2.5). The USEPA issued final revisions to the primary (health-based) PM standards by adding a new annual and 24-hour standard. The deployment of a new monitoring network is a critical component of the PM-2.5 standard. New instrumentation is being deployed, taking advantage of the existing network infrastructure (i.e., IMPROVE and NAMS/SLAMS), coordinating and integrating the existing visibility-monitoring requirements with the new ambient air-quality monitoring programs. The expanded network will include compliance monitors, continuous monitors, special purpose monitors, chemical speciation sampling and analysis sites, and special study sites to optimize the results for priority research.

## THE ROLE OF THE COMMITTEE ON THE ENVIRONMENT AND NATURAL RESOURCES (CENR), AIR QUALITY RESEARCH SUBCOMMITTEE (AQRS)

Over the past 25 years, support for the type of monitoring networks described in this document has been sporadic. Support shifts with the political attention given to a particular environmental issue. Commonly, a phenomenon is asserted to be a major environmental problem and the lack of information that would be needed to understand its nature, extent, and impact is decried. A program of monitoring and research is instituted to gather the knowledge needed to develop an appropriate policy response. A response is fashioned and implemented, and frequently a pledge is given to continue environmental monitoring to evaluate the effectiveness of the policy actions. However, the monitoring program associated with the issue enters an almost immediate decline as new issues are identified, and limited resources are demanded by other problems. In this phase, budget-driven changes such as temporary shutdowns, site moves or closures, changes in sampling intervals, and reductions in quality assurance and quality control diminish the value of the long-term data set due to overall loss of continuity in the historical record. The inefficiency of this approach imposes additional direct and hidden costs on the Nation’s financial resources. The start-up and shutdown costs of designing and implementing networks are significant. A lack of coordination between existing and new monitoring efforts adds to the delays in addressing emerging issues and to the cost of generating the information required to develop sound policy. Finally, the value of an extensive time-series record extends beyond the identification of a specific problem. Long-term time series permits verification that decisions are effective; solutions are, indeed, working; and the ongoing costs and benefits of the given control program are assessed accurately.

The AQRS has identified the air-quality monitoring networks deemed critical for baseline air-quality data in the United States and initiated action to promote research and development on approaches to ensure that existing networks are adaptable to change. Agencies that fund existing core networks are encouraged to consider enhancing the capabilities of these networks through adding constituents and other capabilities in response to emerging issues rather than terminating support for one network in order to support another. Agencies will be encouraged to coordinate quality-assurance efforts, network intercomparisons, and sampling equipment collocations. A one-stop shopping approach for air-quality monitoring data via the Internet will be promoted. By increasing data accessibility for the academic and research communities, the investment in these networks can be leveraged by increasing the number of research applications and interpretive studies. Finally the CENR, AQRS will encourage increased involvement and review of existing monitoring programs by the research community and help design more efficient and less costly ones as needed in the future.

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