

H. ANDREW GRAY

EDUCATION

Ph.D. environmental engineering science, California Institute of Technology, Pasadena, California, 1986

M.S. environmental engineering science, California Institute of Technology, Pasadena, California, 1980

B.S. civil engineering/engineering and public policy, Carnegie-Mellon University, Pittsburgh, Pennsylvania, 1979

EXPERIENCE

Dr. H. Andrew Gray has been performing research in air pollution for over 35 years, within academic, governmental, and consulting environments. He has made significant contributions in the areas of airborne particles and visibility, including the development and application of computer-based air quality models. His areas of expertise are air pollution control strategy design and evaluation, computer modeling of the atmosphere (including AERMOD, CALPUFF, CAMx, etc.), characterization of ambient air quality and air pollutant source emissions, aerosol monitoring and modeling, visibility analysis, receptor modeling, statistical data analysis, mathematical programming, numerical methods, and analysis of environmental public policy. Dr. Gray is currently an independent contractor focusing on particulate matter and visibility related research issues. Previous Gray Sky Solutions projects include assessment of Clean Air Act and other regulations on visibility in Class I (park and wilderness) areas, development of air pollution control plans and emission inventories for tribal lands, review and development of guidelines for modeling long-range transport impacts using the CALPUFF model, evaluation of particulate air quality impacts associated with diesel exhaust emissions, air quality management plan modeling protocol review, a critical review of Clean Air Mercury Rule (CAMR) documents, and assessment of the regional air quality impacts of power plant emissions. Dr. Gray has performed dispersion modeling studies to determine the impacts associated with mercury emissions in the Chesapeake Bay region, and has evaluated the air quality, visibility and health impacts of numerous electric generating facilities, industrial sources, and container ship traffic. Recently, Dr. Gray worked with a team of researchers to evaluate the health effects due to coal-fired power plant emissions throughout China. Dr. Gray was invited by the Royal Institute of International Affairs to participate in the “Balancing Global Energy Policy Objectives: A High-Level Roundtable” meeting in April 2014.

Before starting Gray Sky Solutions, Dr. Gray was the manager of the PM₁₀ and Visibility Program at Systems Applications International (SAI / ICF Inc.). At SAI, Dr. Gray conducted and managed a number of varied air pollution research projects. In the early 1990s, Dr. Gray directed a large (over \$1 million) air-quality modeling program to determine the impact of SO₂ emissions from a large coal-fired power plant on Grand Canyon sulfate and visibility levels. He managed projects to develop carbon particle emission data for the Denver area, designed a PM₁₀ monitoring and modeling program for the El Paso area, determined the appropriate tradeoffs between direct PM₁₀ emissions and emissions of PM₁₀ precursors, estimated the visibility effects in federal Class I areas due to the 1990 Clean Air Act Amendments (results of which were incorporated into EPA's 1993 Report to Congress on the expected visibility consequences of the 1990 Clean Air Act Amendments), and provided assistance to EPA Region VIII's tribal air programs. Other projects include emission inventory development for Sacramento and carbon monoxide modeling of Phoenix, Arizona to support federal and regional implementation plans in those regions, systematic evaluation

of the Interagency Workgroup on Air Quality Modeling (IWAQM) recommendations for the use of MESOPUFF II, a critical assessment of exposures to particulate diesel exhaust in California, and an evaluation of PM_{2.5} and PM₁₀ air quality data in support of EPA's review of the federal particulate matter air quality standards. Later projects included a study of micrometeorology and modeling of low wind speed stable conditions in the San Joaquin Valley (CA), an assessment of the reductions in nationwide ambient particulate nitrate exposures due to mobile source NO_x emission reductions, an evaluation of visibility conditions in the Southern Appalachian Mountains region, a review of cotton ginning emission factors, and a critical review and assessment of the PM₁₀ Attainment Demonstration Plan for the San Joaquin Valley. Dr. Gray was a member of the modeling subcommittee of the technical committee of the Grand Canyon Visibility Transport Commission.

Previous to his tenure at SAI, Dr. Gray was responsible for the PM₁₀ and visibility programs at the South Coast Air Quality Management District which involved directing monitoring, analysis, and modeling efforts to support the design of air pollution control strategies for the South Coast Air Basin of California. He developed and applied the methodologies for assessing PM₁₀ concentrations that were used by the District through numerous subsequent air quality management plan revisions. Dr. Gray authored portions of the 1989 Air Quality Management Plan issued by the District that describe the results of modeling and data analyses used to evaluate particulate matter control strategies. Dr. Gray was instrumental in promoting the development and application of state-of-science models for predicting particulate matter concentrations. His responsibilities included direction and oversight of numerous aerosol-related contracts, including development of the SEQUILIB and SAFER models, construction of an ammonia emission database, and development of sulfate, nitrate and organic chemical mechanisms. In addition, Dr. Gray was responsible for initiating the District's visibility control program.

In research performed at the California Institute of Technology, Dr. Gray studied control of atmospheric fine primary carbon particle concentrations and performed computer programming tasks for acquisition and analysis of real-time experimental data. He designed, constructed, and operated the first long-term fine particle monitoring network in Southern California in the early 1980s. He also developed and applied deterministic models to predict source contributions to fine primary carbon particle concentrations and constructed objective optimization procedures for control strategy design. In research carried out for the Department of Mechanical Engineering at Carnegie-Mellon University, Dr. Gray developed fuel use data for input to an emission simulation model for the northeastern United States.

Specialized Professional Competence

- Air pollution control strategy design
- Atmospheric air quality characterization
- Aerosols and visibility
- Computer modeling and data analysis
- Dispersion modeling for particulate matter and visibility

- Receptor modeling including Chemical Mass Balance (CMB) and factor analysis
- Analysis of environmental public policy

Professional Experience

- Systems Applications International (SAI/ICF)—PM₁₀ and visibility program manager—participated in and managed numerous air quality modeling and analysis projects for public and private sector clients, with emphasis on particulate matter and visibility research
- South Coast Air Quality Management District, El Monte, California—air quality specialist—developed and applied air quality modeling analyses to support air pollution control strategy design for the South Coast Air Basin of California
- California Institute of Technology, Pasadena, California—research assistant—Ph.D. candidate in environmental engineering science. Thesis: Control of atmospheric fine primary carbon particle concentrations (thesis advisors: Dr. Glen Cass, Dr. John Seinfeld, and Dr. Richard Flagan)
- California Institute of Technology, Pasadena, California—laboratory assistant—performed computer programming tasks for acquisition and analysis of real-time experimental data
- Department of Mechanical Engineering, Carnegie-Mellon University, Pittsburgh, Pennsylvania—research assistant—developed fuel use data for an emissions simulation model for the northeastern United States. Grant from the U.S. Department of Energy for evaluation of national energy policy
- Department of Civil Engineering, Carnegie-Mellon University, Pittsburgh, Pennsylvania—consultant—analyzed structural retrofit design for Ferrari Dino import automobile for United States five mph crash test

HONORS AND AWARDS

Harold Allen Thomas Scholarship Award, Carnegie-Mellon University

University Honors, Carnegie-Mellon University

PROFESSIONAL AFFILIATIONS

Air and Waste Management Association

American Association for Aerosol Research

SELECTED PUBLICATIONS AND PRESENTATIONS

The Deposition of Airborne Mercury within the Chesapeake Bay Region from Coal-fired Power Plant Emission in Pennsylvania, in press (2012)

Peer Review of the Interagency Workgroup On Air Quality Modeling Phase 2 Summary Report And Recommendations For Modeling Long Range Transport Impacts (with others), Report compiled by: John S. Irwin, Air Policy Support Branch, Atmospheric Sciences Modeling Division, U.S. Environmental Protection Agency Research Triangle Park, NC 27711 (1999)

Source Contributions to Atmospheric Fine Carbon Particle Concentrations (with G.R. Cass), *Atmospheric Environment*, 32:3805-3825 (1998)

“Monitoring and Analysis of the Surface Layer at Low Wind Speeds in Stable PBL’s in the Southern San Joaquin Valley of California” (with others), presented at the American Meteorological Society’s 12th Symposium on Boundary Layers and Turbulence, Vancouver, British Columbia (July 1997)

“Estimation of Current and Future Year NO_x to Nitrate Conversion for Various Regions of the United States” (with A. Kuklin), presented at the 90th Meeting of the Air and Waste Management Association, Toronto, Ontario (June 1997)

Integrated Monitoring Study (IMS) 1995: Characterization of Micrometeorological Phenomena: Mixing and Diffusion in Low Wind Speed Stable Conditions: Study Design and Preliminary Results (with others), in *Measurement of Toxic and Related Air Pollutants*, Air and Waste Management Association, Pittsburgh, Pennsylvania, pp. 484-500 (1996)

Regional Emissions and Atmospheric Concentrations of Diesel Engine Particulate Matter: Los Angeles as a Case Study (with G.R. Cass), in *Diesel Exhaust: A Critical Analysis of Emissions, Exposure, and Health Effects*, Health Effects Institute, Cambridge, Massachusetts, pp. 125-137 (1995)

“Assessment of the Effects of the 1990 Clean Air Act Amendments on Visibility in Class I Areas”, presented at the 86th Annual Meeting & Exhibition of the Air and Waste Management Association, Denver, Colorado (June 1993)

“Source Contributions to Atmospheric Carbon Particle Concentrations” (with others), presented at the Southern California Air Quality Study Data Analysis Conference, Los Angeles, California (July 1992)

“Modeling Wintertime Sulfate Production in the Southwestern United States” (with M. Ligoeki), presented at the AWMA/EPA International Specialty Conference on PM₁₀ Standards and Nontraditional Particulate Source Controls, Scottsdale, Arizona (January 1992)

“Deterministic Modeling for the Navajo Generating Station Visibility Impairment Study: An Overview,” presented at the 84th Meeting of the Air and Waste Management Association, Vancouver, British Columbia (June 1991)

“Receptor and Dispersion Modeling of Aluminum Smelter Contributions to Elevated PM10 Concentrations” (with R. G. Ireson and A. B. Hudischewskyj), presented at the 84th Meeting of the Air and Waste Management Association, Vancouver, British Columbia (June 1991)

Visibility and PM-10 in the South Coast Air Basin of California (with J.C. Marlia), in *Visibility and Fine Particles*, Air and Waste Management Association, Pittsburgh, Pennsylvania, pp. 468-477 (1990)

Chemical characteristics of PM10 aerosols collected in the Los Angeles area (with others), *J. Air Pollut. Control Assoc.*, 39:154-163 (1989)

Atmospheric carbon particles and the Los Angeles visibility problem (with others), *Aerosol Sci. Technol.*, 10:118-130 (1989)

Receptor modeling for PM10 source apportionment in the South Coast Air Basin of California (with others), in *PM-10: Implementation of Standards*, Air Pollution Control Association, Pittsburgh, Pennsylvania, pp. 399-418 (1988)

Optimization of PM10 control strategy in the South Coast Air Basin (with others), in *PM-10: Implementation of Standards*, Air Pollution Control Association, Pittsburgh, Pennsylvania, pp. 589-600 (1988)

Quantitative high-resolution gas chromatography and high-resolution gas chromatography/mass spectrometry analyses of carbonaceous fine aerosol particles (with others), *Int. J. Environ. Anal. Chem.*, 29:119-139 (1987)

“Development of an Objective Ozone Forecast Model for the South Coast Air Basin” (with others), presented at the 80th Meeting of the Air Pollution Control Association, New York (June 1987)

“PM10 Modeling in the South Coast Air Basin of California” (with others), presented at the 79th Annual Meeting of the Air Pollution Control Association, Minneapolis, Minnesota (1986)

Characteristics of atmospheric organic and elemental carbon particle concentrations in Los Angeles (with others), *Environ. Sci. Technol.*, 20:580-589 (1986)

“Chemical Speciation of Extractable Organic Matter in the Fine Aerosol Fraction” (with others), presented at the 1984 International Chemical Congress of Pacific Basin Societies, Honolulu, Hawaii (1984)

“Source Contributions to Atmospheric Carbon Particle Concentrations” (with others), presented at the First International Aerosol Conference, Minneapolis, Minnesota (1984)

Elemental and organic carbon particle concentrations: A long term perspective (with others), *Sci. Total Environ.*, 36:17-25 (1984)

“Meteorological and Chemical Potential for Oxidant Formation” (with others), presented at the Conference on Air Quality Trends in the South Coast Air Basin, California Institute of Technology, Pasadena, California (1980)

Containing recombinant DNA: How to reduce the risk of escape (with others), *Nature*, 281:421-423 (1979)

OTHER PUBLICATIONS

“Visibility and Health Modeling: Technical Support Document to Comments of Conservation Organizations; EPA’s Proposed Promulgation of Air Quality Implementation Plans, State of Texas; Regional Haze and Interstate Visibility Transport Federal Implementation Plan, 82 Fed. Reg. 912 (proposed Jan. 4, 2017), EPA Docket No. EPA-R06-2016-0611; FRL-995-77-Region 6”, prepared on behalf of the National Parks Conservancy Association, Washington, DC (2016)

“Visibility and Health Modeling: Technical Support Document to Comments of Conservation Organizations; EPA’s Proposed Partial Approval and Partial Disapproval of Texas Regional Haze State Implementation Plan, Partial Disapproval of Oklahoma’s State Implementation Plan, and Proposed Federal Implementation Plans for Texas and Oklahoma for the First Planning Period of 2008 through 2018”, prepared on behalf of the Sierra Club, San Francisco, CA (2016).

“Comments on EPA’s Co-Proposal for the State of Utah’s Regional Haze State Implementation Plan (Docket ID No. EPA-R08-OAR-2015-0463)”, prepared on behalf of the Sierra Club, San Francisco, CA (2016).

“Evaluation of MDEQ’s May 31, 2016 Proposed Sulfur Dioxide One-Hour National Ambient Air Quality Standard State Implementation Plan”, prepared on behalf of Sierra Club, San Francisco, CA (2016)

“Sierra Club v. Union Electric Co., dba Ameren Missouri U.S. District Court for the Eastern District of Missouri, Case No. 14-cv-00408”, prepared on behalf of Sierra Club, San Francisco, CA (2016)

“Comments on MDEQ’s Proposed Sulfur Dioxide One-Hour National Ambient Air Quality Standard State Implementation Plan (dated August 20, 2015)”, expert report prepared on behalf of Sierra Club, San Francisco, CA (2015)

“Natural Resources Defense Council, Inc., Sierra Club, Inc., and Respiratory Health Association (Plaintiffs) v. Illinois Power Resources, LLC and Illinois Power Resources Generating, LLC (Defendants)”, expert report prepared on behalf of Natural Resources Defense Council (2015)

“Visibility Modeling: Technical Support Document to Comments of Conservation Organizations; EPA’s Proposed Federal Implementation Plan for Arkansas for the First Planning Period of 2008 through 2018”, prepared on behalf of Sierra Club, San Francisco, CA and National Parks Conservancy Association, Washington, DC (2015)

Modeling the Visibility Impacts at Class I Areas due to Emissions from the Hunter, Huntington, and Carbon Power Plants, prepared on behalf of the National Parks Conservancy Association, Washington, DC (2015)

“Visibility and Health Modeling: Technical Support Document to Comments of Conservation Organizations; EPA’s Proposed Partial Approval and Partial Disapproval of Texas Regional Haze State Implementation Plan, Partial Disapproval of Oklahoma’s State Implementation Plan, and Proposed Federal Implementation Plans for Texas and Oklahoma for the First Planning Period of 2008 through 2018, prepared on behalf of the National Parks Conservancy Association, Washington, DC (2015)

“Modeling of SO₂ Sources in the Wayne County Non-Attainment Area”, prepared on behalf of Sierra Club, San Francisco, CA (2015)

“The Role of the Regional Haze Rule in Restoring Clean Air at National Parks and Wilderness Areas: Exploring the Impact of Regulatory Interaction on Power Plant Emissions and Visibility in Class I Areas”, report prepared (with others) on behalf of the National Parks Conservancy Association, Washington, DC (2015)

“Review of Illinois 2014 SO₂ Ambient Air Monitoring Network”, prepared on behalf of Sierra Club, San Francisco, CA (2015)

“Review of Missouri’s 2014 SO₂ Ambient Air Monitoring Network”, prepared on behalf of Sierra Club, San Francisco, CA (2014)

“Review of Michigan’s 2014 SO₂ Ambient Air Monitoring Network”, prepared on behalf of Sierra Club, San Francisco, CA (2014)

“Atmospheric Dispersion Modeling of Coal-Fired Power Plant Emissions in China”, prepared on behalf of Greenpeace International (2013)

“Modeling the Air Quality Impacts of Shipping Emissions”, prepared on behalf of Kelley Drye and Warren (2012)

“Cypress Creek Power Plant Modeling: Pollutant Deposition to the Chesapeake Bay and Sensitive Watersheds within the Commonwealth of Virginia,” prepared on behalf of the Chesapeake Bay Foundation, Annapolis, MD (2009)

“Virginia City Power Plant Modeling,” prepared on behalf of the Chesapeake Bay Foundation, Annapolis, MD (2008)

“Chesterfield Power Plant Modeling,” prepared on behalf of the Chesapeake Bay Foundation, Annapolis, MD (2008)

“The Deposition of Airborne Mercury in Pennsylvania,” prepared on behalf of the Chesapeake Bay Foundation, Annapolis, MD (2007)

“The Deposition of Airborne Mercury in Virginia,” prepared on behalf of the Chesapeake Bay Foundation, Annapolis, MD (2007)

“Pollutant Deposition from Maryland Sources,” prepared on behalf of the Chesapeake Bay Foundation, Annapolis, MD (2006)

“Air Quality Modeling and Visibility Impacts Associated with Sammis Power Plant Emissions,” prepared on behalf of the United States of America, Washington, D.C. (2003)

“Air Quality Modeling and Visibility Impacts Associated with Baldwin Power Plant Emissions,” prepared on behalf of the United States of America, Washington, D.C. (2002)

“Assessment of the Impacts of Clean Air Act and Other Provisions on Visibility in Class I Areas” (with others), prepared for American Petroleum Institute, Washington, D.C. (1998)

“California Regional PM₁₀ Air Quality Study: 1995 Integrated Monitoring Study Data Analysis: Time and Length Scales for Mixing Secondary Aerosols During Stagnation Periods” (with others), prepared for California Air Resources Board, Sacramento (1997)

“San Joaquin Valley Regional PM10 Study: *Characterizing Micrometeorological Phenomena: Mixing and Diffusion in Low Wind Speed Conditions Phase III: Monitoring and Data Analysis*” (with others), prepared for California Air Resources Board, Sacramento (1997)

“Cotton Gin Particulate Emission Factors,” prepared for U.S. Environmental Protection Agency, Region VIII, San Francisco, California (1997)

“Benefits of Mobile Source NO_x Related Particulate Matter Reductions” (with A. Kuklin), SYSAPP-96/61, prepared for Office of Mobile Sources, U.S. Environmental Protection Agency, Ann Arbor, Michigan (1996)

“Evaluation of Existing Information on the Effects of Air Pollutants on Visibility in the Southern Appalachians” (with D. Kleinhesselink), SYSAPP-96-95/060, prepared for Southern Appalachian Mountains Initiative, Asheville, North Carolina (1996)

“Statistical Support for the Particulate Matter NAAQS” (with others), SYSAPP-96-95/039, prepared for Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina (1996)

“San Joaquin Valley Regional PM10 Study Support Study 5A: *Characterizing Micrometeorological Phenomena: Mixing and Diffusion in Low Wind Speed Conditions Phase II: Detailed Recommendations for Experimental Plans*” (with others), prepared for California Air Resources Board, Sacramento (1995)

“San Joaquin Valley Regional PM10 Study Support Study 5A: *Characterizing Micrometeorological Phenomena: Mixing and Diffusion in Low Wind Speed Conditions Phase I: Literature Review and Draft Program Recommendations*” (with others), prepared for California Air Resources Board, Sacramento (1995)

“Class I Grouping for Subsequent Assessment of Regional Haze Rules” (with others), SYSAPP-94/129, prepared for Air Quality Strategies and Standards Division, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina (1994)

“Retrospective Analysis of the Impact of the Clean Air Act on Urban Visibility in the Southwestern United States” (with C. Emery and T.E. Stoeckenius), SYSAPP-94/108, prepared for Office of Policy Analysis and Review, Office of Air and Radiation, U.S. Environmental Protection Agency, Washington, D.C. (1994)

“Evaluation of Ambient Species Profiles, Ambient Versus Modeled NMHC:NO_x and CO:NO_x Ratios, and Source-Receptor Analyses” (with G. Yarwood, M. Ligocki, and G. Whitten), SYSAPP-94/081, prepared for Office of Mobile Sources, U.S. Environmental Protection Agency, Ann Arbor, Michigan (1994)

“Diesel Particulate Matter in California: Exposure Assessment” (with M. Ligocki and A. Rosenbaum), SYSAPP-94/077, prepared for Engine Manufacturers Association, Chicago, Illinois (1994)

“Interagency Workgroup on Air Quality Modeling (IWAQM): Assessment of Phase I Recommendations Regarding the Use of MESOPUFF II” (with M. Ligocki and C. Emery), SYSAPP-94/030, prepared for Source Receptor and Analysis Branch, Technical Services Division, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina (1994)

“Analysis of the 1991-1992 Pine Bend Monitoring Data” (with others), SYSAPP-94/007, prepared for Minnesota Pollution Control Agency, St. Paul, Minnesota (1994)

“Assessment of the Effects of the 1990 Clean Air Act Amendments on Visibility in Class I Areas” (with others), SYSAPP-93/162, prepared for Ambient Standards Branch, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina (1994)

“Revised Base Case and Demonstration of Attainment for Carbon Monoxide for Maricopa County, Arizona” (with others), SYSAPP-94-93/156s, prepared for Maricopa Association of Governments, Phoenix, Arizona (1994)

“Sacramento FIP 2005 Modeling Inventory” (with others), SYSAPP-93/237, prepared for Pacific Environmental Services, North Carolina, and U.S. Environmental Protection Agency, Region IX, San Francisco, California (1993)

“Carbon Monoxide Modeling in Support of the 1993 State Implementation Plan for Maricopa County, Arizona” (with others), SYSAPP-93/156, prepared for Maricopa Association of Governments, Phoenix, Arizona (1993)

“Air Quality Modeling of Carbon Monoxide Concentrations in Support of the Federal Implementation Plan for Phoenix, Arizona” (with others), SYSAPP-93/039, prepared for Pacific Environmental Services, North Carolina, and U.S. Environmental Protection Agency, Region IX, San Francisco, California (1993)

“Base Case Carbon Monoxide Emission Inventory Development for Maricopa County, Arizona” (with others), SYSAPP-93/077, prepared for Maricopa Association of Governments, Phoenix, Arizona (1993)

“Sacramento FIP Modeling 3: Future Emissions Inventory” (with others), SYSAPP-93/036, prepared for Pacific Environmental Services, Inc., North Carolina and U.S. Environmental Protection Agency, San Francisco (1993)

“Emissions Inventory Development for the Tribal Air Program” (with M. Causley and S. Reid), SYSAPP-92/146, prepared for U.S. Environmental Protection Agency, Region VIII, Denver, Colorado (1992)

“Carbon Particle Emissions Inventory for Denver Brown Cloud II: Development and Assessment” (with S. B. Reid and L. R. Chinkin), prepared for Colorado Department of Health, Denver, Colorado (1992)

“Analysis to Determine the Appropriate Trade-off Ratios Between NO_x, SO_x, and PM₁₀ Emissions for the Shell Martinez Refinery” (with M. Ligocki), SYSAPP-92/006, prepared for Shell Oil Co., Martinez, California (1992)

“Modeling Program for PM-10 State Implementation Plan Development for the El Paso/Ciudad Juarez Airshed” (with C. Emery and M. Ligoeki), SYSAPP-91/134, prepared for U.S. Environmental Protection Agency, Dallas Texas (1991)

“Deterministic Modeling for Navajo Generating Station Visibility Study. Volume I. Technical Report” (with others), SYSAPP-91/045a, prepared for Salt River Project, Phoenix, Arizona (1991)

“Deterministic Modeling in the Navajo Generating Station Visibility Study” (with others), SYSAPP-91/004, prepared for Salt River Project, Phoenix, Arizona (1991)

“Analysis of Contributions to PM10 Concentrations During Episodic Conditions” (with A. B. Hudischewskyj and R. G. Ireson), SYSAPP-90/072, prepared for Kaiser Aluminum and Chemical Corporation (1990)

“Preparation of Elemental and Organic Carbon Particle Emission Inventories for the Denver Area: Work Plan” (with L. R. Chinkin), SYSAPP-90/068, prepared for Colorado Department of Health (1990)

“Evaluation of Control Strategies for PM10 Concentrations in the South Coast Air Basin,” Air Quality Management Plan: 1988 Revision, Appendix V-O. South Coast Air Quality Management District, El Monte, California (1988)

“Annual PM10 Dispersion Model Development and Application in the South Coast Air Basin,” Air Quality Management Plan: 1988 Revision, Appendix V-L. South Coast Air Quality Management District, El Monte, California (1988)

“PM10 Modeling Approach” (with others), 1987 AQMP Revision Working Paper No. 2, South Coast Air Quality Management District, El Monte, California (1986)

“Workplan for Air Quality Modeling and Analysis,” 1987 AQMP Revision Working Paper No. 5, Planning Division, South Coast Air Quality Management District, El Monte, California (1986)

“Control of Atmospheric Fine Primary Carbon Particle Concentrations,” (EQL report No. 23), Ph.D. thesis, California Institute of Technology, Pasadena, California (1986)

“Policy on Recombinant DNA Activities: Relaxing Guidelines While Increasing Safety,” project report, Department of Engineering and Public Policy, Carnegie-Mellon University, Pittsburgh, Pennsylvania (1978)

“Air Pollution Control Analyses for State Implementation Plan Revisions in Allegheny County,” project report, Department of Engineering and Public Policy, Carnegie-Mellon University, Pittsburgh, Pennsylvania (1978)

EMPLOYMENT HISTORY

Systems Applications International	Manager, PM ₁₀ and Visibility Program	1989–1997
South Coast Air Quality Management District	Air Quality Specialist	1985–1989
California Institute of Technology, Pasadena, California	Research Assistant Laboratory Assistant	1979–1985 1979
Carnegie-Mellon University, Dept. of Mechanical Engineering Pittsburgh, Pennsylvania	Research Assistant	1978–1979