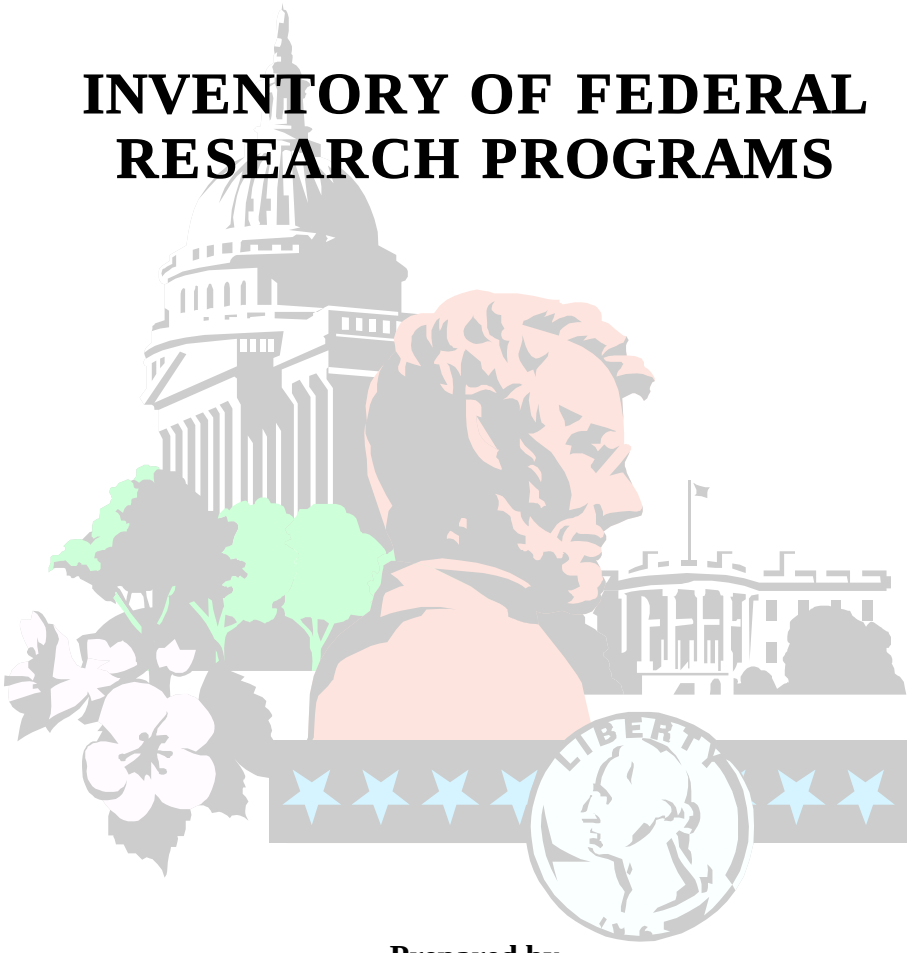
ATMOSPHERIC PARTICULATE MATTER RESEARCH

INVENTORY OF FEDERAL RESEARCH PROGRAMS



Prepared by

COMMITTEE ON THE ENVIRONMENT AND NATURAL RESOURCES
AIR QUALITY RESEARCH SUBCOMMITTEE
September, 1998

Air Quality Research Subcommittee

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PREFACE

The Federal sector's atmospheric sciences research related to particulate matter (PM) is coordinated through the Committee on Environment and Natural Resources (CENR) Air Quality Research Subcommittee (AQRS). This inventory provides information on PM research conducted by the agencies and departments that make up the AQRS indicating present emphasis and future directions. The focus of the Subcommittee is, as the name implies, on air quality research and that focus is reflected in the projects described in the research inventory. The Subcommittee coordinates closely with the control technology and health effects research communities, but those activities are beyond the scope of the Subcommittee.

Areas of Emphasis

The Inventory contains short descriptions of the various PM research projects currently being conducted by individual agencies. The information from the program descriptions is summarized in Table 1 using the research categories suggested by the NRC Committee on Research Priorities for Airborne Particulate Matter[1]. The major aspects of atmospheric process research, and the primary emphasis of NARSTO (the North American public-private partnership focused on ozone and PM research) are described in three of the research categories: 1) aerosol methods and monitoring, 2) atmospheric chemistry and physics, meteorology, and modeling, and 3) emissions characterization and source apportionment. These topics have been further expanded and the distribution of Federal funds among the topics is presented in Figure 1 to indicate areas of current emphasis. Total Federal funding in these research areas was approximately $26M in FY 1998.

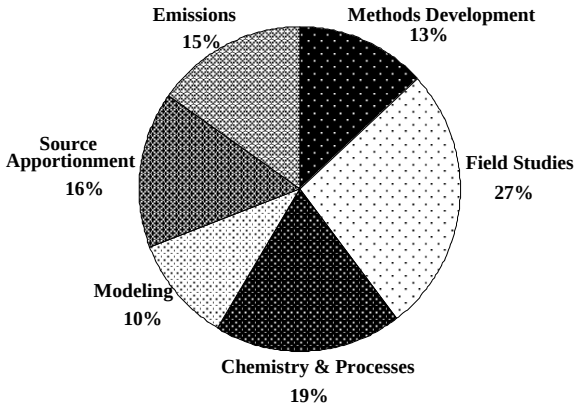

Figure 1. Allocation of resources within PM atmospheric process research in the Federal sector.

The two additional research topics described in Table 1: 1) exposure assessment and relationships and 2) risk management and cost benefits provide a bridge to health effects and control technology research. Total Federal sector investments in these areas was approximately $4M in FY 1998.

Major Agency Emphasis in PM Research

The allocation of resources by the Agencies that make up the AQRS is based on their varied missions and capabilities. In the case of PM research, the member agencies have combined diverse perspectives and complimentary capabilities into a comprehensive research program. The major research foci for each agency is described below.

Department of Energy

- Optical properties of aerosols – radiative forcing
- Processes controlling formation and distribution
- Emission inventories
- Control technology development – power plants

Department of the Interior (National Park Service)

- Optical properties of aerosols – visibility

[1] NRC, 1998, Research Priorities for Airborne Particulate Matter I. Immediate Priorities and a Long-Range Research Portfolio, Washington, D.C.

Environmental Protection Agency
- Health studies
  - Susceptibility variation
  - Exposure studies
  - Modeling personal exposure
- PM compliance measurement methods development
- Source / receptor relationships
- Air quality model development

National Aeronautics and Space Administration
- Space-based aerosol sensing

National Oceanic and Atmospheric Administration
- Processes controlling regional distribution of fine particles
- Fugitive (wind-blown) dust
- Advanced chemical measurement technology

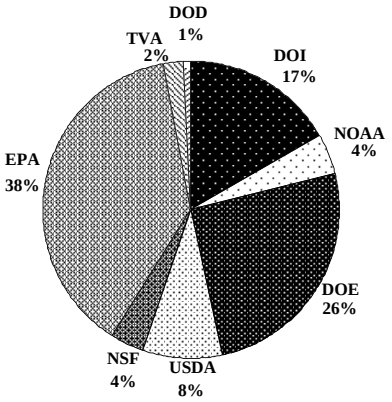

Figure 2. Allocation of Resources by the agencies of the AQRSC.

National Science Foundation
- Global lower-tropospheric aerosol studies

Department of Agriculture
- Fugitive dust – agricultural practices
- PM formation during prescribed burns and wildfires
- Control technology – cotton gins

Tennessee Valley Authority
- PM formation in power plant plumes
- PM "supersite" monitoring – rural/urban

Department of Defense (U.S. Air Force)
- Characterization of PM generated as a result of flight operations

The break-out of the atmospheric-processes related research funds among the various agencies is shown in Figure 2.

Future Research Foci

Much of the current Federal PM research program needs to continue into the foreseeable future if we are to better characterize PM exposures and understand the processes that control the formation and distribution of PM. In Subcommittee discussions, the following areas have been targeted for additional emphasis:

- Measurement technology: There is a need to provide a better evaluation of the strengths, weaknesses, and intercomparability of current PM measurement methodologies. Efforts to assist in the movement of some of the more complex technologies toward more routine (simpler, easier to operate and maintain) application would also be welcome. There is also a need for new technologies to better characterize ambient PM.
- Atmospheric Chemistry: More work needs to be done to clarify the complex interaction that occurs between precursor gases (SO_2, NO_x, VOCs, and NH_3) in the formation of secondary aerosols. There is significant ongoing research in this area but efforts are fragmented and need to be better integrated.
- Modeling: Both EPA and NOAA have ongoing efforts. There is a need for better parameterizations of chemical and physical processes that are responsible for formation rates and characteristics of ambient aerosols. Specialized field studies are needed to provide a diagnostic evaluation of existing models and specific information needed for model improvement.
- Emission Characterization and Source Apportionment: Better inventory information is needed on emission of primary aerosols, particularly carboneaceous aerosols and secondary aerosol precursors, particularly NH_3 and semi-volatile organic compounds (SVOCs).

Table 1. Particulate Matter Air Quality Research Inventory - US Federally Sponsored Activities - Current as of 1998

Organization	Exposure Assessment and Relationships	Aerosol Methods and Monitoring	Atmospheric Chemistry and Physics, Meteorology, and Modeling	Emissions Characterization and Source Apportionment	Risk Management, Controls, and Cost-Benefits	Geographic Region Included in Study Area
1. NPS - Dept. of the Interior		Optical properties of Aerosols and their effects on visibility ... IMPROVE				National
2. NPS - Dept. of the Interior				Big Bend Regional Aerosol and Visibility Observational Study...BRAVO		Big Bend National Park, TX
3. NOAA - Dept. of Commerce			Processes of fine PM formation and distribution			National
4. NOAA - Dept. of Commerce		AIRMoN, deposition of chemicals carried by particles				National
5. NOAA - Dept. of Commerce				Origins and dispersion of primary PM		National
6. Energy Research - DOE , Biological & Environmental Research			Aerosols part of Atmospheric Chemistry Prgm			National
7. Energy Research - DOE , Biological & Environmental Research		Aerosols part of Radiation Measurement Prgm				National
8. Energy Research - DOE , Biological & Environmental Research			Indirect part of Atmospheric Chemistry Prgm			National
9. Energy Research - DOE , Biological & Environmental Research		Indirect part of Environmental . Meteorology Prgm				National
10. Fossil Energy - DOE, Federal Energy Technology Center		Ambient PM2.5 Sampling and Analysis				Upper Ohio River Valley
11. USDA, Forest Service - Forest Research				Smoke management and Air Quality		National
12. USDA/ARS, Land Management and Water Conservation Research Unit				Wind Erosion and Air Quality Prediction		Washington State
13. USDA/ARS, Cropping Systems Lab & Southwestern Cotton Ginning Research Lab				Emissions from cotton ginning	Evaluation of collection equipment for cotton gins	TX, OK, NM
14. USDA/ARS, Application Technology Research Unit			Processes affecting pest control application			

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Organization	Exposure Assessment and Relationships	Aerosol Methods and Monitoring	Atmospheric Chemistry and Physics, Meteorology, and Modeling	Emissions Characterization and Source Apportionment	Risk Management, Controls, and Cost-Benefits	Geographic Region Included in Study Area
15. NSF - Atmospheric Chemistry.			Studies on the Formation, Fate, and Composition of tropospheric PM			
16. EPA - ORD, National Exposure Research Laboratory	Longitudinal Panel Studies; correlating exposure and individuals activity					TBDl
17. EPA - ORD, National Exposure Research Laboratory	Exposure Factors; effecting relation of outdoor, indoor, & personal exposure					National
18. EPA - ORD, National Exposure Research Laboratory	Modeling personal exposure to PM of ambient origin					National
19. EPA - ORD, National Exposure Research Laboratory			Improving organic aerosols chemistry for multi-scale modeling			National
20. EPA - ORD, National Exposure Research Laboratory		Southern Oxidants Study PM				Southeast
21. EPA - ORD, National Exposure Research Laboratory				Receptor Modeling and source chemical profiles		National
22. EPA - ORD, National Exposure Research Laboratory		New PM Analytical Methods for PM measurement				National
23. EPA - ORD, National Exposure Research Laboratory		Collaboration on Health Studies; ambient sampling and data				MD
24. EPA - ORD, National Exposure Research Laboratory			Models-3/ CMAQ for PM; and a new neighborhood scale version			National
25. EPA - ORD, National Exposure Research Laboratory				Source Apportionment and CMB analysis of urban sources		National
26. EPA - ORD, National Exposure Research Laboratory		FRM and Equivalency program for PM2.5				National

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Organization	Exposure Assessment and Relationships	Aerosol Methods and Monitoring	Atmospheric Chemistry and Physics, Meteorology, and Modeling	Emissions Characterization and Source Apportionment	Risk Management, Controls, and Cost-Benefits	Geographic Region Included in Study Area
27. EPA -ORD, National Center for Environmental Research and Quality Assurance		Exploratory grants on PM environmental characterization and measurement method				
28. EPA -ORD, National Center for Environmental Research and Quality Assurance			Exploratory grants on PM atmospheric Chemistry and Modeling			
29. EPA - ORD, National Risk Management Laboratory				Characteristics of Emissions of PM from Indoor and Outdoor Sources		
30. EPA - ORD, National Risk Management Laboratory					Evaluate Techniques to Control or Prevent PM emissions	
31. TVA				Sources, Formation, and Transport in the Tennessee Valley		Tennessee Valley Region
32. TVA				Particle Formation in the Plume		Middle TN
33. TVA		FRM Monitoring Partnerships and Regional Supersite				TN Valley (GSMNP)
34. US Air Force, Air Force Research Lab, AFRL/MLQ				Air Force PM emissions characterization		
35. NASA		Remote, space- based sensing techniques applied to atmospheric PM				

PROJECT DESCRIPTORS

FEDERAL PM RESEARCH INVENTORY

Project No. 1

ORGANIZATION:
Department of the Interior, National Park Service (NPS)

RESEARCH TITLE:
Optical Properties of Aerosols and their Effects on Visibility

FUNDING LEVEL:
FY98 – $ 1.24M (NPS) $0.08M (FWS); FY99 -- same as FY98

CONTACT:
Mark A. Scruggs, Chief, Research and Monitoring Branch, Air Resources Division, National Park Service, P.O. Box 25287, Denver, CO 80225; telephone: (303) 969-2077; fax: (303) 969-2822; e-mail: MarkScruggs@nps.gov.

RESEARCH ACTIVITY:
Exposure assessment and relationships ( ), Aerosol methods and monitoring (**x**)
Atmospheric chemistry and physics, meteorology, and modeling ( ) Emission characterization and source apportionment ( ) Risk assessment and management, cost-benefits ( )

RESEARCH DESCRIPTION:
The major thrust in understanding optical properties of atmospheric aerosols is the need to understand how visibility is related to emissions and emission changes. To this end the NPS participates in and sponsors a routine fine particle and visibility monitoring program, conducts special studies to understand key elements related to aerosol optical properties, and has an ongoing aerosol optical modeling and data analysis program. Some key elements of this program are:

- Coordination and major sponsorship of the IMPROVE (Interagency Monitoring for Protected Visual Environments) national visibility monitoring program, a principal component of which is fine particle sampling at 68 locations in or near Class I areas.
- Apportionment of light extinction among chemical species using statistical and deterministic method.
- Understanding how hygroscopicity changes as a function of aerosol mixing characteristics
- Understanding how scattering characteristics are changed as a function of particle formation mechanisms. For instance, homogenous sulfate formation in a dry environment versus formation involving cloud processes.
- Investigating both theoretically and experimentally how absorptive properties of carbon are changed as a function of particle formation. Externally mixed carbon versus carbon inclusions.
- Evaluating absorption measurement methodologies. Currently there is about a factor of two variability between various measurement methodologies.
- Continued development of source apportionment methodologies including statistical treatments of back trajectories and more recently single particle analysis techniques.
- Development of methodologies for doing temporal trend analysis of fine particle data.
- Continued development of image processing techniques for purposes of assessing the visual impact of emission changes. The model includes state of the art radiation transfer calculations and optical property algorithms.

POLICY PAYOFFS:

a. A better understanding of how existing emissions affect current visibility as well as a how to predict how changes in emissions may change current visibility conditions. This is important in tracking progress with respect to this nation's national visibility goal and in protecting and enhancing visibility in national parks and wilderness areas.
b. A better understanding of how increased use of prescribed fire by Federal land managing agencies may affect regional visibility and PM 2.5 concentrations.

Project No. 2

ORGANIZATION:
Department of the Interior, National Park Service (NPS)

RESEARCH TITLE:
US-Mexico Transboundary Air Pollution [Big Bend Regional Aerosol and Visibility Observational (BRAVO) Study]

FUNDING LEVEL:
FY98 -- $ 0.7M (EPA) $0.2M (NPS); FY99 -- $6M (EPA) $ 0.4M (NPS)

CONTACT:
Miguel I. Flores, Assistant Chief, Air Resources Division, National Park Service, P.O. Box 25287, Denver, CO 80225; telephone: (303) 969-2076 ; fax: (303) 969-2822; e-mail: MiguelFlores@nps.gov.

RESEARCH ACTIVITY:
(Select NRC report category that best describes research)
Exposure assessment and relationships ( ) Aerosol methods and monitoring ( )
Atmospheric chemistry and physics, meteorology, and modeling ( ) Emission characterization and source apportionment (**x**) Risk assessment and management, cost-benefits ( )

RESEARCH DESCRIPTION:
Emissions from Mexico have long been implicated as having a significant impact on fine particle concentrations and visibility conditions in national parks and wilderness areas of the US southwest. Since 1993, the US and Mexican governments have specifically been investigating the causes of poor visibility at Big Bend National Park, Texas. At issue is the extent to which emissions from 2 uncontrolled, coal-fired power plants in the Mexican state of Coahuila (the Carbon I and Carbon II power plants) contribute to visibility impairment at the park. An extensive and intensive tracer release study utilizing multiple tracers to be conducted during summer-fall 1999 will investigate the causes of visibility impairment at the park, apportion such impairment to specific regional sources on both sides of the border, characterize the chemical composition of visibility reducing particles, and identify the transport corridors associated with poor visibility at the park. Some key elements of this study are:

- Understand the long-range, transboundary transport of visibility-reducing fine particles from regional sources in the US and Mexico.
- Quantify the contributions of specific US and Mexican sources (or source regions) responsible for poor visibility at Big Bend National Park.
- Determine the Carbon I and Carbon II impacts to Big Bend hazes
- Determine the relative contribution of other major pollution emission sources in the US and Mexico affecting Big Bend hazes.
- Determine the chemical constituents of fine particles responsible for regional hazes along the US-Mexico border, including single-particle size and composition.
- Evaluate absorption measurement methodologies.
- Continued development of source apportionment methodologies including statistical treatments of back trajectories and more recently single particle analysis techniques.
- Determine effects of meteorology including moisture from Gulf of Mexico on aerosol composition and size.

POLICY PAYOFFS:

- A better understanding of how regional sources in US and Mexico affect current visibility as well as a how to predict how changes in regional emissions may change current visibility conditions at Big Bend and elsewhere in the region.
- This information will drive future policy regarding transboundary air pollution under Border XXI framework.
- Although focused on visibility, BRAVO findings have broader health-related implications and will also provide valuable information for Texas and other states as they prepare PM 2.5 and regional haze SIPs.

Project No. 3

ORGANIZATION:
Department of Commerce, National Oceanic and Atmospheric Administration (NOAA)

RESEARCH TITLE:
Improved understanding of the processes involved in the formation and distribution of fine particles in the atmosphere

FUNDING LEVEL:
FY 1998 - $0.45M, FY 1999 - $0.7M

CONTACT:
Daniel L. Albritton, Director, NOAA Aeronomy Laboratory
Mail Code R/E/AL, 325 Broadway, Boulder, CO 80303; telephone: 303-497-5785;
fax: 303-497-5373; email: aldiroff@al.noaa.gov

RESEARCH ACTIVITY:
(Select NRC report category that best describes research)
Exposure assessment and relationships ( ), Aerosol methods and monitoring ( ), Atmospheric chemistry and physics, meteorology, and modeling (X), Emission characterization and source apportionment ( ), Risk assessment and management, cost-benefits ( )

RESEARCH DESCRIPTION:
The Laboratory's fine particle research program is conducted under the auspices of NOAA's Health of the Atmosphere program and consists of three coordinated components, which are aimed at developing a better predictive capability for fine particulate matter.
1. Laboratory characterization of aerosol formation processes. Using a variety of state-of-the-art experimental techniques, the rates of the gas-phase chemical processes and heterogeneous transformations are being quantified. These studies will help define aerosol formation rates and the role of aerosols in promoting atmospheric transformations. 2. Field campaigns and methods development to define aerosol formation in rural areas. New methods are being developed to measure aerosol precursors and to perform in situ measurements of the chemical composition of individual particles. These techniques will be deployed in conjunction with other ground-based, airborne and remote sensing measurements in a series of major field campaigns conducted throughout the U.S.
3. Diagnostic and predictive modeling of aerosol processes. Diagnostic models are a vital tool in evaluating and assessing the level of understanding. In collaboration with the field campaigns and laboratory studies, the Laboratory's Eulerian chemical-transport model is being used to elucidate the processes that regulate gas-to-particle conversion.

POLICY PAYOFFS:
(i) A better understanding of the relative contribution of primary versus secondary aerosols to ambient particle loadings, providing a clearer focus for emission control programs.
(ii) A better characterization of the composition of ambient aerosols, providing additional information on contributing sources. Characterizing the chemical composition and physical characteristics of ambient particles and their copollutants is an essential step in the development of a definitive causal mechanism in PM-related health effects. (iii) An evaluation of the accuracy of available predictive modeling tools used in both the research and regulatory communities through intercomparison with well-characterized measurements of aerosol and aerosol precursors.

Project No. 4

ORGANIZATION:
Department of Commerce, National Oceanic and Atmospheric Administration (NOAA)

RESEARCH TITLE:
The Atmospheric Integrated Research Monitoring Network (AIRMoN)

FUNDING LEVEL:
FY 1998 - $0.2M, FY 1999 - $0.2M
(Note that this is not the total level of support for AIRMoN. It represents the portion dedicated to studies of chemicals carried by particles.)

CONTACT:
Rayford P. Hosker Jr., Director, NOAA Air Resources Laboratory, Atmospheric Turbulence and Diffusion Division, 456 South Illinois Avenue, Oak Ridge, TN 37831-2456; telephone: 423-576-1233; fax: 423-576-1327; email: hosker@atdd.noaa.gov

RESEARCH ACTIVITY:
Exposure assessment and relationships ( ), Aerosol methods and monitoring (X), Atmospheric chemistry and physics, meteorology, and modeling ( ), Emission characterization and source apportionment ( ), Risk assessment and management, cost-benefits ( )

RESEARCH DESCRIPTION:
The Atmospheric Integrated Research Monitoring Network is an array of stations designed to provide a research-based foundation for 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 Tends Network (CASTNet) for dry. A subprogram is specifically designed to detect the benefits of emissions controls mandated by the Clean Air Act Amendments of 1990. AIRMoN operates with two distinct research components, AIRMoN-dry and AIRM6N-wet. The AIRMoN-dry sampling protocol emphasizes the need for chemical information related to particulate concentrations. The focus is on those anions and cations also measured by AIRMoN-wet - sulfate, nitrate, ammonium, and a number of metallic cations. AIRMoN-dry measures the air concentrations of particles, but the data obtained also permit a direct focus on their rates of deposition.

AIRMoN-dry operates with a weekly sampling protocol that parallels that of NADP. Dry deposition algorithms for the pollutants of interest are explored in intensive field programs, conducted regularly by teams at Oak Ridge and at Research Triangle Park. At this time, there is a renewed focus on particulate species, with new techniques for measuring their rates of dry deposition directly now being explored. Note that AIRMoN-dry operates as a partner of the EPA CASTNet program. Together, these two programs constitute the national capability to quantify dry deposition of atmospheric particles. When added to the NADP program, the result is the national capability to monitor the rate of surface removal of airborne particles of all kinds.

ANTICIPATED OUTPUTS:
(i) A better understanding of the exposure climatology of airborne particles arising from all sources, but with emphasis on sulfate and nitrogen species.
(ii) Improved knowledge of the surface sinks of particle-borne chemical species (dry and wet deposition).
(iii) Development of techniques for attributing changes in air concentration to specific causes, such as changes in emissions mandated by law.
(iv) Improved prediction of the consequences of specific control and/or regulatory options, related to the protection of the public and ecosystems against exposure to chemicals carried by atmospheric particles.

Project No. 5

ORGANIZATION:
Department of Commerce, National Oceanic and Atmospheric Administration (NOAA)

RESEARCH TITLE:
The origins and dispersion of primary particulates – resuspended dust, volcanic ash, and forest fires.

FUNDING LEVEL:

Resuspended dust	FY 1998 - $0.2M, FY 1999 - $0.2M
Volcanic ash	FY 1998 - $0.1M, FY 1999 - $0. IM
Forest fires	FY 1998 - $0.2M, FY 1999 - $0.2M(?)

CONTACT:
Bruce B Hicks, Director, NOAA Air Resources Laboratory, Mail Code R/E/AR, 1315 East West Highway, Silver Spring, MD 20910; telephone: 301-713-0684; fax: 301-713 0119; email: bruce.hicks@,noaa.gov

RESEARCH ACTIVITY:
Exposure assessment and relationships ( ), Aerosol methods and monitoring, Atmospheric chemistry and physics, meteorology, and modeling ( ), Emission characterization and source apportionment (X), Risk assessment and management, cost-benefits

RESEARCH DESCRIPTION:

(1) Resuspended dust. The Air Resources Laboratory has been conducting a long-term study of the resuspension of surface dust, led by Dr. Dale Gillette of the ARL Atmospheric Sciences Modeling Division in Research Triangle Park, NC. The study focuses on the identification of processes by which dust from arid areas is entrained into the air and is transported to distant areas where effects on local particulate concentrations can be severe. For example, dust from Africa affects air quality in Miami, and dust from Asia affects Hawaii. In the US, the experimental center of attention is the Owens Lake region of eastern California.

A key area of uncertainty relates to the processes by which the dust enters the atmosphere. Recent research indicates that a key factor is the presence of large particles (~ 100 Fm diameter) on the surface. It is the wind-blown agitation of these larger particles that causes smaller particles to be ejected from the surface and entrained in the air. This new understanding is being captured in predictive models at this time.

This is a multi-agency activity, with current support from DoD augmenting the NOAA base funding.

(2) Volcanic ash. The Air Resources Laboratory conducts research on the modeling of the transport and dispersion of atmospheric particles from volcanic eruptions. The particles in question are of great concern, because they reside at the flight levels of commercial aircraft and can cause jet engines to stop working. ARL models are routinely used to provide the foecasts distributed to the international commercial aircraft community, through ongoing association with the National Weather Service and with the International Civil Aviation Organization. At this time, research focuses on the improvement of forecasts of the potential for disruption of air traffic routes in the event of eruptions of specific volcanoes, and on the improvement of methods for assimilating observational information from satellites.

This program is funded by NOAA base resources. The volcanic ash products can be viewed on the Internet at

http://www.arl.noaa/gov/ready/vaftad

(3) Forest fires.

ARL capabilities to forecast the atmospheric dispersion of particles are routinely exercised in the event of major fires, such as those that were ignited in Kuwait following the Gulf War and those that have recently affected forests in Indonesia, Brazil, and Mexico. The ARL activity is organized through the World Meteorological Organization, which has a coordinated program in which selected organizations produce "approved" dispersion forecasts. These are the Regional Specialized Meteorological Centers for dispersion forecasting. For the Americas, this service is provided by the USA and Canada. In the USA, the RSMC is a joint operation of the National Centers for Environmental Prediction and the Air Resources Laboratory. ARL develops the models; the National Weather Service runs them once they are tested and accepted.

ARL develops dispersion models for predicting exposure out to considerable distances downwind. At the current state of development, the products are not well proven. To hasten the development, ARL views this as a community-wide activity. The best ARL products are made available routinely on the Internet, where they are accessed regularly by many interested "clients" who are actively encouraged to compare predictions against their own observations and to feed the results back to the ARL model development team. In the case of the Mexican forest fires, the most involved contributors in this process have been environmentalists of the state of Texas and the U.S. Forest Service, who have routinely made use of the products for issuing guidance on potential exposures.

The technique development process makes use of every opportunity that arises. Work started with the oil fire smoke situation following the Gulf War. Work continued with the forest fires in Indonesia, and with fires in northwestern USA and in the Amazon. The Mexican fires constitute the most recent application of the ARL products, that are now felt to be quite refined and ready for trial operational use.

The ARL model run on ARL's internal computing systems, at Silver Spring, Maryland. Their outputs are available for inspection via the Internet, at:

http://www.arl.noaa/gov/ready/yucatanfire.html

POLICY PAYOFFS

(i) A better understanding of the role of primary particles from surface resuspension, volcanic eruption, and forest fires as a contributor to particulate air quality.

(ii) Improved knowledge of particle-borne chemical species encountered in US cities.

(iii) Development of predictive models, for use in warning the population and commerce of coming periods or places of high exposure.

(iv) Improved prediction of the consequences of specific control and/or regulatory options, related to the protection of the public and ecosystems against exposure to hazardous materials carried by atmospheric particles.

Project No. 6

ORGANIZATION:
Department of Energy, Office of Energy Research (ER), Office of Biological and Environmental Research

RESEARCH TITLE:
Aerosol research component of the DOE Atmospheric Chemistry Program

FUNDING LEVEL:
FY 1998 - $2.OM, FY 1999 - $2.1M

CONTACT:
Peter Lunn, Program Director for Atmospheric Sciences, Department of Energy (ER-74), 19901 Germantown Road, Germantown, Maryland 20874; telephone: 301-903-4819; fax: 301-903-8519; email: peter.lunn@oer.doe.gov

RESEARCH ACTIVITY:
(Select NRC report category that best describes research) Exposure assessment and relationships ( ), Aerosol methods and monitoring ( ), Atmospheric chemistry and physics, meteorology, and modeling (X), Emission characterization and source apportionment ( ), Risk assessment and management, cost-benefits

RESEARCH DESCRIPTION:
10 of 28 research projects within the DOE Atmospheric Chemistry Program are concerned directly with aerosols and PM issues:

(a) Benkovitz (Brookhaven) Global Emissions Inventories for Aerosol Research;
(b) Schwartz (Brookhaven) Hemispheric Scale-Chemical and Microphysical Aerosol Model;
(c) Tang (Brookhaven) Aerosol Optical Properties and Phase Transformation;
(d) Weber (Brookhaven) Nanoparticle Size Distribution (2.7-10 nm) Measured by UCNC Pulse ...
(e) Novakov (LBNL) Cloud Condensation Nucleus Activity of Organic Aerosols;
(f) Atherton (LLNL) Investigating the Role of Aerosols, Stratospheric Transport, and Natural;
(g) Garrett (PNNL) Nucleation of Tropospheric Aerosols: A Joint Laboratory and Theoretical Study;
(h) Davidovitz (Boston College) Study of Heterogeneous Processes Related to the Chemistry of Tropospheric Oxidants and Aerosols;
(i) McMurry (Univ. of Minnesota) Composition of Freshly Nucleated, Ultrafine Particles; and
(j) Worsnip (Aerodyne) Atmospheric Pressure Flow Reactor/Aerosol Mass Spectrometer Studies of Tropospheric Aerosol Nucleation and Growth Kinetics.

ANTICIPATED OUTPUTS:
(i) The new PM-2.5 standard imposes a burden on the nation's ability to meet its energy needs and therefore impacts energy policy. Understanding the life cycle of aerosols allows the development and application of models that can be used with confidence to devise energy efficient and cost-effective strategies. (ii) There are major scientific uncertainties in the effect of aerosols on climate, which also impacts energy policy. Reduction of these uncertainties leads to more realistic assessments and more sensible energy policy.

Project No. 7

ORGANIZATION:
Department of Energy, Office of Energy Research (ER), Office of Biological and Environmental Research

RESEARCH TITLE:
Aerosol research component of the DOE Atmospheric Radiation Measurement Program

FUNDING LEVEL:
FY 1998 - $1.OM, FY 1999 - $1.OM

CONTACT:
Wanda Ferrell, Program Director for Atmospheric Radiation, Department of Energy (ER-74), 19901 Germantown Road, Germantown, Maryland 20874; telephone: 301-903-0043; fax: 301-903-8519; email: wanda.ferrell@oer.doe.gov

RESEARCH ACTIVITY:
(Select NRC report category that best describes research) Exposure assessment and relationships ( ), Aerosol methods and monitoring ( ), Atmospheric chemistry and physics, meteorology, and modeling (X), Emission characterization and source apportionment ( ), Risk assessment and management, cost-benefits

RESEARCH DESCRIPTION:
Some of the research projects within the DOE Atmospheric Radiation Measurement Program are concerned directly with aerosols and their effect on radiative forcing.

ANTICIPATED OUTPUTS:
(i) The new PM-2.5 standard imposes a burden on the nation's ability to meet its energy needs and therefore impacts energy policy. Understanding the life cycle of aerosols allows the development and application of models that can be used with confidence to devise energy efficient and cost-effective strategies.
(ii) There are major scientific uncertainties in the effect of aerosols on climate, which also impacts energy policy. Reduction of these uncertainties leads to more realistic assessments and more sensible energy policy.

Project No. 8

ORGANIZATION:
Department of Energy, Office of Energy Research (ER), Office of Biological and Environmental Research

RESEARCH TITLE:
Indirect research component of the DOE Atmospheric Chemistry Program

FUNDING LEVEL:
FY 1998 - $4.1M, FY 1999 - $4.OM

CONTACT:
Peter Lunn, Program Director for Atmospheric Sciences, Department of Energy (ER-74), 19901 Germantown Road, Germantown, Maryland 20874; telephone: 301-903-4819; fax: 301-903-8519; email: peter.lunn@oer.doe.gov

RESEARCH ACTIVITY:
(Select NRC report category that best describes research) Exposure assessment and relationships ( ), Aerosol methods and monitoring ( ), Atmospheric chemistry and physics, meteorology, and modeling (X), Emission characterization and source apportionment ( ), Risk assessment and management, cost-benefits

RESEARCH DESCRIPTION:
18 of 28 research projects within the DOE Atmospheric Chemistry Program are concerned indirectly with aerosols and PM issues.
(a) Doskey (Argonne) Atmospheric Chemicals' Sources and Fates, (b) Gaffney (Argonne) Atmospheric Chemistry of Organic Oxidants and Their Precursors, (c) Wesely (Argonne) Dry Air-Surface Exchange, (d) Daum (Brookhaven) Field Studies in Atmospheric Chemistry, (e) Lee (Brookhaven) Multi-Phase Atmospheric Chemistry, (f) Springston (Brookhaven), Instrumentation for Field Programs, (g) Berkowitz (PNNL) Qualitative Assessment of Role of Heterogeneous Chemistry, (h) Doran (PNNL) Dependence of Urban-Scale Oxidant Chemistry on Boundary-Layer Processes, (i) Fast (PNNL) Influence of Stratospheric Intrusions of Ozone on Surface Ozone Concentrations, (j) Brasseur (NCAR) Impact of Human Activities on Ozone in the Troposphere, (k) Carmichael (U. of Iowa) Role of Heterogeneous Chemistry of Volatile Organic Compounds, (l) Finlayson-Pitts (UC-Irvine) Laboratory Studies of the Role of Halogen Chemistry in the Formation and Fate of Ozone in the Remote and Polluted Atmosphere, (m) Madronich (NCAR) Ultraviolet Radiation in the Pollution Shield, (n) McElroy (Harvard) Impact of Tropospheric Planetary Wave Variability, (o) Penner (U. of Michigan) Global Atmospheric Chemistry Modeling, (p) Wang (SUNY) Atmospheric Ozone as a Climate Gas, and (q) Weinstein-Lloyd (SUNY) Atmospheric Peroxyl Radicals and Peroxides. Also (r) Wesely (Argonne) as Chief Scientist of the DOE Atmospheric Chemistry Program.

ANTICIPATED OUTPUTS:
(i) The new PM-2.5 standard imposes a burden on the nation's ability to meet its energy needs and therefore impacts energy policy. Understanding the life cycle of aerosols allows the development and application of models that can be used with confidence to devise energy efficient and cost-effective strategies.
(ii) There are major scientific uncertainties in the effect of aerosols on climate, which also impacts energy policy. Reduction of these uncertainties leads to more realistic assessments and more sensible energy policy.

Project No. 9

ORGANIZATION:
Department of Energy, Office of Energy Research (ER), Office of Biological and Environmental Research

RESEARCH TITLE:
Indirect research component of the DOE Environmental Meteorology Program

FUNDING LEVEL:
FY 1998 - $2.OM, FY 1999 - $3.OM

CONTACT:
Peter Lunn, Program Director for Atmospheric Sciences, Department of Energy (ER-74), 19901 Germantown Road, Germantown, Maryland 20874; telephone: 301-903-4819; fax: 301-903-8519; email: peter.lunn@oer.doe.gov

RESEARCH ACTIVITY:
(Select- NRC report category that best describes research) Exposure assessment and relationships ( ), Aerosol methods and monitoring ( ), Atmospheric chemistry and physics, meteorology, and modeling (X), Emission characterization and source apportionment ( ), Risk assessment and management, cost-benefits

RESEARCH DESCRIPTION:
The DOE Environmental Meteorology Program supports aerosol issues, indirectly, by focusing on the movement of airborne pollutants. In FY 99 the emphasis will be on vertical transport and mixing. Also the DOE Gulfstream (G-1) aircraft is made available for aerosol studies.

ANTICIPATED OUTPUTS:
(i) The new PM-2.5 standard imposes a burden on the nation's ability to meet its energy needs and therefore impacts energy policy. Understanding the life cycle of aerosols allows the development and application of models that can be used with confidence to devise energy efficient and cost-effective strategies.
(ii) There are major scientific uncertainties in the effect of aerosols on climate, which also impacts energy policy. Reduction of these uncertainties leads to more realistic assessments and more sensible energy policy.

Project No. 10

ORGANIZATION:
Department of Energy, Office of Fossil Energy, Federal Energy Technology Center

RESEARCH TITLE:
Ambient $PM_{2.5}$ Sampling and Analysis--Upper Ohio River Valley Project (UORVP)

FUNDING LEVEL:
FY 1998: $1.5 million FY 1999: TBD FY 2000: TBD

CONTACT:
Thomas J. Feeley, III, Project Manager; DOE/FETC, MS 922-256, P.O. Box 10940, Pittsburgh, PA 15236; telephone (412) 892.6134; fax (412) 892.5917; email: feeley@fetc.doe.gov

RESEARCH ACTIVITY:
NRC Category: Aerosol methods and monitoring

RESEARCH DESCRIPTION:
The UORVP represents the largest component of DOE/FEÕs current ambient $PM_{2.5}$ research program. This effort will involve the installation and operation of ambient fine particulate ÒsuperÓ sites within both urban and rural settings in an area encompassing eastern Ohio, northwestern West Virginia, and western Pennsylvania. These sites will be equipped with an array of Federal Reference Method (FRM) and non-FRM equipment and instrumentation (intermittent and continuous sampling) necessary for the collection and analysis of aerosol, gas-phase, and biological particulate matter. The sites will also collect meteorological data including wind speed and direction, relative humidity, UV radiation, insolation, temperature and precipitation. An important focus will be on the potential lose of volatiles associated with FRM filter-based sampling and sample collection and handling. The purpose of the UORVP is to try to better understand the relative contribution of anthropogenic (e.g., coal-based power systems), and biogenic emissions sources in the upper Ohio River Valley region on downwind ambient air quality. These sites may also be used to monitor other pollutants, such as ozone and/or mercury. Of particular note, EPA models have predicted that the Ohio River Valley and western Pennsylvania are areas susceptible to potentially high mercury deposition. In addition, the sites may serve as research platforms for testing new ambient fine particulate monitoring equipment. Finally, the UORVP monitoring sites will provide ambient air quality concentration and compositional data in support of a proposed human-exposure/$PM_{2.5}$ study. DOE/FE will collaborate with EPA, state and local environmental agencies, industry, and academia, and environmental groups in the operation of the monitoring sites.

POLICY PAYOFFS:
The UORVP will result in an improved understanding of (1) the characteristics and composition of urban and rural $PM_{2.5}$ aerosols and ambient precursor gases; (2) spatial and temporal variations in ambient fine particulates; (3) the contribution of anthropogenic, with a focus on coal-based power systems, and biogenic emission sources on ambient air quality; (4) the performance of FRMs in collecting volatile species, such as ammonium nitrate, and determining total mass, (5) local and regional atmospheric transport of primary particulate and secondary-particulate precursors, (6) the linkages between $PM_{2.5}$ and ozone precursor gases, and (7) the relationship between $PM_{2.5}$ concentrations at ambient monitoring sites and personal exposure to particulate matter of ambient origin. This information will directly address several of the research priorities identified in the NRC report.

Project No. 11

ORGANIZATION:
Department of Agriculture, Forest Service (FS), Forest Research

RESEARCH TITLE:
Smoke Management and Air Quality (Focused)

FUNDING LEVEL:
FY 1998 - $1.9M
Requested for FY 1999 - $1.9 M

CONTACT:
Robert Lewis, Deputy Chief, Forest Service Research, P.O. Box 96090, Washington, DC 20090-6090: Telephone: (202) 205-1665; fax: (202) 205-1530

RESEARCH ACTIVITY:
Exposure assessment and relationships ( ), Aerosol methods and monitoring ( ), Atmospheric chemistry and physics, meteorology, and modeling ( ), Emission characterization and source apportionment (X), Risk assessment and management, cost-benefits ( )

RESEARCH GOAL:
To improve the understanding of interactions between forest ecosystems and air pollution, including air pollution resulting from forest fires.

RESEARCH DESCRIPTION:
In some areas of the U.S., forest health problems have increased the risk of catastrophic forest fires. Prescribed burning has been used to improve forest health. Fire in wild land vegetation is recognized as one of the basic forces controlling succession of many ecosystems and as a major tool used in vegetation management. However, the processes affecting the rate of burning and the rate of smoke evolution are poorly understood. In the U.S., prescribed burning and wildfires produce over 4 million tons of particulate matter and 0.5 trillion tons of carbon dioxide annually (FS, 1994). Burning of tropical forest lands, savanna regions, and other forest regions of the world release many times this amount of particulate matter and gases to the atmosphere. Research attempts to characterize the compounds in smoke that are known to damage human health, to identify chemical compounds in smoke that can be used to distinguish smoke particles generated from other sources, to characterize the trace compounds from biomass burning that affect global climate change, and to determine effects of fuel chemistry on fire behavior and smoke production.

Research also examines the use of prescribed fire and management of air quality. In particular the amount of smoke emitted and its trajectory must be accurately predicted in order to use prescribed fire responsibly and with the permission of state regulator agencies. Understanding and modeling biomass consumption, emissions production, and dispersion are essential steps in developing smoke management systems. Finally, research also examines the potential for air quality impacts to sensitive and remote wilderness ecosystems and wilderness values (air quality related values- AQRVs)

PROGRAM MILESTONES:
In 1998, Forest Service Research will continue work on characterizing emissions from fires, including both wildfires and prescribed bums. This work will focus on forest and range ecosystems with emphasis on cooperative investigations to characterize (physical and chemical properties) emissions from fuel types for which emissions factors are lacking. Work in this area will be coordinated with the Department of the Interior, the US EPA, and state air agencies. Additionally, work with international cooperators will continue including work with peer scientists in Brazil, Zambia. Canada, Germany, Bulgaria, the Check Republic, and (potentially) the Russian Federation to aid in development of information on carbon balance and air quality implications on a global scale. Another area of focus will be using gained emission information to test and develop

improved smoke dispersion models, and during 1998 a research guidance document will be developed on the issue in cooperation with the National Wildfire Coordination Group (NWGC- EXPRESS TEAM). Finally, FS research will continue its leadership role in characterization of Wilderness air quality. *In 1999,* FS will work on preliminary development and field testing of new dispersion modeling and smoke information techniques. Models of biomass consumption and emissions fate will be integrated into these programs. International cooperation will continue on biomass burning as it relates to both air quality, global change, and wilderness issues. *In 2000,* FS will continue model development to support state implementation plans (SIPS) and regional haze program development. Biomass consumption and emissions factor research will continue, with findings coordinated with EPA for possible inclusion into AP-42 and to support on-going studies of fire fighter smoke exposure consequences. Work will also continue on measurement and tracking of air quality related values (AQRVs) in Wilderness, with partial focus on dry deposition/forest canopy interface issues. International cooperation will continue, with programs in Brazil, Zambia, Germany, Canada, South Africa, the Russian Federation, Bulgaria, the Check Republic, and Uzbekistan.

ANTICIPATED OUTPUTS:
Understanding interactions between forest ecosystems and air quality, including the effects of smoke, will help resource managers and policy makers make more informed decisions. As attempts are made to restore forest health in some areas, knowledge of effects of prescribed burning on air quality will help weigh the risks and benefits of different policies, especially in relationship to the Clean Air Act. Specifically, the information gained will be critical in regional haze issues and fine particulate standards understanding, compliance and data exchange.

Project No. 12

ORGANIZATION:
USDA/ARS, Land Management and Water Conservation Research Unit

RESEARCH TITLE:
Wind Erosion and Air Quality Prediction, Management and Technology

FUNDING LEVEL:
Annual Funding: CRIS =$435,933, PM= $343,000

CONTACT:
Dr. Keith Saxton, USDA/ARS, Smith Hall - WSU, Pullman, WA 99160
PH:509-335-2724, E-mail ksaxton@wsu.edu

RESEARCH ACTIVITY:
Exposure assessment and relationships ( ), Aerosol methods and monitoring ( ), Atmospheric chemistry and physics, meteorology, and modeling ( ), Emission characterization and source apportionment (X), Risk assessment and management, cost-benefits ( )

RESEARCH DESCRIPTION:
Objectives:
a. Develop new understanding of mechanisms of agricultural dust particulate occurrence and emission due to wind erosion and field operations.
b. Develop control practices for wind events and farm machine operations including new conservation practices, crop rotations, residue and soil surface management and farm machine improvements.
c. Develop and apply analyses for source detection of particulates.
d. Develop prediction techniques for wind erosion and dust emissions for a range of climates, soils, crops and machine operations.

Approach:
A series of wind erosion measurement sites have been established on highly erodible areas in eastern and south central Washington, which are representative of much of the Northwest region. These instrument packages include the latest techniques developed by the wind erosion WEPS team so that the data will be fully compatible and will provide calibration and verification of the improved wind erosion equation and the latest version of the WEPS model. These instruments include a complete weather station with electronic data logger, 16 to 20 two-meter high vertical masts each supporting several point samplers to measure soil movement in all wind directions, and several additional specialized samplers of wind and soil. These wind erosion measurements are quite similar to the standard methods used for the WEPS model verification. Long-term climatic data of the region will be obtained and analyzed to determine design variables such as probabilities of wind directions, velocities and durations. Two or more PM-10 and PM-2.5 samplers will be included within the field sites and downwind off-site to compare particulate sizes from in field wind erosion with that found off -site. A sampling procedure will be developed for the PM-10 samplers to determine particulates and sources during and between wind erosion events. New methodology is being developed to utilize biological materials associated with dust emitted from agricultural fields and measured on downwind filters as unique markers to identify approximate sources and relative contributions.

Keywords:
Tillage, fallow, residue, dryland, source detection, biomarkers, cereal, models, direct seeding, dust, particulate, wind erosion, air quality, conservation.

ANTICIPATED OUTPUTS:

a. PM-10 and PM-2.5 particulates in urban regions include multiple sources, such as industry and auto emissions,. smoke, pollen, etc. in addition to mineral dust. It is important to determine the relative magnitude of agricultural dust contributions to particulate volumes in urban regions downwind of agricultural wind erosion and field operations which generate fugitive dust. As opposed to early speculation and Eastern US data, preliminary evidence shows a significant agricultural contribution of PM-2.5 in Western US dry farming regions whose impacts will be correctly assessed.

b. New methodology has been developed to utilize biological materials associated with dust emitted from agricultural fields and which can be measured on downwind filters as unique markers to identify approximate sources and relative contributions. This approach will aid in validating mathematical models and prediction methods and provide opportunities to identify those agricultural fields and operations most beneficial to provide remedial support. Biological mapping of areas across the nation will allow regional and national inventory of soil biological systems.

c. Existing mathematical models and prediction methods will be adapted and enhanced to accurately predict wind erosion from the variety of field situations found throughout the western US with emphasis on regions in Washington and Idaho. The information derived from these models and methods will also be useful to conduct research and assist collaboration with other researchers across the nation.

Project No. 13a

ORGANIZATION:
USDA/ARS, Cropping Systems Research Lab, Cotton Production & Processing Research Unit

RESEARCH TITLE:
Evaluation of improved dust collection equipment for cotton gins.

FUNDING LEVEL:
FY 1998 - $0.05M, FY 1999 - $0.05M

CONTACT:
Roy V. Baker, USDA ARS, Rt. 3 Box 215, Lubbock, TX 79401
telephone: 806-746-5353, fax: 806-744-4402, email: rbaker@mail.csd.ars.usda.gov

RESEARCH ACTIVITY:
Exposure assessment and relationships ( ), Aerosol methods and monitoring ( ), Atmospheric chemistry and physics, meteorology, and modeling ( ), Emission characterization and source apportionment ( ), Risk assessment and management, cost-benefits (X).

RESEARCH DESCRIPTION:
EPA Method 201A techniques are used to evaluate improved dust collector designs for use at cotton gins handling stripper harvested cotton of the type normally grown in Texas, Oklahoma and eastern New Mexico. Equipment of interest is installed in a full-scale research gin plant and compared to standard collection equipment in a setting that closely resembles that found at commercial cotton ginning installations. The objective of this work is to identify improved techniques for controlling PM10 and total suspended particulate at cotton gins.

ANTICIPATED OUTPUTS:
a. A better understanding of the relative effectiveness of a variety of dust collectors.
b. Development of design criteria that can be used by the commercial sector to reduce particulate emissions from ginning operations.
c. A better characterization of the amount and composition of particulate emissions from cotton gins.

Project No. 13b

ORGANIZATION:
USDA/ARS, Southwestern Cotton Ginning Research Laboratory

RESEARCH TITLE:
Development of Ginning Systems and Knowledge to Enhance Value & Textile Utility of Western Cottons, Objective 5) Improve the efficiency of the cyclone used in emission control.

FUNDING LEVEL:
FY 1998 - $25,000, FY 1999 - $25,000

CONTACT:
S.E. Hughs USDA,ARS, SW Cotton Ginning Research Laboratory PO Box 578 Mesilla Park, NM 88047 telephone: 505-526-6381 fax 505-525-1076 email: shughs@nmsu.edu

RESEARCH ACTIVITY:
Exposure assessment and relationships ( ), Aerosol methods and monitoring ( ),Atmospheric chemistry and physics, meteorology, and modeling ( ), Emission characterization and source apportionment (X), Risk assessment and management, cost-benefits ( ).

RESEARCH DESCRIPTION:
Control of all emissions from the ginning process will need to be continually improved and monitored for the foreseeable future in order to meet continually changing operational licensing requirements by various air quality regulatory agencies across the cotton belt. In addition, partly due to the relatively new PM2.5 standard, the weight and size distribution of gin particulate emissions will need to be better characterized and documented by both laboratory and field studies. Also, research must be done in cooperation with other entities, as to how well the current emission predictive models fit the ginning industry.

ANTICIPATED OUTPUTS:
A better understanding of the ginning industries contribution to the PM 10 and PM2.5 levels in a given area.

Project No. 14

ORGANIZATION:
USDA/ARS, Ohio Agricultural Research and Development Center

RESEARCH TITLES:
a. Improved Application Technology for Pest Control and Bioregulating Agents
b. Biological, Microclimate, and Transport Processes Affecting Pest-Control Application Technology

FUNDING LEVEL:

CONTACT:
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RESEARCH ACTIVITY:
Exposure assessment and relationships ( ), Aerosol methods and monitoring ( ), Atmospheric chemistry and physics, meteorology, and modeling (X), Emission characterization and source apportionment ( ), Risk assessment and management, cost-benefits ( ).

RESEARCH DESCRIPTION:
The unit mission is to conduct basic and development research on application technology for controlling insects and diseases in horticultural, nursery, greenhouse and field crops, including biological control strategies, and to increase control effectiveness with reduced application levels of control agents and reduced environmental impact.

a. Assessment of spray drift loss from orchard, nursery and field crop application operations, and development of models, databases and technology to mitigate drift, including research on spray solution formulations, and on shielded, air-assist and electrostatic technologies. Laboratory, wind-tunnel and large-scale field studies are required.
b. Basic chemistry and physics, and dynamic transport processes at the plant interface to improve retention at first contact. Drift-reduction and surface-active chemistries are studied and modeled.
c. Laboratory and field studies and evaluations of technology and instrumentation for assessing crop coverage and off-target dosages are an essential part of the research program.

ANTICIPATED OUTPUTS:
a. Greater worker safety and reduction of exposure risks to the public.
b. With more effective application at reduced dosages, more profitability for the producer, assurance of safe and quality food and ornamental products for the consumer.
c. Provision of improved and more technically sound models, databases and technology for regulatory agencies, including APHIS and EPA.

Project No. 15

ORGANIZATION:
National Science Foundation (Atmospheric Chemistry)

RESEARCH TITLE:
Studies on the Formation, Fate and Composition of Particulate Matter in the Troposphere

FUNDING LEVEL:
Contributing (estimate): FY 1998 $1.5M (NSF total; $1.0M Atmospheric Chemistry Program, remainder mostly (NCAR); FY 1999 (estimate): unchanged

CONTACT:
Anne-Marie Schmoltner, Director, Atmospheric Chemistry Program, National Science Foundation, 4201 Wilson Blvd., Room 775, Arlington, VA, 22230; telephone: 703-306-1522; fax: 703-306-0377; email: aschmolt@nsf.gov.

RESEARCH ACTIVITY:
Atmospheric chemistry and physics, meteorology, and modeling (X).

RESEARCH DESCRIPTION:
The Atmospheric Chemistry Program supports research activities that focus on the fundamental chemistry and physics of fine particles in the troposphere. Instrument development and analytical technologies are supported that target fine particle collection, measurement, and chemical characterization. Atmospheric chemical and transport models are applied to understanding the formation, fate and transport of fine particles in the lower troposphere. Primary and secondary sources of fine particles are identified through advanced analytical technologies. Laboratory experiments are conducted that simulate the photochemical reaction conditions and aerosol nucleation and growth phenomena of secondary fine particles from natural and anthropogenic precursor compounds. Multi-investigator field campaigns are conducted as process-level studies. Measurements of fine aerosol chemical and physical measurements are used to improve and validate current chemical and transport models for urban and rural atmospheres.

POLICY PAYOFFS:
1. New information about the chemistry, formation, transport and fate of fine particles is aimed at improving the scientific basis for their regulation and for control of known precursors.
2. Advances in fine particle collection instrumentation and analytical chemical methods benefit the routine monitoring activities by regulatory agencies through more efficient and accurate measurements.
3. Improved aerosol models will enhance predictive models of atmospheric air quality.

Project No. 16

ORGANIZATION:
U.S. Environmental Protection Agency, Office of Research and Development, National Exposure Research Laboratory (EPA-ORD-NERL)

RESEARCH TITLE:
Longitudinal Panel Studies

FUNDING LEVEL:
FY-1998 - $2,165K & 7.0 FTEs (Estimated Project Cost FY98/00 = $5,800K)

CONTACT:
Dr. Linda S. Sheldon, Science Team Leader, EPA-ORD-NERL (MD-56)
Research Triangle Park, NC 27711, (P) 919-541-2205, (F) 919-541-1486

RESEARCH ACTIVITY AREA:
Exposure Assessment and Relationships **(X)**, Aerosol Methods and Monitoring **( )**, Emission Characterization and Source Apportionment **( )**, Atmospheric Chemistry and Physics, Meteorology, and Modeling **( )**, Risk Assessment and Management, Cost Benefits **( )**

RESEARCH DESCRIPTION:
The correlation between personal exposures to PM from ambient and personal activities is not clearly defined. Longitudinal studies that evaluate changes in personal exposure with changes in ambient PM concentration have only been conducted on a limited number of high-risk individuals (i.e., patients with chronic obstructive pulmonary disease, COPD, or cardiovascular disease). Such persons have activity patterns that are different from those of healthier individuals. They may engage in fewer activities requiring extensive physical activity, they may avoid activities that elevate personal exposures to particles, or they may spend more time indoors at home than healthier persons. All these factors may alter the importance of indoor particle sources and impact the relationship between personal exposures and ambient PM concentrations.
To address these critical research issues, a series of longitudinal panel studies will be designed and conducted (1) to characterize interpersonal and intrapersonal variability in exposure to PM, and (2) to describe the relationship between personal exposures PM of ambient origin and ambient exposure estimates based on central-site monitoring. The research will include characterizing personal exposure to PM of ambient origin and associated pollutant gases, for susceptible subpopulations. Three panel studies will be conducted in order to evaluate different susceptible subpopulations and different regions of the country. Activity patterns of susceptible subpopulations across time will also be studied. Susceptible subpopulations will include COPD patients, individuals with cardiovascular disease, the elderly, and/or asthmatics.

ANTICIPATED OUTPUTS:
Exposure of susceptible subpopulations (e.g., COPD patients, heart disease patients, and susceptible subpopulations) to total PM/gases and those of ambient origin; longitudinal relationship between ambient, outdoor, indoor central, indoor residence, personal concentration measures for PM/gases; relationship of measures to personal activities; longitudinal activity pattern data by region and season. Preliminary report - FY01, Final Report - FY02.

Project No. 17

ORGANIZATION:
U.S. Environmental Protection Agency, Office of Research and Development, National Exposure Research Laboratory (EPA-ORD-NERL)

RESEARCH TITLE:
Exposure Factors: Physical and Chemical Relationships Between Outdoor Monitoring Sites and Indoor Concentrations/Personal Exposures

FUNDING LEVEL:
FY1998 - $600K & 4 FTEs (Estimated Project Cost FY98/00 = $2,400K)

CONTACT:
Dr. Linda S. Sheldon, Science Team Leader, EPA-ORD-NERL (MD-56)
Research Triangle Park, NC 27711, (P) 919-541-2205, (F) 919-541-1486

RESEARCH ACTIVITY AREA:
Exposure Assessment and Relationships **(X)**, Aerosol Methods and Monitoring **( )**, Emission Characterization and Source Apportionment **( )**, Atmospheric Chemistry and Physics, Meteorology, and Modeling **( )**, Risk Assessment and Management, Cost Benefits **( )**

RESEARCH DESCRIPTION:
The research will include differentiation of the contributions made by ambient air and by penetration of particles of ambient origin indoors. Some of the research will include first-principle studies of processes, empirical characterizations, and numerical and non-dimensional modeling. Key study elements are listed below.
Make field measurements of the influence of key factors for a variety of microenvironments (e.g., homes, schools, offices, etc.). Key factors affecting indoor concentrations may include building type, age, and geographic location; air exchange rates; air conditioning; indoor particle resuspension; meteorology.
Perform controlled lab/test home parametric studies to identify important factors affecting indoor concentrations.
Examine the impact of selected human activities on personal exposures for both adults and children. Characterize flow fields around people associated with specific activities. What causes enrichment? Do children have different types of exposure than adults?
Examine the effect of infiltration and how HVAC affects the indoor concentration of ambient PM/gases.
Characterize the spatial and temporal variability of critical, potential, causal agents, (i.e., ultrafine particles) across the community and into the indoor microenvironments.

ANTICIPATED OUTPUTS:
Understanding of key physical/chemical parameters that influence personal/indoor exposure to PM of ambient origin. Preliminary report - FY00, Final Report - FY01

Project No. 18

ORGANIZATION:
U.S. Environmental Protection Agency, Office of Research and Development, National Exposure Research Laboratory (EPA-ORD-NERL)

RESEARCH TITLE:
Analysis/Modeling PM of Ambient Origin From the Stationary Monitor to Personal Exposure

FUNDING LEVEL:
FY98 - $200K & 3 FTEs (Estimated Project Cost FY98/00 = $2,150K)

CONTACT:
Dr. Haluk Ozkaynak - Science Team Leader, EPA-ORD-NERL (MD-56)
Research Triangle Park, NC 27711, (P) 919-541-5172, (F) 919-541-1486

RESEARCH ACTIVITY AREA:
Exposure Assessment and Relationships **(X)**, Aerosol Methods and Monitoring **( )**, Emission Characterization and Source Apportionment **( )**, Atmospheric Chemistry and Physics, Meteorology, and Modeling **( )**, Risk Assessment and Management, Cost Benefits **( )**

RESEARCH DESCRIPTION:
Knowledge gained from past and present longitudinal studies will be integrated through this modeling work. Work will begin with a first-generation model (extension of simple predictive model); refinements will be made when other data become available. This first-generation model will be based on existing outdoor measurements, time/activity and census data, and semi-empirical methods for estimating micro-environmental PM concentrations. The first-generation model is needed soon in order to develop the most appropriate hypotheses/designs for exposure measurement studies. Subsequent models will be refined using the data gained from the new exposure research. In FY98, statistical space-time models of the distribution of PM will be developed for selected cities based on available monitoring data. The exposure model will be developed and assessed in these locations using different sets of measurement data, thus assuring comparability of observed measurements with model predictions at each stage of exposure model development and testing.

ANTICIPATED OUTPUTS:
Models of exposure to PM of ambient origin for the general population and susceptible subpopulations. Preliminary Model - FY99, FY00; Refined Model - FY03.

Project No. 19

ORGANIZATION:
U.S. Environmental Protection Agency, Office of Research and Development, National Exposure Research Laboratory (EPA-ORD-NERL)

RESEARCH TITLE:
Organic Content of Aerosols, improving model chemistry

FUNDING LEVEL:
FY98 - $500K (Estimated Project Cost FY98/00 = $500K)

CONTACT:
Dr. Ed Edney, Science Team Leader, EPA-ORD-NERL (MD- 84)
Research Triangle Park, NC 27711 (P) 919-541-3905, (F) 919-541-4787

RESEARCH ACTIVITY AREA:
Exposure Assessment and Relationships **( )**, Aerosol Methods and Monitoring **( )**, Emission Characterization and Source Apportionment **( )**, Atmospheric Chemistry and Physics, Meteorology, and Modeling **(X)**, Risk Assessment and Management, Cost Benefits **( )**

RESEARCH DESCRIPTION:
In many parts of the United States, ambient aerosols consist mainly of complex mixtures of organic compounds, inorganic salts and acids, and liquid water. While the thermodynamics of aqueous mixtures of inorganic salts and acids is reasonably well understood, only recently have theories been developed for describing the partitioning of SVOCs between gas and aerosol phases in the absence of liquid water films. The purpose of this task is to use a thermodynamic approach to develop a first generation model for those aerosols that contain organic and inorganic fractions including liquid water. A series of laboratory experiments will be conducted to determine the partitioning of a number of mixtures of atmospherically relevant organic and inorganic compounds between the gas and aerosol phase as a functions of chemical composition, relative humidity, and temperature. The organic compounds should include non-polar compounds as well as polar compounds, the latter of which should include those compounds that may play a role in secondary organic aerosol formation. Emphasis will be placed on investigating those conditions where liquid water is present. This research will develop a thermodynamic model based on the laboratory data and other relevant information, and will incorporate the thermodynamic model into Models3/CMAQ.

ANTICIPATED OUTPUTS:
An improved understanding of the thermodynamics of atmospherically relevant aerosols (Final Report - FY01). A first generation model for atmospheric aerosols containing organic and inorganic fractions including liquid water (FY01). Journal articles - FY00 and FY01.

Project No. 20

ORGANIZATION:
U.S. Environmental Protection Agency, Office of Research and Development, National Exposure Research Laboratory (EPA-ORD-NERL)

RESEARCH TITLE:
Southern Oxidants Study PM Research

FUNDING LEVEL:
FY98 - $0 & 1 FTE (Estimated Project Cost FY98/00 = $1,600K)

CONTACT:
Dr. Basil Dimitriades, Project Officer and Technical Consultant, EPA-ORD-NERL (MD-80)
Research Triangle Park, NC 27711, (P) 919-541-2706, (F) 919-541-1379

RESEARCH ACTIVITY AREA:
Exposure Assessment and Relationships **( )**, Aerosol Methods and Monitoring **(X)**, Emission Characterization and Source Apportionment **( )**, Atmospheric Chemistry and Physics, Meteorology, and Modeling **( )**, Risk Assessment and Management, Cost Benefits **( )**

RESEARCH DESCRIPTION:
The Southern Oxidants Study (SOS) is a strategic alliance of research scientists, engineers, and air quality managers from university, federal and state governments, industry and public interest groups. Specific objectives of the 1998-00 effort are to: (1) obtain emission inventory data for ammonia --- a fine particle precursor, (2) assess and provide measurement methodology in support of the requisite field campaigns, (3) provide modeling support to such campaigns, and (4) conduct the requisite field campaigns. The 1999 program will focus on the atmospheric processes that control the formation and distribution of both ozone and PM. A major field study is planned in the Nashville, Tennessee area, and plans will also be developed for a field intensive in the Houston, Beaumont, Port Arthur area of East Texas in 2000. Aircraft will be used to determine the aerosol distribution in the region and monitor the gas-to-particle formation in both power plant and urban plumes. Ground-based measurements will include NOy and VOC species, as well as size, optical properties, composition and mass of ambient aerosols. In addition, aerosol precursors, such as ammonia, SO_2, and nitrates will be measured. An ozone/aerosol LIDAR will be located at one of the chemistry sites. The program will be supported by an array of at least five wind and temperature profilers and a water vapor profiling system.

ANTICIPATED OUTPUTS:
An observation-based information on key processes that result in atmospheric formation of ozone and fine particles and on interactions of such processes. An assessment of measurement methodologies for ambient aerosols. An emission inventory data base for the Nashville/Middle Tennessee region.

Project No. 21

ORGANIZATION:
U.S. Environmental Protection Agency, Office of Research and Development, National Exposure Research Laboratory (EPA-ORD-NERL)

RESEARCH TITLE:
Receptor Modeling

FUNDING LEVEL:
FY98 - $755K & 4 FTEs (Estimated Project Cost FY98/00 = $1,125K)

CONTACT:
Dr. Charles W. Lewis, Science Team Leader and Science Coordinator, EPA-ORD-NERL (MD-47)
Research Triangle Park, NC 27711 (P) 919-541-3154, (F) 919-541-0239

RESEARCH ACTIVITY AREA:
Exposure Assessment and Relationships **( )**, Aerosol Methods and Monitoring **( )**, Emission Characterization and Source Apportionment **(X)**, Atmospheric Chemistry and Physics, Meteorology, and Modeling **( )**, Risk Assessment and Management, Cost Benefits **( )**

RESEARCH DESCRIPTION:
Receptor modeling is concerned with the acquisition of chemically speciated air pollutant data and the use of those data in conjunction with mathematical procedures (receptor models) for identifying and quantifying the sources of those pollutants and any others of interest. This task emphasizes using this methodology to establish relationships that connect sources to exposure at the individual level, as distinct from the ambient environment. NERL's PM speciation program is centered around its x-ray fluorescence (XRF), scanning electron microscopy (SEM), and ion chromatography (IC) capabilities. The original ambient orientation of the program will be modified to add the capability of analyzing air samples from a broader range of samplers. Source profile measurements will focus on source types that are both important and ubiquitous (e.g., mobile source/tunnel measurements), and may be done in collaboration with NRMRL. A receptor modeling approach to indoor PM will allow the indoor/outdoor fractions of indoor PM to be determined without the need for traditional auxiliary measurements (e.g., air exchange rates). Carbon-14 measurements are also performed under this task to determine the fraction of PM that is biogenic and to help quantify secondary organic PM formation under summertime conditions.

ANTICIPATED OUTPUTS:
Chemically-speciated PM data bases from a variety of indoor/outdoor field studies; within 4 months of sample availability, up-to-date PM chemical profiles of critical indoor/outdoor sources (FY00), and presentations/journal articles (FY99 - FY01).

Project No. 22

ORGANIZATION:
U.S. Environmental Protection Agency, Office of Research and Development, National Exposure Research Laboratory (EPA-ORD-NERL)

RESEARCH TITLE:
Development and Evaluation of New PM Analytical Methods

FUNDING LEVEL:
FY98 - $990K & 3.0 FTEs (Estimated Project Cost FY98/00 = $2,851K)

CONTACT:
Dr. Russell W. Wiener, Management Coordinator, EPA-ORD-NERL (MD-46)
Research Triangle Park, NC 27711, (P) 919-541-1910, (F) 919-541-1153

RESEARCH ACTIVITY AREA:
Exposure Assessment and Relationships **( )**, Aerosol Methods and Monitoring **(X)**, Emission Characterization and Source Apportionment **( )**, Atmospheric Chemistry and Physics, Meteorology, and Modeling **( )**, Risk Assessment and Management, Cost Benefits **( )**

RESEARCH DESCRIPTION:
New particle measurement methods are needed to characterize the spatial and temporal variability in PM and PM exposures. In particular, "real-time" measurements of particulate mass, size, and chemical composition in ambient air, indoor microenvironments, and for personal exposures are needed. This research into new PM analytical methods will focus on state-of-the-art continuous and non-invasive aerosol measurement methods for personal, indoor, and ambient sampling. Single-particle analysis methods to quantitatively count and physically/chemically characterize ambient PM pollution will be improved, tested, and applied to real-world samples. This research will (1) develop/evaluate methods with the ability to provide real-time monitoring of aerosol concentration, size distribution, and/or chemical composition, (2) utilize new and existing methods to chemically speciate PM as a function of size in ambient, microenvironmental, or personal samplers, (3) develop methodology with the phase Doppler anemometer to measure aspiration efficiency in complex flows to help accurately assess "true" particle concentrations collected by ambient, microenvironmental, and personal samplers, (4) develop and evaluate methods to provide chemical, morphological, and size characterization of individual particles in support of particulate matter and health effects research, and (5) develop and/or review enhanced $PM_{2.5}$ or PM_{10} instruments. An improved version of the FRM will be developed to provide longer periods of unattended operation. This research will also combine an integrated mass measurement device (FRM) with an optical particle counter and/or nephelometer to provide particle size distribution and/or real-time continuous concentration measurements.

ANTICIPATED OUTPUTS:
Demonstration of new chemical speciation instruments for fine PM (FY00), application of new real-time mass & speciation methods on ambient aerosols (FY00 to FY01), and presentations/journal Articles (FY99 to FY01).

Project No. 23

ORGANIZATION:
U.S. Environmental Protection Agency, Office of Research and Development, National Exposure Research Laboratory (EPA-ORD-NERL)

RESEARCH TITLE:
Collaboration on Health Studies

FUNDING LEVEL:
FY98 - $982K & 0.5 FTE (Estimated Project Cost FY98/00 = $1,272K)

CONTACT:
Dr. Roy B. Zweidinger, EPA-ORD-NERL (MD-47)
Research Triangle Park, NC 27711 (P) 919-541-2324, (F) 919-541-3451

RESEARCH ACTIVITY AREA:
Exposure Assessment and Relationships **( )**, Aerosol Methods and Monitoring **(X)**, Emission Characterization and Source Apportionment **( )**, Atmospheric Chemistry and Physics, Meteorology, and Modeling **( )**, Risk Assessment and Management, Cost Benefits **( )**

RESEARCH DESCRIPTION:
NERL is collaborating with the EPA-ORD-National Health and Environmental Effects Research Laboratory (NHEERL) in several areas related to toxicology, clinical studies, and epidemiology. Generally, this involves providing expertise on chemical speciation, PM sampling, and exposure. In addition to these joint research activities, NERL will use the joint epidemiology studies as an opportunity to study total exposure to PM of ambient origin. Both NERL and NHEERL anticipate that their broader programs will be iterative. For example, information from NHEERL on toxic PM species will help guide chemical speciation performed by NERL, and the characterization of particles by NERL will help guide choices of PM species for NHEERL mechanism studies. The NERL is also working with other institutions by providing resources or providing information from research monitoring platforms. These research platforms will either be phased out because the related health studies are completed or they will be supported as part of the National PM Monitoring Network (i.e., speciation sites or supersites).

ANTICIPATED OUTPUTS:
This research will provide (1) analytical expertise, sampling support, and methodology to NHEERL for several ongoing research activities: PM Concentrator studies, Six City PM Epidemiology/Toxicology Coherence Study, and PM samples for toxicological testing; (2) data for investigators of exposure, risk assessment, epidemiology, and modeling studies involving validating/ verifying observations related to fine and coarse PM mass or investigating effects from other potential health indicators, such as daily hourly maximum concentrations, metals, organic carbon, etc.; and (3) exposure monitoring support to short-term, intensive epidemiology/exposure studies aimed at identifying morbidity effects on vulnerable population subgroups.

Project No. 24

ORGANIZATION:
U.S. Environmental Protection Agency, Office of Research and Development, National Exposure Research Laboratory (EPA-ORD-NERL)

RESEARCH TITLE:
Development of Models-3/CMAQ - PM; and Extension to Neighborhood Scales

FUNDING LEVEL: FY98 - $1,707K & 6 FTEs (Estimated Project Cost FY98/00 = $5,471K)

CONTACT:
Dr. Jason Ching, Project Leader, EPA-ORD-NERL (MD-80)
Research Triangle Park, NC 27711, (P) 919-541-4801, (F) 919-541-1379

RESEARCH ACTIVITY AREA:
Exposure Assessment and Relationships **( )**, Aerosol Methods and Monitoring **( )**, Emission Characterization and Source Apportionment **( )**, Atmospheric Chemistry and Physics, Meteorology, and Modeling **(X)**, Risk Assessment and Management, Cost Benefits **( )**

RESEARCH DESCRIPTION:
Currently available, regional-to-urban (and suburban) scale air quality models for particulate matter and aerosols require substantial additional development and evaluation before they will be sufficiently reliable for planning to achieve the new PM NAAQS. Research here will develop and evaluate (operationally and diagnostically) a PM modeling capability within EPA's Models-3 Community Multi-scale Air Quality (CMAQ) modeling system. Included is research on: the interaction of PM with actinic flux calculation schemes, an advanced plume-in-grid modeling treatment for major point sources, techniques for deriving long term averages from short term model runs, treatment of gas-particle transformation of SVOCs, and evaluation through comparison of model results to field observations during the intensives of the Eulerian Model Evaluation Field Study (EMEFS), the Southern Oxidant Study in Nashville, the Southeastern Aerosols Visibility Study, and data from the new PM speciation network being deployed in 1999.
This project will also set up and run Models-3/CMAQ with an added nest at 1.3 km resolution to bring it down from urban to neighborhood scales. Research will prepare emission and meteorology modeling and science algorithms, conduct and perform sensitivity and process analyses to investigate response and contribution of different science process modules to solutions at 1.3km scale, and investigate methods to relate site-monitored data to model outputs at 1.3 km. The candidate approach is to invoke the Principle of Neural Networking and to use data from an existing urban site (such as the PM platform study in the Baltimore area) for the demonstration. Auxiliary studies will be performed including (1) physical modeling of flow and dispersion in street canyon and (2) computational fluid dynamics modeling to relate to outputs from the Models-3/CMAQ to investigate methods to better relate CMAQ for use in human exposure modeling.

ANTICIPATED OUTPUTS:
Models-3/CMAQ-PM developed and preliminarily evaluated against SOS-Nashville and SEAVS databases (FY99). Third public release of CMAQ-PM (FY00). Case studies demonstrating modeling capability at neighborhood scales (FY00 - FY01).

Project No. 25

ORGANIZATION:
U.S. Environmental Protection Agency, Office of Research and Development, National Exposure Research Laboratory (EPA-ORD-NERL)

RESEARCH TITLE:
Source Apportionment

FUNDING LEVEL:
FY98 - $185K & 4 FTEs (Estimated Project Cost FY98/00 = $1,205K)

CONTACT:
Dr. Charles W. Lewis, Science Team Leader and Science Coordinator, EPA-ORD-NERL (MD-47)
Research Triangle Park, NC 27711 (P) 919-541-3154, (F) 919-541-0239

RESEARCH ACTIVITY AREA: Exposure Assessment and Relationships **( )**, Aerosol Methods and Monitoring **( )**, Emission Characterization and Source Apportionment **(X)**, Atmospheric Chemistry and Physics, Meteorology, and Modeling **( )**, Risk Assessment and Management, Cost Benefits **( )**

RESEARCH DESCRIPTION:
This task emphasizes the implementation of source apportionment methodology in its more traditional setting (i.e., to determine the quantitative impact of source emission categories on ambient air concentrations). Specific objectives are to: (1) provide for the laboratory measurement of aerosol chemical species for use in the source apportionment of ambient air, (2) perform receptor modeling (source apportionment) on selected field data sets, and (3) improve existing receptor models. This research combines laboratory chemical analysis (principally, XRF, SEM, and IC) and mathematical receptor modeling. Samples are generally collected in field studies conducted under different tasks. The receptor models used include CMB8, UNMIX, multiple linear regression, etc.

ANTICIPATED OUTPUTS:
Improved receptor models (CMB8, UNMIX) [FY01], Chemical Mass Balance analysis of urban sources of PM to provide an input to a source reconciliation effort using an Eulerian source-based model, and presentations/journal articles (FY99 - FY01).

Project No. 26

ORGANIZATION:
U.S. Environmental Protection Agency, Office of Research and Development, National Exposure Research Laboratory (EPA-ORD-NERL)

RESEARCH TITLE:
Federal Reference and Equivalent Method Program - Development and Quality Assurance

FUNDING LEVEL:
FY98 - $374K & 2 FTEs (Estimated Project Cost FY98/00 = $536K)

CONTACT:
Dr. Russell W. Wiener, Management Coordinator, EPA-ORD-NERL (MD-46)
Research Triangle Park, NC 27711, (P) 919-541-1910, (F) 919-541-1153

RESEARCH ACTIVITY AREA:
Exposure Assessment and Relationships **( )**, Aerosol Methods and Monitoring **(X)**, Emission Characterization and Source Apportionment **( )**, Atmospheric Chemistry and Physics, Meteorology, and Modeling **( )**, Risk Assessment and Management, Cost Benefits **( )**

RESEARCH DESCRIPTION:
The new $PM_{2.5}$ NAAQS required the development of a new FRM for $PM_{2.5}$. Extensive quality assurance methods must be developed to support the data quality objectives for the new NAAQS. This research will evaluate $PM_{2.5}$ Reference Samplers; determine the performance of sequential samplers versus single-filter; examine the impact of filter retrieval and sampler servicing on precision and data quality; determine service requirements for WINS/jet cleaning frequency and the impact of dust collection on the separation efficiency of the impactor; make an empirical determination of each critical experimental error in the FRM measurement process; identify and rank the key factors that affect field performance of the FRM; develop operating and preventive maintenance guidelines for use of these samplers for routine $PM_{2.5}$ monitoring; develop a provisional estimate of the lower limit of detection of the measurement of $PM_{2.5}$ using FRM samplers and develop a provisional estimate of sampler operating precision; conduct off-site evaluations of prototype $PM_{2.5}$ reference samplers; review the installation and operation of the $PM_{2.5}$ FRM samplers at out-of-state field sites operated by state or local technicians; assure that these samplers are operated according to the guidelines developed above, and further refine those guidelines based on feedback from the field operators; incorporate all necessary design and/or operational changes to the FRM sampler, and update the fine particulate regulations (40 CFR 50, Appendix L; 40 CFR 53; and 40 CFR 58); review new applications and develop criteria for Class III designation as required.

ANTICIPATED OUTPUTS:
Preliminary reports - FY00, Final Report - FY01 covering Local and Off-Site Field Evaluations of Prototype and Application Grade $PM_{2.5}$ Reference Samplers, Performance of a Modified Sierra Andersen 246B Inlet, An estimate of the lower limit of detection of the measurement of $PM_{2.5}$ using FRM samplers.

Presentations/Journal Articles - FY99 to FY01 addressing the Development of a new FRM for Fine Particles, Field Evaluation of the FRM, and Quality Assurance Handbook. Draft Section 2.12 of the EPA Quality Assurance Handbook for Air Pollution Measurement Systems (QA Handbook)

Project No. 27

ORGANIZATION:
U.S. Environmental Protection Agency, Office of Research and Development, National Center for Environmental Research and Quality Assurance (EPA-ORD-NCERQA)

RESEARCH TITLE:
Exploratory Research (Grants) for PM related Environmental Characterization and Measurement Methods

FUNDING LEVEL:
FY-1998 - $2, 100K (Estimated Project Cost FY98/00 = $3,600K)

CONTACT:
Deran Pashayan, Assistant Center Director, EPA-ORD-NCERQA (8723R)
Ronald Regan Bldg, 1300 Penn. Ave., Wash, DC 20004 , (P) 202-564-6913, (F) 202-565-2448

RESEARCH ACTIVITY AREA:
Exposure Assessment and Relationships **( )**, Aerosol Methods and Monitoring **(X)**, Emission Characterization and Source Apportionment **( )**, Atmospheric Chemistry and Physics, Meteorology, and Modeling **( )**, Risk Assessment and Management, Cost Benefits **( )**

RESEARCH DESCRIPTION:
13 exploratory research grants addressing the development, testing, and evaluation of measurement methods and instruments for determining the size fractionated composition fine articulate matter; and the application of newly proven techniques to field measurements of important constituents of PM in various regions of the country. The 13 awards cover ongoing work over the FY98-00 time period based on awards made during FY96-98. No new awards are anticipated in this area during FY99-00.
These 13 include:
Kamens, “Partitioning of Semivolatile or Organic Compounds in Organic and Inorganic Aerosols: A Unified Approach”;Johnson, “A Portable Device for Real-Time Measurement of the Size and Composition of Atmospheric Aerosols”;Chameides, “Southern Center for the Integrated Study of Secondary Air Pollutants”; Friedlander, “ Morphological and Chemical Characteristics of the Submicron Atmospheric Aerosol: Implication for Standards”; Wexler, “Real-Time Measurement of the Size and Composition of Atmospheric Particulate Matter”; Prather, “Real-Time Monitoring of Individual Atmospheric Aerosol Particles: Establishing Correlations between Particle Size and Chemical Speciation”;Ondov, “Development of Semi-Continuous Monitor for Determination of Trace Elements and Heavy Metals in Ambient Aerosol Particles”;Koutrakis, “Development and Evaluation of a Novel Sampling Method to Determine the Phase of Semi-Volatile Organic Compounds”;Lippmann, “Development of a Continuous Monitoring System for PM10 and Components of PM2.5";Koutrakis, “Development and Validation of a Novel Technique to Measure Ambient Particle Properties:Bound Water, Mass Density and Mean Diameter”; Dasgupta, “Field-Useable Compact Capillary Based Ion/Liquid Chromatographs. Real-Time Gas/Aerosol Analyzers”;Eatough, “Continuous Measurement of PM2.5 and Associated Semi-Volatile Particulate Species” and Smith, “Real-Time Analysis of PAY Bound to Size-Resolved Atmospheric Particles by Tandem Time of Flight Mass Spectrometers”.

ANTICIPATED OUTPUTS:
New measurement methods to allow the size specific speciation of PM in all ranges of importance to health and atmospheric sciences researchers, and to the regulator and regulated community, needing to identify the types, levels, and trends in ambient PM, and its sources and source regions. These methods directly support the data needs associated with periodic review and implementation of the PM NAAQS.

Project No. 28

ORGANIZATION:
U.S. Environmental Protection Agency, Office of Research and Development, National Center for Environmental Research and Quality Assurance (EPA-ORD-NCERQA)

RESEARCH TITLE:
Exploratory Research (Grants) for PM related Atmospheric Chemistry and Modeling

FUNDING LEVEL:
FY-1998 - $1, 150K (Estimated Project Cost FY98/00 = $2,550K)

CONTACT:
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RESEARCH ACTIVITY AREA:
Exposure Assessment and Relationships **( )**, Aerosol Methods and Monitoring **( )**, Emission Characterization and Source Apportionment **( )**, Atmospheric Chemistry and Physics, Meteorology, and Modeling **(X)**, Risk Assessment and Management, Cost Benefits **( )**

RESEARCH DESCRIPTION:
Six exploratory research grants addressing aspects of secondary aerosol formation, transport, and fate; employing laboratory chemical and physical process and/or producing atmospheric modeling approaches for describing secondary particle dynamics on urban to regional scales. Six awards cover ongoing work over the FY98-00 time period based on awards made during FY96-98. No new awards are anticipated in this area during FY99-00.

These six include:
McNider, “Development of Assimilation Techniques for GOES Satellite Data in Regional Photochemical Modeling”;Mathur, “Modeling Investigation of Nhx Cycling in the Troposphere and its Impact on Particulate Matter and Acidic Substances Budgets”;Miller, “Aerosol Partitioning and Heteorogenous Chemistry”;Cass, “Research Consortium on Ozone and Fine Particulate Formation in California and the Northeastern United States”Ziemann, “Investigations of the Chemistry of Secondary Aerosol Formation Using Thermal Desorption Particle Beam Mass Spectrometry”and Pankow, “A Study of the Gas/Particle Partitioning of Chlorinated Dibenzodioxins (CDDs) and Chlorinated Dibenzofurins (CDFs) to Ambient and Model Aerosol Materials”.

ANTICIPATED OUTPUTS:
Descriptions of the atmospheric processes involved in the formation, transport, and fate of secondary PM to be incorporated into Air Quality Models and used as part of Observational Based Modeling, to project and/or evaluate the impacts of source control measures on area air quality.

Project No. 29

ORGANIZATION:
U.S. Environmental Protection Agency, Office of Research and Development, National Risk Management Research Laboratory (EPA-ORD-NRMRL)

RESEARCH TITLE:
Determine Emission Rates and Chemical and Physical Characteristics of Particles from Indoor and Outdoor Sources

FUNDING LEVEL:
FY-1998 - $1,619K and 18.4 FTE (Estimated Project Cost FY 98/00 = $10,000K)

CONTACT:
W. Gene Tucker, Particle Team Leader, EPA-ORD-NRMRL (MD-54), Research Triangle Park, NC 27711, (E-Mail: tucker.gene@epamail.epa.gov) (P) 919-541-2746, (F) 919-541-5485

RESEARCH ACTIVITY AREA:
Exposure Assessment and Relationships ( ), Aerosol Methods and Monitoring ( ), Emissions Characterization and Source Apportionment (**X**), Atmospheric Chemistry Physics, Meteorology, and Modeling ( ), Risk Assessment and Management, Cost Benefits ( )

RESEARCH DESCRIPTION:
The goal of this research program is to improve the Nation's understanding of the sources which contribute to the fine particle exposures of greatest concern to the health research and regulatory community. Lab and field studies are performed to determine emission rates and physical and chemical characteristics of particles from these sources. Research will be conducted to: (1) develop new or improved emission factors for sources of primary fine particles and ammonia, one of the gaseous precursors of secondary fine particles; (2) develop information on the size distribution and composition of primary particles; (3) generate and chemically characterize source particles to support toxicological research conducted by ORD's National Health and Environmental Effects Research Laboratory (NHEERL); and (4) determine the penetration of outdoor particles into buildings and emissions from indoor sources. Projects underway will generate data on particle emissions from on-road diesel vehicles, wood stoves, fireplaces, and oil- and coal-fired boilers. Other areas of emphasis are validation of instrumentation for measuring the size distribution of emissions from fugitive dust sources, and measuring ammonia emissions from animal waste facilities.

ANTICIPATED RESULTS:
Data on particle size, composition and physical characteristics will be used to support future risk assessments and to improve the source-specific chemical markers used in source-receptor models. The data on emission rates will be translated into improved emissions factors which are used by federal, state, and local officials to prepare detailed emissions inventories. Individual reports and journal articles will be prepared during FY 99-FY01 describing the results of research on the outdoor source categories mentioned above and the studies of indoor penetration rates.

Project No. 30

ORGANIZATION:
U.S. Environmental Protection Agency, Office of Research and Development, National Risk Management Research Laboratory (EPA-ORD-NRMRL)

RESEARCH TITLE:
Evaluate Techniques to Control or Prevent Emissions of Fine Particles

FUNDING LEVEL:
FY-1998 - $300K and 1.5 FTE (Estimated Project Cost FY 98/00 = $2,000K)

CONTACT:
W. Gene Tucker, Particle Team Leader, EPA-ORD-NRMRL (MD-54), Research Triangle Park, NC 27711, (E-Mail: tucker.gene@epamail.epa.gov) (P) 919-541-2746, (F) 919-541-5485

RESEARCH ACTIVITY AREA:
Exposure Assessment and Relationships ( ), Aerosol Methods and Monitoring ( ), Emissions Characterization and Source Apportionment ( ), Atmospheric Chemistry Physics, Meteorology, and Modeling ( ), Risk Assessment and Management, Cost Benefits (**X**)

RESEARCH ACTIVITY AREA:
Existing particle control technologies for combustion systems have limited capability to reduce primary fine particles smaller than 2.5 microns. The overall objective is to determine whether existing technologies can be cost-effectively modified to improve capture efficiency and to evaluate innovative combustion modification or flue gas cleaning approaches. The current focus is on pilot-scale evaluations of improved fabric filters and electrostatic precipitators for industrial and utility boilers. Studies are also underway to determine whether PM technologies can be combined with technologies needed for other pollutants (sorbents for acid gases and produce a technical assessment of technologies currently available to control fine particle emissions. The assessment will evaluate emission reductions that can be achieved using various technology combinations and will provide such information to support policy relevant technology scenarios of interest to the Office of Air and Radiation (OAR).

ANTICIPATED RESULTS:
The results from this research will provide guidance that can be used by sources and federal, state and local officials to assess whether specific technologies or technology combinations are capable of reducing fine particles to required levels. In addition, results from this research will provide insights on unique technology combinations that could be used to optimize air emission reductions from specific source categories. Reports and journal articles will be produced throughout the period with the initial technical assessment of PM technologies in FY-99.

Project No. 31

ORGANIZATION:
Tennessee Valley Authority

RESEARCH TITLE:
Improved understanding of the sources, formation and transport of fine particulate matter in the Tennessee Valley region

FUNDING LEVEL:
FY 1998 - $0.31M; FY 1999 - $0.12M

CONTACT:
Frances P. Weatherford, Acting Manager, Atmospheric Sciences & Environmental Assessments Tennessee Valley Authority, CTR 2Q, Muscle Shoals, AL 35662-1010; telephone: 256-386-2344; fax: 256-386-2126; e-mail: fpweatherford@tva.gov

RESEARCH ACTIVITY:
Emissions Characterization and Source Apportionment

RESEARCH DESCRIPTION:
This research program is funded through TVA's Research & Technology Development Program and is designed to address uncertainties associated with fine particulate matter that are of importance to the utility industry in dealing with control of fine particulate matter and precursor emissions.
A study of the mobile source contribution to fine particulate mass will be conducted. Will use two continuous PM mass monitors: one collocated with a routine fine PM monitor operated as part of TVA's fine particulate matter monitoring network and one located in the same community adjacent to a major interstate highway. The contribution of mobile sources will be inferred from the difference in PM mass and chemistry at the two monitors that capture the same community sources. This will provide information on mobile source contribution that is currently lacking in the TN Valley.

1. A sampler incorporating state-of-the-art collection techniques for semi-volatile aerosol particles has been built under contract with Brigham Young University. The sampler is being operated this summer in the field along with one of the FRM monitors in the TVA network. The data collected will help in determining the contribution of semi-volatile aerosols to fine particulate matter loadings.
2. Chemical Mass Balance (CMB) modeling technique is being applied to historical and recently-collected chemically-speciated samples of PM2.5 in an effort to determine source attribution for PM2.5 in the TN Valley. Information would be of use in determining relative contributions of potential sources of PM2.5 and precursor emissions.
3. A grid modeling system and a single source model are being evaluated for use in particulate matter strategy development. The objective of this work is to optimize ozone/PM control strategies for environmental benefits and control costs.

POLICY PAYOFFS:

1. Improved understanding of the relative contribution of emissions from coal-fired utilities and other sources to atmospheric loadings of PM2.5. This, in turn, will provide information for determining sources and emissions to control that will result in reduce ambient concentrations.
2. Will provide information that will be important in assessing causal agents for health impacts.
3. Will provide information that will be used in state implementation strategy development.

Project No. 32

ORGANIZATION:
Tennessee Valley Authority

RESEARCH TITLE:
Particle Formation in Plumes

FUNDING LEVEL:
FY 1998 - $0.18M; FY 1999 - $0.19M (Jointly funded by TVA, DOE and EPRI)

CONTACT:
Frances P. Weatherford, Acting Manager, Atmospheric Sciences & Environmental Assessments, Tennessee Valley Authority, CTR 2Q, Muscle Shoals, AL 35662-1010; telephone: 256-386-2344; fax: 256-386-2126; e-mail: fpweatherford@tva.gov

RESEARCH ACTIVITY:
Emissions Characterization and Source Apportionment

RESEARCH DESCRIPTION: During the summers of 1998 and 1999, airborne measurements of oxidant precursors and aerosol particles will be made in the plume of a large coal-fired power plant in middle TN. Determination of the relative contributions of primary emissions of fine particles and in-plume production of secondary particulate mass will be made. Comparisons of oxidant formation before and after installation of low-NOx burners will be made as well as an assessment of impacts on the visibility of the plume. Measurements include the gaseous species -- ozone, SO2, NOy species and canister hydrocarbons – and particle sampling for chemical speciation, plume size distributions and particle scattering. In 1999, the study will be done in conjunction with the 1999 Nashville Field Study. This project is cofunded by TVA Research & Technology Development, EPRI and DOE-FETC.

POLICY PAYOFFS:
- Improved understanding of the emissions from coal-fired utilities that contribute to atmospheric loadings of PM2.5. This, in turn, will provide information for determining sources and emissions to control that will result in reduce ambient concentrations.
- Information will be utilized in testing and validation of improved particle formation models.
- Will provide information that will be important in assessing causal agents for health impacts.
- Will provide information that will be used in state implementation strategy development.

Project No. 33

ORGANIZATION:
Tennessee Valley Authority

RESEARCH TITLE:
FRM Monitoring Partnerships and Regional Supersite

FUNDING LEVEL:
FY 1998 - $0.23M; FY 1999 - $0.32M (Jointly funded by TVA, DOE and EPRI)

CONTACT:
Frances P. Weatherford, Acting Manager, Atmospheric Sciences & Environmental Assessments, Tennessee Valley Authority, CTR 2Q, Muscle Shoals, AL 35662-1010; telephone: 256-386-2344; fax: 256-386-2126; e-mail: fpweatherford@tva.gov

RESEARCH ACTIVITY:
Aerosol methods and monitoring

RESEARCH DESCRIPTION:
TVA Fossil & Hydro and the state and local air regulatory agencies in the TN Valley have established a PM2.5 monitoring network in six major urban areas and two rural areas. PM2.5 samples are being collected utilizing the proposed FRM methodology and instrumentation. Mass determinations are made on all filters and a subset is analyzed for species composition (a separate project). The longest running site has been in operation for over a year. In the fall of 1998, a PM2.5 monitoring "supersite" will be established near the Great Smoky Mountains National Park (GSMNP) at Look Rock. This project is jointly funded by TVA Research and Technology Development Program, EPRI and DOE-FETC. Enhanced monitoring of fine particles and related gases will be conducted at this site, beginning in FY 1999. Additional particulate measurements at the nearby Cove Mountain site will begin in the spring 1999 and continue through the ozone season. Research measurements of aerosol physical properties and chemical composition at the Look Rock site will be conducted in the summer 1999 in conjunction with the major Nashville field study. The site will continue operation through 2000.

POLICY PAYOFFS:
- Determination of the ambient levels of PM2.5 in urban and background areas in the TN Valley.
- Will provide advance information on areas in the Valley that could be designated as nonattainment for PM2.5.
- Will provide information that will be used in state implementation strategy development.
- Will provide information on source identification, instrument development and testing, and PM model evaluation and validation.

Project No. 34

ORGANIZATION:
U.S. Air Force, Air Force Research Laboratory, Material Directorate, Airbase and Environmental Technology Division AFRL/MLQ

RESEARCH TITLE:
Particulate Matter Laboratory Analysis and Air Force Particulate Emission Characterization

FUNDING LEVEL:
FY-1998 - $198K
FY-1999 - $263K
FY-2000 - $169K

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RESEARCH ACTIVITY AREA:
Exposure Assessment and Relationships **( )**, Aerosol Methods and Monitoring **( )**, Emission Characterization and Source Apportionment **(X)**, Atmospheric Chemistry and Physics, Meteorology, and Modeling **( )**, Risk Assessment and Management, Cost Benefits **( )**

RESEARCH DESCRIPTION:
The objective of this project is to develop techniques to accurately determine the chemical composition and size distribution of PM generated by Air Force operations. Special emphasis on analysis of source samples from aircraft engine exhaust, diesel engine exhaust, and painting operations. GC/MS/IR analysis will be used to identify individual organic compounds.

ANTICIPATED OUTPUTS:
Detailed chemical composition and size distribution of PM from Air Force emission sources; ambient measurements of PM mass, chemical composition, and size distribution on Air Force bases. Preliminary report - FY00, Final Report - FY02