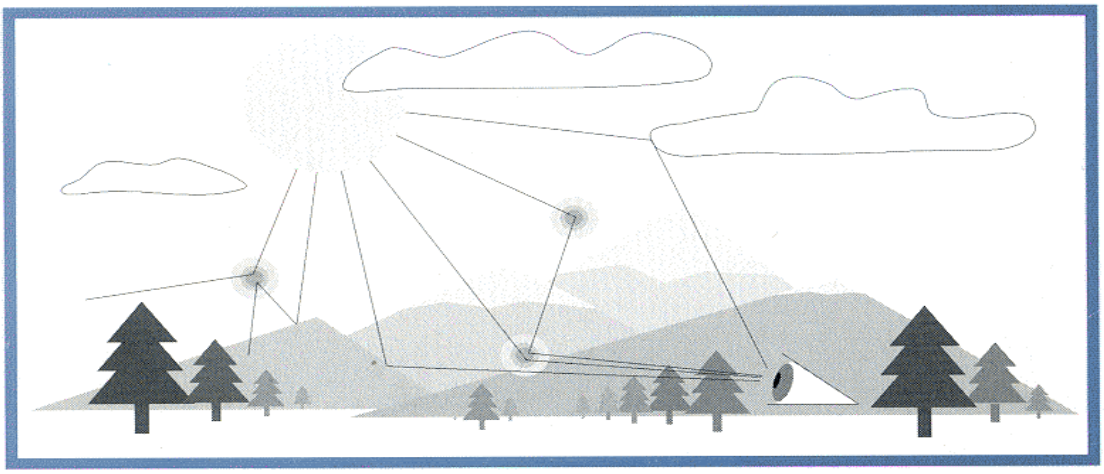
Aerosols and Atmospheric Optics:

Radiative Balance and Visual Air Quality

Volume A



CELEBRATING 75 YEARS OF LEADERSHIP
75
1919-1994
AGU

AIR & WASTE MANAGEMENT
ASSOCIATION

SINCE 1907

ProceedingsoftheInternationalSpecialtyConference

AEROSOLS AND ATMOSPHERIC OPTICS:

Radiative Balance and Visual Air Quality

Jointly sponsored by

Air & Waste Management Association
and
American Geophysical Union

Hosted by

A&WMA Great Basin Chapter
Rocky Mountain States Section

VIP-41

Aerosols and Atmospheric Optics: Radiative Balance and Visual Air Quality

Proceedings of the International Specialty Conference
Snowbird, Utah, USA
September 26-30, 1994

Publication Policy

This publication contains technical papers published essentially as they were presented at a recent international specialty conference, which was jointly sponsored by the Air & Waste Management Association and the American Geophysical Union. The papers have not been subject to the editorial review procedures of the co-sponsors, and opinions expressed therein are not to be interpreted as having the endorsement or support of the co-sponsors.

Copies of this two volume set are available to Air & Waste Management Association members for $65 (others $90). For a complete publications listing, contact the Order Fulfillment Clerk, A&WMA, One Gateway Center, Third Floor, Pittsburgh, PA 15222, phone (412) 232-3444, fax (412) 232-3450.

Contents

Session 1B: Regional and Spatial Patterns
Peter H. McMurry, Session Chair

Session 1C: Part I - Determination of Optical Depth or Albedo
L. Willard Richards, Session Chair

Session 1D: Part II - Determination of Optical Depth or Albedo
Antony D. Clarke, Session Chair

Topic 2. Atmospheric Optics
Warren H. White and Graeme L. Stephens, Topic Co-Chairs

Session 2A: Climate and Aerosols
Warren H. White, Session Chair

Session 2B: Visibility and Extinction
Edward S. Macias, Session Chair

Session 2C: Radiative Transfer
Kirk A. Fuller, Session Chair

Topic 3. Atmospheric Aerosols
Barry L. Huebert and Sonia M. Kreidenweis, Topic Co-Chairs

Session 3A: Hygroscopic Aerosols
Barry L. Huebert, Session Chair

Session 3B: Sulfate Aerosols
Sonia M. Kreidenweis, Session Chair

Topic 6. Atmospheric Science as Applied to Societal Issues

Steven L. Rhodes and Ronald C. Henry, Topic Co-Chairs

Posters

1E: Instrumentation (gas; gas and particle)

1F: Instrumentation (particle)

1G: Instrumentation (optical properties)

1H: Measurement Summaries

2C: Radiative Transfer

3A: Hygroscopic Aerosols

3B: Sulfate Aerosols

3C: Organic Aerosols

4A: Chemistry and Physics of Single Particles

4B: Aerosol-Cloud Interactions

5A: Source Receptor Relationships

5B: Roles of Emissions, Transport, and Transformation on Visibility in the Southwest

Acknowledgments

The following organizations have provided financial support to the conference:

Brigham Young University

Electric Power Research Institute

Geneva Steel

Southern California Edison

PacifiCorp

USDI - National Park Service

U.S. Department of Energy

USDI - Forest Service

International Science Foundation

Appreciation is expressed to Becky Armstrong,
Natalie Lucero, and Tamary Shoemaker
for their assistance in preparing
the abstract book and conference proceedings.

Printing of the proceedings books was provided courtesy of Southern California Edison
is gratefully acknowledged.

Conference Committees

Technical Program Co-Chairs
William C. Malm, USDI - National Park Service
Peter K. Mueller, EPRI

General Conference Chair
Delbert J. Eatough, Brigham Young University

Exhibition Chair
Joseph A. Martone, CH2M Hill

Technical Program Committee
Scott Archer, USDI - Bureau of Land Management
Prem Bhardwaja, Salt River Project
Ronald C. Henry, University of Southern California
Helmuth Horvath, Institut für Experimentalphysik der Universität Wien
Sonia M. Kreidenweis, Colorado State University
Peter H. McMurry, University of Minnesota
Roger A. Pielke, Colorado State University
Marc L. Pitchford, NOAA/U.S. EPA
Steven L. Rhodes, NCAR
L. Willard Richards, Sonoma Technologies, Inc.
Graeme L. Stephens, Colorado State University
John G. Watson, Desert Research Institute
Warren H. White, Washington University

Local Arrangements Comniittee
Judie Eatough, Brigham Young University
Nolan F. Mangelson, Brigham Young University
David W. Mills, PacifiCorp
Tamary Shoemaker, Brigham Young University
LaRell K. Smith, Brighain Young University

Visibility Committee (AB-6)
Warren White, Chair
Chuck McDade, Vice Chair
Robert Farber, Secretary

Topic Chairs

1. Field Observations
Peter H. McMurry
L. Willard Richards

2. Atmospheric Optics
Warren H. White
Graeme L. Stephens

3. Atmospheric Aerosols
Barry L. Huebert
Sonia M. Kreidenweis

4. Joint Session Between Optics and Aerosols
Sonia M. Kreidenweis
K. A. Fuller

5. Atmospheric Dynamics
John G. Watson
Roger A. Pielke

6. Atmospheric Science as Applied to Societal Issues
Steven L. Rhodes
Ronald C. Henry

Particulate Committee (AB-1)
Steve Heisler, Chair
Delbert Eatough, Vice Chair and Secretary

Great Basin Chapter
Joseph Martone, Chair
David W. Mills, Vice Chair
Howard Saxion, Secretary
Paul Scott, Treasurer

Rocky Mountain States Section
Sharleen Pendergrass, Chair
David Holstein, Vice Chair
Jennifer Grinspoon, Secretary
David Gaige, Treasurer
W. Gale Biggs, Membership

List of Exhibitors

Air Resource Specialists, Inc. (Fort Collins, CO)
Professional consulting and support services in air quality monitoring, modeling and analysis.

ENSR Consulting & Engineering (Camarillo, CA)
Advanced atmospheric modeling and field research studies. Display involved operating IBM RISC-6000 workstation.

Rupprecht & Patashnick Co, Inc. (Albany, NY)
TEOM Series 1400A Ambient Particulate Monitor and Partisol Model 2000 Air Sampler, both for measurement of PM-10, 2.5 & TSP. Both are U.S. EPA approved. Also, the 5400 Atmospheric Carbon Particulate Monitor.

TSI Incorporated, Particle Instrument Division (St Paul, MN)
New high-sensitivity integrating nephelometer, condensation particle counters, and particle shape analyzer for atmospheric aerosol measurement and climate research.

URG Corporation (Carrboro, NC)
Outdoor/indoor ambient air sampling instruments for acid aerosols (2.5 μm cut), organic and inorganic. Versatile air pollutant sampler (10 μm cut and 2.5 μm cut). Annular denuders, sampling pumps, filter packs, cyclones.

PREFACE

The conference proceedings is meant to be a complete record of the papers presented; however, the papers have not been peer reviewed. In some cases, the proceedings include complete draft manuscripts; in other cases, only an extended abstract and the visuals used at the conference are presented. The table of contents is a road map not only to the conference proceedings, but also to the order in which the papers were presented.

For those authors that chose to publish their papers in a peer-reviewed journal format, arrangements were made with the Air & Waste Management Association and the American Geophysical Union for publication in special editions of their respective journals: Journal of Air & Waste Management Association and Journal of Geophysical Research. The technical co-chairs were appointed as guest editors for these journals.

The conference was organized around the interaction of radiation with aerosols and the resulting effect on visibility and global climate. Visibility has been of concern for many years, especially to the military where the ability to see a target was of vital importance. However, visibility in terms of the ability to clearly see landscapes and urban features has evolved as a critical issue in recent years. Every three to four years beginning in 1981, a visibility specialty conference has focused on issues pertaining to understanding how natural and manmade emissions impair our ability to see and appreciate the environment around us. These conferences have not only addressed the interaction of light with the atmosphere, but have also addressed the chemistry and physics of aerosol transport, transformation, and deposition. Because visibility involves the "seeing" and appreciating of urban or rural "vistas," a portion of the conferences have always focused on the perceptual nature of the interaction between the human visual system and the visual environment, as well as on the value the human observer places on good visibility.

[NOTE: APCA sponsored an earlier Visibility Speciality Conference "View on Visibility – Regulatory and Scientific" in Denver, Colorado, on November 26-27, 1979]

More recently, global climate change has emerged as a societal concern. The role of aerosols on radiative balance and hence its effect on climate change is now recognized as an important area of global climate research. Radiative balance requires an understanding of how electromagnetic energy, including visible radiation or light, interacts with the atmosphere. As in the field of visibility, it is necessary to understand how particles and gases are formed and transported as a function of meteorology and emissions, and how these constituents absorb and scatter or redirect radiation from the incident direction.

Because research on visibility and global climate change have evolved somewhat independently of each other, scientists in their respective communities, although aware of one another's work, have not consistently had the opportunity to exchange information on a detailed level. It was felt that a forum was needed to facilitate the open exchange of ideas and research results involving scientists from both fields. Therefore, a conference was organized around the general topics of aerosols and atmospheric optics as they relate to radiative balance and visual air quality.

The resulting International Specialty Conference, "Aerosols and Atmospheric Optics: Radiative Balance and Visual Air Quality," was held September 26-30, 1994 at Snowbird, Utah, and was cosponsored by the Air & Waste Management Association and the American Geophysical Union. Snowbird, nestled high in the Wasatch Mountain Range, was an ideal location to report on the relationships between aerosols and atmospheric optics. The conference Technical Program Co-chairs were William C. Malm of the USDI-National Park Service and Peter K. Mueller of the

Electric Power and Research Institute, while the Program Chair was Delbert J. Eatough of Brigham Young University. More than 150 papers were submitted to the conference, with approximately 125 papers presented.

The conference was unique because it brought together scientists from many nations. Russia was well represented, with eight scientists and nine papers. Other countries and their representation were as follows: Canada, with four scientists and five papers; Australia, with two scientists and two papers; Estonia, with one scientist and one paper; Germany, with one scientist and one paper; Austria, with one scientist and one paper; England, with one scientist and two papers; Iran, with one scientist and one paper; The Netherlands, with two scientists and two papers; Italy, with one scientist and two papers; and Mexico, with four scientists present.

The conference was organized to cover five primary topics, each supported by sessions on key aspects and with an overview lecture by knowledgeable scientists in their respective areas. The topics were to be fundamental to the interests of both the visibility and global climate communities. The conference topics evolved into six major topics: 1) Field Observations, with Topic Co-chairs Peter H. McMurry and L. Willard Richards, and Session Chairs Peter K. Mueller, Peter H. McMurry, L. Willard Richards, and Antony D. Clarke; 2) Atmospheric Optics, with Topic Co-chairs Warren H. White and Graeme L. Stephens, and Session Chairs Warren H. White, Edward S. Macias, and Kirk A. Fuller; 3) Atmospheric Aerosols, with Topic Co-chairs Barry L. Huebert and Sonia M. Kreidenweis, and Session Chairs Barry L. Huebert and Sonia M. Kreidenweis; 4) a Joint Session between Optics and Aerosols, with Topic Co-chairs Sonia M. Kreidenweis and Kirk A. Fuller, and Session Chairs Kirk A. Fuller and Cynthia Twohy; 5) Atmospheric Dynamics, with Topic Co-chairs John G. Watson and Roger A. Pielke, and Session Chairs Judith C. Chow, Mark C. Green, and Christian Seigneur; and 6) Atmospheric Science as Applied to Societal Issues, with Topic Co-chairs Steven L. Rhodes and Ronald C. Henry, and Session Chair Ronald C. Henry. Papers in all sessions were presented in platform or poster format.

State-of-the-science lectures were presented by Peter H. McMurry and L. Willard Richards on measurements, Warren H. White and Patrick Minnis on atmospheric optics, Stephen E. Schwartz on atmospheric aerosols, John H. Seinfeld on atmospheric dynamics, and Ronald C. Henry and Robert Watson on atmospheric science as applied to societal issues.

The first session under field observations reviewed sampling methodologies and programs. Several papers emphasized the need for field observations as ground truth for theoretical models and the need for well-established data quality goals.

A second session on regional and spatial patterns reported on modeling and characterizing vertical optical and aerosol profiles, as well as on spatial and temporal patterns associated with a number of field studies. A session on determination of optical depth or albedo reported on measurements of extinction, aerosols, and optical depth over marine and terrestrial environments and introduced new measurement techniques.

The second topic, atmospheric optics, opened with a session on climate and aerosols. Discussion focused on the need for standard conventions for calculating extinction budgets to reduce ambiguities. Direct and indirect mechanisms of radiative forcing by atmospheric aerosols were reviewed, along with current estimates of magnitudes. A global climate model was used to estimate the effect of mineral dust on radiative forcing while other discussion centered around the use of radiative perturbation theory as a tool to parameterize radiative impacts in climate models. A session on visibility and extinction highlighted the potential importance of atmospheric absorption and associated carbonaceous material to atmospheric extinction and albedo. A visibility equilibrium model was used to estimate the effect of aerosols on climate, while other discussions addressed the

effect and calculational accuracy of aerosol size models as they related to optical properties. Other papers discussed the three-dimensional modeling of the relationship between aerosols and visibility effects. One presentation incorporated a full treatment of dispersion and radiative transfer calculations to show how a scene is modified using computer imaging techniques.

A session on radiative transfer featured several papers that discussed the relationship between aerosol size distribution and the scattering phase function. Papers addressed the need for radiative transfer algorithms that incorporate an accurate handling of multiple scattering effects. A paper was presented on new measurement technologies to measure the full matrix of aerosol and hydrosol consisting of nonspherical particles. The influence of aerosols on ground-level irradiance was discussed, along with the effect of crystalline clouds on scattering and absorption. One of the more interesting papers focused on lidar data collected from the space shuttle Discovery. Results from the experiment included the mapping of the eye of Typhoon Melissa and observations of smoke plumes from South American biomass burning and Saharan dust over the Atlantic Ocean.

The third topic was atmospheric aerosols. The first session, on hygroscopic aerosols, focused on the effect of mixed aerosols in variable humidity environments on their optical properties. Experiments on the theory of nucleation were presented, and the need for aerosol observations to validate models was emphasized. A session on sulfate aerosols described recent measurements of chemical speciation, size distributions, and hygroscopicity of particulate matter with an emphasis on sulfate, its degree of neutralization, and consequent impact upon light extinction. Results reported from a number of field studies re-emphasized the importance of sulfates to extinction, the role of heterogenous chemistry in sulfate production, and seasonal variations in sulfate characteristics. They also indicated the need for better estimates of sulfur speciation and hygroscopicity. Some critical sampling needs that were identified included improved size resolved impactor measurements and elucidation of whether a non-extractable sulfur component exists.

A session on organic aerosols reported on new sampling strategies to minimize sampling artifacts. Another paper reported on organic measurements in the summer 1990 SJVAQS/AUSPEX study in California. In general, the results in this session pointed to the ubiquity of organic compounds in the atmosphere and their significant role in light extinction. Strategies for improved understanding of organic sampling artifacts and for minimizing such artifacts are urgently needed. There is also a need for more information on the speciation of particulate organic matter, which would assist in understanding hygroscopic behavior and scattering/absorption characteristics.

The fourth topic was a joint session between optics and aerosols. The lead session dealt with the chemistry and physics of single particles. Much of our current understanding of the properties of atmospheric aerosols is based on earlier studies conducted either theoretically or in controlled laboratory settings, often involving single particles. In this session, papers representing the state of the art in particle diagnostics were presented and fell roughly into two categories: 1) investigations of the optical properties of particles that cannot be completely described by the standard Lorenz-Mie theory for spheres, and 2) techniques for studying the chemistry and thermodynamics of single particles. A second session on aerosol/cloud interactions primarily dealt with how aerosol particles influence cloud microphysics by acting as cloud condensation nuclei (CCN). In particular, the apparent increase in droplet number and decrease in droplet size in marine stratus caused by particulate emission from ships was discussed. Other presentations dealt not with stratus clouds but with upper tropospheric clouds such as contrails and cirrus. A laboratory technique for studying the formation of supercooled droplets of ice was introduced, and observations of the condensation of individual water and sulfuric acid droplets at temperatures down to 233 °K were presented. Finally, the feasibility of using the counterflow virtual impactor for measuring condensed water was demonstrated.

The fifth topic, atmospheric dynamics, began with a session on source receptor relationships. A number of papers focused on the apportionment of extinction, sulfur, and other aerosol species to their sources in the Grand Canyon region of the southwestern United States, while other papers examined the application of chemical mass balance modeling for the apportionment of secondary and primary aerosols. Two papers examined the use of tracers of opportunity to apportion or identify source areas that contribute to visibility degradation on the Colorado Plateau. A personal computer implementation of a particle transport model was presented. A second session on the role of emissions, transport, and transformation on visibility in the Southwest included several papers that focused on source receptor relationships on or near the Colorado Plateau. Emission inventories, variation in regional and mesoscale wind fields as a function of interpolation schemes and first principal calculations, the effect of climatology on visibility, and clean air corridors were examined.

A final session on air quality and visibility models presented several new models for examining the effects of relative humidity, marine aerosol dynamics, and diurnal variations. A second-generation plume model was presented, along with a new source-oriented model for air pollutant (including organics) effects on visibility. Model validation needs were discussed.

The final topic was on atmospheric science as applied to societal issues. Considerable discussion centered on the role of the scientist in decision-making processes that affect the society in which we live. Decision makers make decisions with or without scientific input. Therefore, it is imperative that the scientist become involved in the decision-making process and that the decisions be based on good science, although it may be incomplete. Papers examined the level of haze that is just perceptible, the value people place on visibility as a function of haze, and the adequacy of scientific information to make a decision. The results of setting visibility standards at Lake Tahoe were discussed, and conceptual and functional definitions of clean air corridors were proposed.

[NOTE: Pages 1 through 1270 are not included in this file.
Please contact the author(s) directly for copies of their manuscripts]

Subject Index

A

*Indicates abstract only.

* Indicates abstract only.

*Indicates abstract only.

*Indicates abstract only.

*Indicates abstract only.

*Indicates abstract only.

*Indicates abstract only.

*Indicates abstract only.

*Indicates abstract only.

*Indicates abstract only.

R

*Indicates abstract only.

*Indicates abstract only.

*Indicates abstract only.

*Indicates abstract only.

*Indicates abstract only.

Author Index

Aerosols & Atmospheric Optics: Radiative Balance and Visual Air Quality
Snowbird, UT - 26-30 September 1994

List of Attendees

Joseph Adlhoch
Air Resource Specialists
1901 Sharp Point Drive,
Suite E
Fort Collins, CO 80525
Phone (303) 484-3423
Fax (303) 484-7941

Pamela Aker
University of Pittsburgh
Department of Chemistry
Pittsburgh, PA 15260
Phone (412) 624-8680
Fax (412) 624-8552

Klaus Anders
ITLR/University of Stuttgart
Pfaffenwaldring 31
Stuttgart 70550
Germany
Phone 497116852030
Fax 497116852317

Michael P. Anisimov
Kemerovo Science Center
of Siberia
Russian Academy of Science
Aerosol Laboratory
Rukavishnikov Street 21
Kemerovo 650610
Russia
Phone 01173842268697
Fax 01173842258989

Diederik C. Apgar
1261 1 SE 59th Street
Bellevue, WA 98006-3955
Phone (206) 562-4893
Fax (206) 931-4599

Scott F. Archer
USDI - BLM
DFC, Bldg 50 (SC-212A)
P.O. Box 25047
Denver, CO 80225
Phone (303) 236-6400

Rebecca L. Armstrong
CIRA
Colorado State University
Fort Collins, CO 80523
Phone (303) 491-8365
Fax (303) 491-8598

William P. Arnott
Desert Research Institute
Atmospheric Sciences Center
5625 Fox Avenue
P.O. Box 60220
Reno, NV 89506-0220
Phone (702) 677-3123
Fax (702) 677-3157

Robert Bachman
USDA - Forest Service
2107 NE 60th Street
Vancouver, WA 98665
Phone (503) 326-5427
Fax (503) 326-3050

William Balson
Decision Focus, Incorporated
650 Castro Street, Suite 300
Mountain View, CA
94041-2055
Phone (415) 960-3450
Fax (415) 960-3656

Paul Bell
Colorado State University
Department of Psychology
Fort Collins, CO 80523
Phone (303) 491-7215
Fax (303) 491-1032

Mark C. Beaubien
Yankee Environmental
Systems
101 Industrial Blvd.
P.O. Box 746
Turners Falls, MA 01376
Phone (413) 863-0200

Tyler J. Beck
TSI Incorporated
P.O. Box 64394
500 Cardigan Road
Saint Paul, MN 55164
Phone (612) 490-2726
Fax (612) 490-3860

Prem S. Bhardwaja
1521 Project Drive
Tempe, AZ 85072
Phone (602) 236-2860
Fax (602) 236-3407

Andres Birjulin
Colorado State University
Department of Psychology
Fort Collins, CO 80523
Phone (303) 491-1320

Max P. Bleiweiss
U.S. Army Research
Laboratory
AMSRL-BE-A
WSMR, NM 88002
Phone (505) 678-5713
Fax (505) 678-8822

Carl B. Bowman
National Park Service
P.O. Box 129
Grand Canyon, AZ 86023
Phone (602) 638-9300

Gail P. Box
University of South Wales
School of Physics
Sydney 2052 Australia
Phone 612-385-4570
Fax 612-663-3420

Michael A. Box
University of South Wales
School of Physics
Sydney 2052 Australia
Phone 612-385-4545
Fax 612-663-3420

Bruce Bradshaw
Idaho Department of Health
& Welfare
1410 North Hilton
State house Mail
Boise, ID 83720-9000
Phone (208) 334-0502

Eileen Brown
Colorado State University
Statistics Department
Fort Collins, CO 80523

Michael Brown
Los Alamos National Lab
TSA-4, MS B299
Los Alamos, NM 87545
Phone (505) 667-1788
Fax (505) 665-5125

Sheila Burns
Colo Department of Health
APCD-TS-BI
4300 Cherry Creek Dr South
Denver, CO 80222-1530
Phone (303) 692-3223
Fax (303) 782-5493

Catherine Cahill
Desert Research Institute
5625 Fox Avenue
Reno, NV 89506
Phone (702) 677-3299
Fax (702) 677-3303

Thomas A. Cahill
University of California
Crocker Nuclear Lab
Davis, CA 95616-8569
Phone (916) 752-1120
Fax (916) 752-4107

Fem M. Caka
1306 W. 1200 N.
Mapleton, UT 84664
Phone (801) 489-3147

Christian M. Carrico
3212 Newark
Civil Engineering Lab MC250
205 N. Mathews
Urbana, IL 61801
Phone (217) 333-6973
Fax (217) 333-9464

Glen R. Cass
Calif Institute of Technology
Env Engineering 138-78
Pasadena, CA 91125
Phone (818) 356-6888
Fax (818) 395-2940

Lauraine G. Chestnut
RCG/Hagler, Bailly, Inc.
P.O. Drawer O
Boulder, CO 80306
Phone (303) 449-5515
Fax (303) 443-5684

Judith C. Chow
Desert Research Institute
5625 Fox Avenue
P.O. Box 60220
Reno, NV 89506-0220
Phone (702) 677-3108
Fax (702) 677-3316

John P. Christiano
12795 W. Alameda Parkway
Lakewood, CO 80228
Phone (303) 969-2070
Fax (303) 969-2822

D. Scott Cismoski
Air Resource Specialists, Inc.
1901 Sharp Point Dr, Suite E
Fort Collins, CO 80525
Phone (303) 484-7941
Fax (303) 484-3423

Antony D. Clarke
University of Hawaii
Department of Oceanography
School of Ocean & Earth Sci
1000 Pope Road, MSB 307
Honolulu, HI 96822
Phone (808) 956-6215
Fax (808) 956-9225

I. Colbeck
University of Essex
Institute for Envi Research
Colchester C04 3SQ
United Kingdom
Phone 44206872203
Fax 44206873598

Scott Alan Copeland
Colorado State Univ CIRA
Fort Collins, CO 80523
Phone (303) 491-8406
Fax (303) 491-8598

John E. Core
WESTAR Council
1001 SW 5th Ave, Ste 1100
Portland, OR 97204-1147
Phone (503) 220-1660
Fax (503) 220-1651

Wenxuan Cui
Department of Chemistry
Brigham Young University
Provo, UT 94602
Phone (801) 378-5257
Fax (801) 378-5474

David Dandy
Colorado State University
Atmospheric Science Dept
Foothill Campus
Fort Collins, CO 80523
Phone (303) 491-8350
Fax (303) 491-8449

Stuart L. Dattner
Texas Natural Resource
Conservation Commission
Research Section
P.O. Box 13087
Austin, TX 78711-3087
Phone (512) 239-1811
Fax (512) 239-1605

Derek Day
Colorado State University
CIRA
Fort Collins, CO 80523
Phone (303) 491-8406
Fax (303) 491-8598

Thomas P. DeFelice
Univ of Wisc - Milwaukee
Atmospheric Science Group
Lapham Hall Room 358
3209 N. Maryland Ave.
Milwaukee, WI 53211
Phone (414) 229-3834
Fax (414) 229-5452

Ronald J. Dickson
Radian Corporation
103 89 Old Placerville Road
Sacramento, CA 95827-2506
Phone (916) 362-5332
Fax (916) 362-2318

David L. Dietrich
Air Resource Specialists, Inc.
1901 Sharp Point Dr, Ste E
Ft Collins, CO 80525-4402
Phone (303) 484-7941
Fax (303) 484-3423

Ralph Dlugi
University of Munich
Meteorological Institute
Theresienstr. 37
Munich D-80333 Germany
Phone 89-181090
Fax 89-182260

J. Christopher Doran
Pacific Northwest Laboratory
P.O. Box 999
MSIN K6-11
Richland, WA 99352
Phone (509) 376-4734
Fax (509) 372-2285

Alecia Du
Department of Chemistry
Brigham Young University
Provo, UT 84602
Phone (801) 378-2576
Fax (801) 378-5474

Philip A. Durkee
Naval Postgraduate School
Meteorology Department,
Code MR/De
589 Dyer Road, Room 254
Monterey, CA 93943-5114
Phone (408) 656-3465
Fax (408) 656-3061

L. Fermi Durosinmi
Clark County Health District
P.O. Box 4426
Las Vegas, NV 89127
Phone (702) 383-1276
Fax (702) 383-1443

Delbert J. Eatough
Department of Chemistry
Brigham Young University
Provo, UT 84602
Phone (801) 378-6040
Fax (801) 378-5474

Judith Eatough
Departinent of Chemistry
Brigham Young University
Provo, UT 84602
Phone (801) 378-6040

Michele Eatough
Department of Biology
Brigham Young University
Provo, UT 84602

Norman L. Eatough
1508 Gulf Street
San Luis Obispo, CA 93405
Phone (805) 544-0234

Eric Edgerton
ESE, Incorporated
4515 Prospectus Dr, Suite J
Durham, NC 27713
Phone (919) 544-3903
Fax (919) 544-3882

Silvia Eidels
Instituto Mexicano del
Petrole Newton 280
#303 Col Polanco
Mexico 11560, D.F.
Mexico
Phone 525-545-7846
Fax 525-587-0009

Annmarie Eldering
University of Iowa
Department of Civil &
Environmental Engineering
1136 Engineering Bldg.
Iowa City, IA 52242-1527
Phone (319) 335-3654
Fax (319) 335-5660

Robert A. Eldred
University of California
Crocker Nuclear Lab
Air Quality Group
Davis, CA 95616-8569
Phone (916) 752-1124
Fax (916) 752-4107

Joseph B. Elkins
116 Modina Drive
Cary, NC 27513
Phone (919) 541-5653
Fax (919) 541-1903

Daniel W. Ely
Colo Departinent of Health
Air Pollution Control Div
APCD-TS-BI
4300 Cherry Creek Dr South
Denver, CO 80222-1530
Phone (303) 692-3228
Fax (303) 782-5493

Gardner Evans
U.S. Environmental
Protection Agency
Atmospheric Science
Modelling Division
AREAL, Mail Drop 80A
Res Tri Park, NC 27711
Phone (919) 541-3887
Fax (919) 541-7588

Victoria A. Evans
Res Mgmt International, Inc.
384 Bel Marin Keys Blvd, B
Novato, CA 94949
Phone (707) 527-9372
Fax (707) 527-9398

Robert J. Farber
Southern California Edison
P.O. Box 800
Rosemead, CA 91770-0800
Phone (818) 302-9693
Fax (818) 302-9730

Michael Farmer
Phone (505) 527-5623
Fax (505) 527-5633

James W. Fitzgerald
Naval Research Laboratory
Remote Sensing Div Code 7228
Washington, DC 20375
Phone (202) 767-2362
Fax (202) 404-8011

Robert G. Flocchini
University of California
Department of Land, Air &
Water Res.
Department of Physics
Davis, CA 95616-8569
Phone (916) 752-1120
Fax (916) 752-4107

Debra S. Fuller
c/o Kirk Fuller
Colorado State University
Dept of Atmospheric Science
Fort Collins, CO 80523

Kirk A. Fuller
Colorado State University
Dept of Atmospheric Science
Fort Collins, CO 80523
Phone (303) 491-8644

Lee Ellen Fuller
c/o Kirk Fuller
Colorado State University
Dept of Atmospheric Science
Fort Collins, CO 80523

Dennis Garvey
U.S. Army Research Lab
Battlefield Envir. Direct
White Sands, NM 88002
Phone (505) 678-5677
Fax (505) 678-2053

Elizabeth Gearhart
University of California
Crocker Nuclear Laboratory
Davis, CA 95616-8569
Phone (916) 752-9044
Fax (916) 752-0952

Kristi Gebhart
CIRA (NPS-Air)
Colorado State University
Fort Collins, CO 80526
Phone (303) 491-8406
Fax (303) 491-8598

Steven J. Ghan
Battelle Pacific NW Labs
Battelle Blvd.
P.O. Box 999, K6-08
Richland, WA 99352
Phone (509) 376-8632

Kevin Golden
U.S. EPA Region VIII
8PM-CBF
999 18th Street, Suite 500
Denver, CO 80202-2466
Phone (303) 293-0955

Yahya Golestaru
Colorado State University
CIRA
Fort Collins, CO 80523
Phone (303) 491-8443
Fax (303) 491-8598

Emmanual Gonzalez
Instituto Mexicano del Petroleo
Ele Centrol I Cardends #152
Cardends CP 07730
Mexico
Phone 05679246
Fax 05870009

Mark C. Green
Desert Research Institute
Water Resources Center
755 East Flamingo Road
Las Vegas, NV 89119
Phone (702) 895-0450
Fax (702) 895-0427

Lee P. Gribovicz
Wyoming Department of
Environmental Quality
250 Lincoln Street
Lander, WY 82520-2848
Phone (307) 332-3144
Fax (307) 332-7726

L. Guise-Bagley
Center for Atmospheric
Research Experiments
Atmospheric Envi Service
R.R. #1
Egbert, ON L0L 1N0 Canada
Phone (705) 458-1141
Fax (705) 458-1143

Adel F. Hanna
MCNC
NC Supercomputing Center
P.O. Box 12889
3021 Comwallis Road
Res Tri Park, NC 27709
Phone (919) 248-9230
Fax (919) 248-9845

Kathleen Heffley
Air Issues Branch
Environment Canada
351 St. Joseph Blvd, Floor 11
Hull, PQ K1A 0H3 Canada
Phone (819) 994-6052
Fax (819) 994-0549

Steven L. Heisler
ENSR Consulting & Eng
1220 Avenida Acaso
Camarillo, CA 93012-8727
Phone (805) 388-3775
Fax (805) 388-3577

Ronald Henry
University of Southern Calif
Environmental Engineering
3620 S. Vermont Street
Los Angeles,CA 90089-2531
Phone (213) 740-0596
Fax (213) 744-1426

Edwin Hirst
University of Hertfordshire
Engineering Research &
Development Center
Hatfield, Herts ALI 0 9AB
United Kingdom
Phone 44707284169
Fax 44707284185

Ray Hoff
Center for Atmospheric
Research Experiments
Atmospheric Envi Service
R.R. #1
Egbert, ON L0L 1N0 Canada
Phone (705) 458-1141
Fax (705) 458-1143

Claire Hong
U.S. Envi Protection Agency
AT-082
1200 Sixth Avenue
Seattle, WA 98109
Phone (206) 553-1813
Fax (206) 553-01 10

Helmuth Horvath
Experimental Physics
Boltzmarmgasse 5
Vienna A-1090 Austria
Phone 431313673077
Fax 4313102338

James G. Hudson
Desert Research Institute
Atmospheric Sciences Center
P.O. Box 60220
Reno, NV 89506-0220
Phone (702) 677-3119
Fax (702) 677-3157

Barry L. Huebert
University of Hawaii
Department of Oceanography
Honolulu, HI 96822
Phone (808) 965-6896
Fax (808) 956-9225

Dale Huffman
P.O. Box 271572
Fort Collins, CO 80527
Phone (303) 482-0701

Janja Husar
c/o Rudolf B. Husar
Washington University
CAPITA, Box 1124
Urbauer 319
One Brookings Drive
St. Louis, MO 63130-4899

Rudolf B. Husar
Washington University
CAPITA, Box 1124
Urbauer 319
One Brookings Drive
St. Louis, MO 63130-4899
Phone (314) 935-6099
Fax (314) 935-6145

Hanharan Iyer
Colorado State University
Department of Statistics
Fort Collins, CO 80513
Phone (303) 491-6870
Fax (303) 491-7895

Christopher Johnson
Colorado State University
CIRA
Fort Collins, CO 80523
Phone (303) 491-8406
Fax (303) 491-8598

Jonathan D. Kahl
University of Wisconsin
P.O. Box 413
Department of Geosciences
Milwaukee, WI 53201
Phone (414) 229-4561
Fax (414) 229-5452

Prakash K. Karamchandani
ENSR Consulting & Eng
1220 Avenida Acaso
Camarillo, CA 93012
Phone (805) 388-3775
Fax (805) 388-3577

Yorain J. Kaufman
Goddard Space Flight Center
NASA Code 913
Greenbelt, MD 20771
Phone (301) 286-4866
Fax (301) 286-1759

Caroline Kaye
c/o Paul Kaye
Goods Inwards Hatfield
University of Hadordshire
College Lane
Hatfield, Herts AL10 9AB
United Kingdom

Paul Kaye
Goods Inwards Hatfield
University of Hertfordshire
College Lane
Hatfield, Herts AL10 9AB
United Kingdom
Phone 0707-28-4184
Fax 0707-28-4099

Robert Keislar
Desert Research Institute
P.O. Box 60220
Reno, NV 89506
Phone (702) 677-3209
Fax (702) 677-3157

Ulle Kikas
Tartu University
Air Electricity Laboratory
Ulikooli 18
Tartu EE2400 Estonia
Phone 372-7-433450
Fax 372-7-435440

Young Kim
NOAA/ERL/ARUSRRB
R/E/Arxl
325 Broadway
Boulder, CO 80303
Phone (303) 497-6815
Fax (303) 497-6546

Michael Kleeman
Calif Institute of Technology
Pasadena, CA 91125
Phone (818) 395-6892
Fax (818) 395-2940

Miroslav Kocifaj
Astronomical Institute
Slovak Academy of Sciences
Dubravska Cesta 9
Bratislava 842 28 Slovenia

Sonia Kreidenweis
Colorado State University
Atmospheric Science Dept
Foothill Campus
Fort Collins, CO 80523
Phone (303) 491-8350
Fax (303) 491-8449

Foeke Kuik
Royal Netherlands
Meteorological Institute
P.O. Box 201, 3730 AE
DeBilt, The Netherlands
Phone 31-30-206-482
Fax 31-30-210-407

Peter Lahm
c/o ADEQ-AQD (5095)
3033 N. Central
Phoenix, AZ 85012
Phone (602) 207-2356
Fax (602) 207-2366

Nels R. Larson
Battelle PNL, K6-85
P.O. Box 999
Richland, WA 99352
Phone(509) 376-4333

Douglas A. Latimer
Latimer & Associates
679 Quince Circle
Boulder, CO 80304-1030
Phone (303) 440-3332
Fax (303) 444-7072

Nels Laulainen
Atmos Processes (K6-08)
Battelle-Northwest
P.O. Box 999
Richland, WA 99352

John Leary
Western Governors' Assn
Suite 1705 South
600 Seventeenth Street
Denver, CO 80202-5442
Phone (303) 623-9378
Fax (303) 534-7309

Howard M. Liljestrand
University of Texas
Civil Engineering, 8.6 ECJ
Austin, TX 78712
Phone (512) 471-4604
Fax (512) 471-0592

Chin-I Lin
Pacific Gas & Electric Co.
R & D Department
3400 Crow Canyon Road
San Ramon, CA 94583-1308
Phone (510) 866-5396
Fax (510) 866-5318

May-Ling Lin
c/o Chin-I Lin
Pacific Gas & Electric Co.
3400 Crow Canyon Road
San Ramon, CA 94583-1308

Yangang Liu
Desert Research Institute
Atmospheric Sciences Center
P.O. Box 60220
Reno, NV 89506-0220
Phone (702) 671-3229

N. Lu
Kansas State University
Department of Physics
Manhatten, KS 66506-2601
Phone (913) 532-1626
Fax (913) 532-6806

Jan Lukac
Slovak Academy of Sciences
Geophysical Institute
Dfibravski cesta 9
842 28 Bratislava
Slovak Republic

Edward S. Macias
Washington University
Campus Box 1134
Chemistry Departinent
St. Louis, MO 63130
Phone (314) 935-5151
Fax (314) 935-5188

Tedi Macias
c/o Edward Macias
Washington University
Campus Box 1134
Chemistry Departinent
St. Louis, MO 63130

William C. Malm
National Park Service
3312 Rawhide Drive
Laporte, CO 80535-9329
Phone (303) 491-8292

Nolan F. Mangelson
Department of Chemistry
Brigham Young University
Provo, UT 84602
Phone (801) 378-3668
Fax (801) 378-5474

Eugene Marshall
PacifiCorp
Electric Operations
1407 West North Temple
Salt Lake City, UT
84140-1001
Phone (801) 220-2235
Fax (801) 220-4307

C. V. Mathai
AZ Public Service Co.
Mail Stop 9366
P.O. Box 53999
Phoenix, AZ 85072-3999
Phone (602) 250-3569
Fax (602) 250-3813

George M. Mathews
Advanced Sciences, Inc.
405 Urban Street, Suite 401
Lakewood, CO 80028-1236
Phone (303) 980-0036
Fax (303) 980-1206

Robert Matsumura
University of California
Crocker Nuclear Lab
Davis, CA 95616-8569
Phone (916) 752-1120
Fax (916) 752-4107

Naydene N. Maykut
Puget Sound APC Agency
Air Pollution Control
10 Union Street, Suite 500
Seattle, WA 98101-2038
Phone (206) 689-4062
Fax (206) 343-7522

Charles E. McDade
ENSR Consulting & Eng
1220 Avenida Acaso
Camarillo, CA 93012-8727
Phone (805) 388-3775
Fax (805) 388-3577

Michael R. McGown
Idaho Air Quality Bureau
c/o Pat Mowry
1410 N. Miton
Boise, ID 83706
Phone (208) 334-5860
Fax (208) 334-0576

Peter H. McMurry
University of Minnesota
Dept of Mechanical Eng
111 Church Street SE
Minneapolis, MN 55455-0150
Phone (612) 625-3345
Fax (612) 625-6069

Randi Nfichalsky
ASRC Suny Albany
100 Fuller Road
Albany, NY 12205
Phone (518) 442-3809
Fax (518) 442-3867

Joseph Nfichalsky
ASRC Suny Albany
100 Fuller Road
Albany, NY 12205
Phone (518) 442-3809
Fax (518) 442-3867

Paulette Bauer Middleton
c/o UCAR
P.O. Box 3000
Boulder, CO 80307-3000
Phone (303) 497-8620
Fax (303) 497-2038

V.B. Mikheev
Russian Academy of Sci
Institute of Inorganic Chem
Novosibirsk
Russia

David W. Mils
Pacific Power
1407 W. North Temple St.
Salt Lake City, UT 84140
Phone (801) 220-2301
Fax (801) 220-4307

Patrick Minnis
NASA Langley Research
Center MS 420
Hampton, VA 23681
Phone (804) 864-5671
Fax (804) 864-7996

Vincent A. Mirabella
Southern California Edison
2244 Walnut Grove Ave.
P.O. Box 800
Rosemead, CA 91770-3714
Phone (818) 302-9748
Fax (818) 302-9730

Michael I. Mschenko
NASA - Goddard Institute
for Space Studies
2880 Broadway
New York, NY 10025
Phone (212) 678-5528
Fax (212) 678-5552

Brian Mitchell
National Park Service
12795 W. Alameda Parkway
P.O. Box 25287
Denver, CO 80225-0287
Phone (303) 969-2071

John V. Molenar
Air Resource Specialists, Inc.
1901 Sharp Point Dr, Suite E
Ft Collins, CO 80525-4402
Phone (303) 484-7941
Fax (303) 484-3423

Charles T. (Tom) Moore
Arizona Dept of Envi Quality
T5033
3033 North Central Avenue
Phoenix, AZ 85012
Phone (602) 207-2363
Fax (602) 207-2366

Hans Moosmüller
Desert Research Institute
Energy and Envi Engineering
5625 Fox Avenue
P.O. Box 60220
Reno, NV 89506-0220
Phone (702) 677-3194
Fax (702) 677-3157

Marie Colette Moucheron
University of Colorado
Mechanical Eng Department
Boulder, CO 80309-0427
Phone (303) 492-6107
Fax (303) 492-2863

Judith Mueller
3801 Magnolia Drive
Palo Alto, CA 94306
Phone (415) 855-2586
Fax (415) 855-1069

Peter K. Mueller
3801 Magnolia Drive
Palo Alto, CA 94306
Phone (415) 855-2586
Fax (415) 855-1069

Daniel M. Murphy
NOAA Aeronomy Lab
325 Broadway
Boulder, CO 80303
Phone (303) 497-5640
Fax (303) 497-5373

Wang Nai-ning
Shanghai Institute of
Mechanical Engineering
516 Jun Gong Road
Shanghai 200093
People's Republic of China
Phone 86-021-5433040
Fax 86-021-5431258

William D. Neff
NOAA/Envi Technology Lab
R/E/ET7
325 Broadway
Boulder, CO 80303
Phone (303) 497-6265
Fax (303) 497-6978

William L. Neumiller
Montana Power Co.
P.O. Box 38
Colstrip, MT 59323
Phone (406) 748-2780
Fax (406) 748-2552

Christine O'Neill
2012 Hoxie
Richland, WA 99352
Phone (509) 946-5308

Ali H. Omar
University of Illinois
4142 NCEL MC 250
205 N. Mathews
Urbana, IL, 61801
Phone (217) 333-7773
Fax (217) 333-9464

Elba R. Ortik
Cerrada de Paseo Nuero #7
Paseos de Fonquera DF
Mexico
Phone 011-670-7169

James R. Ouimette
Chevron Research & Tech
1003 W. Cutting Blvd.
Richmond, CA 94804-2452
Phone (510) 242-3412
Fax (510) 242-5947

Prasad P. Pai
ENSR
1220 Avenida Acaso
Camarillo, CA 93012
Phone (805) 388-3775
Fax (805) 388-3577

Fred L. Paul
TSI Incorporated
P.O. Box 64394
500 Cardigan Road
Saint Paul, MN 55164-0394
Phone (612) 490-2825
Fax (612) 490-3860

Janice Peterson
USDA - Forest Service
Mt. Baker-Shoquahnie NF
21905 64th Avenue West
Mountlake Terrace, WA
98043-2278
Phone (206) 744-3425
Fax (206) 744-3255

Richard E. Peterson
Texas Tech University
Department of Geosciences
Box 41094/Science 125
Lubbock, TX 79409
Phone (806) 742-3101
Fax (806) 742-0100

A.G. Petrushin
Institute of Exp Meteorology
SPA "Typhoon"
82 Lenin Avenue
Obniski, Kaluga Region
249020 Russia
Fax 095-255-2225

Christodoulow Pilinis
Calif Institute of Technology
Envirorunental Quality Lab
Pasadena, CA 91125

Marc Pitchford
NOAA/EPA
P.O. Box 93478
Las Vegas, NV 89193-3478
Phone (702) 895-0432
Fax (702) 895-0496

Inna N. Plakhina
Russian Acad of Sciences
Institute of Atmos Physics
Laboratory of Atmosphere-
Ocean Interaction
Pyzhevsky 3, Moscow
10952 Russia
Fax 70952331662

Bruce Polkowsky
U.S. Envi Protection Agency
Ambient Standards Branch
Res Tri Park, NC 27711
Phone (919) 541-5532

Joanne Pottier
Environment Canada
700-1200 West 73rd Avenue
Vancouver, BC V6P 6H9
Phone (604) 664-9098
Fax (604) 664-9195

Sara C. Pryor
Univ of British Columbia
Department of Geography
1984 West Mail
Vancouver, BC V6T 1Z2
Phone (604) 822-2556
Fax (604) 822-6150

Keith J. Puckett
Environment Canada
Atmos Environment Service
4905 Dufferin Street
Downsview, ON M3H 5T4
Canada
Phone (416) 739-4836
Fax (416) 739-4882

Xu Qun
Jiangsu Met Institute
Bei-Ji-Guo, No. 2
Nanjing
Jiangsu Province, 210008
People's Republic of China
Fax 86-25-3306279

Patrick Reddy
Colorado Dept of Health
APCD-TS-BI
4300 Cherry Creek Dr South
Denver, CO 80222-1530
Phone (303) 692-3239
Fax (303) 782-5493

Peter D. Reid
BC Envirorunent
Southern Interior Region
1259 Dalhousie Drive
Kamloops, BC V2C 5Z5
Canada
Phone (604) 371-6296
Fax (604) 8.18-4000

L. Willard Richards
5510 Skylane Blvd,Suite 101
Santa Rosa, CA 95403-1083
Phone (707) 527-9372
Fax (707) 527-9398

Nancy Richards
c/o L. Willard Richards
5510 Skylane Blvd,Suite 101
Santa Rosa, CA 95403-1083
Phone (707) 527-9372
Fax (707) 527-9398

David M. Ross
Colorado State University
CIRA
Foothills Campus
Ft Collins, CO 80523-0001
Phone (303) 491-8365
Fax (303) 491-8598

Terry Ross
Center for Energy &
Econoniic Development
ARCO Tower
707 17th Street, Suite 2956
Denver, CO 80202
Phone (303) 292-3211
Fax (303) 634-7496

Norbert Roth
ITLR/Uriiversity of Stuttgart
Pfaffenwaldring 31
Stuttgart 70550 Germany
Phone 497116852320
Fax 497116852317

Carlo Rozzi
Southern California Edison
P.O. Box 800
Rosemead, CA 91770
Phone (818) 302-9730

Lynn M. Russell
Calif Institute of Technology
Division of Chemistry &
Chemical Eng (210-41)
Pasadena, CA 91125
Phone (818) 395-3692
Fax (818) 568-8743

Steven Sakiyama
Ministry of the Environment
Lands & Parks
Air Resources Branch
777 Broughton Street
Victoria, BC V8V IX5
Canada
Phone (604) 387-9942
Fax (604) 356-7197

A.V. Savchenko
Institute of Exp Meteorology
82 Lenin St.
Obninsk, Kaluga Region
24920 Russia

Kristi Savig
Air Resource Specialists, Inc.
1901 Sharp Point Dr, Suite E,
Fort Collins, CO 80525
Phone (303) 484-7941
Fax (303) 484-3423

Bret Schichtel
Washington University
CAPITA,
Campus Box 1124
Urbauer 319
One Brookings Drive
St. Louis, MO 63130-4899
Phone (314) 935-6099
Fax (314) 935-6145

Timothy Schneider
Colorado State University
CIRA
Fort Collins, CO 80523

David E. Schorran
Desert Research Institute
Energy & Envi Engineering
5625 Fox Avenue
Reno, NV 89506
Phone (702) 677-3187
Fax (702) 677-3157

Y.R. Schuitemaker
P.O. Box 201, 3730 AE
DeBilt, The Netherlands
Phone 313-020-6482
Fax 313-021-0407

Stephen E. Schwartz
Brookhaven National Lab
Bldg. 426
Upton, NY 11973
Phone (516) 282-3 1 00
Fax (516) 282-2887

Mark Alan Scruggs
Phone (303) 969-2077
Fax (303) 987-6699

Christian Seigneur
ENSR
1320 Harbor Bay Parkway
Alameda, CA 94502-6556
Phone (510) 865-1888
Fax (510) 748-6799

John H. Seinfeld
Calif Institute of Technology
Mail Code 104-44
Pasadena, CA 91125-0001
Phone (818) 395-4100
Fax (818) 585-1729

Gilmore Sem
TSI Inc.
Box 64394
Saint Paul, MN 55164
Phone (612) 490-2729
Fax (612) 490-3860

Cannine Serio
DEFA, Universita Basilicata
Via della
Tecnica, 3 Potenza 80125
Italy
Phone 39971474666
Fax 3997156537

Jack D. Shannon
Argonne National Laboratory
9700 South Cass Avenue,
ER/203
Argonne, IL 60439-4843
Phone (708) 252-5807
Fax (708) 252-5498

K.C. Shaw
P.O. Box 2500, MD 40
Provo, UT 94603
Phone (801) 227-9276
Fax (801) 227-9198

Kay Shelar
1379 Los Arboles Avenue
Sunnyvale, CA 94087
Phone (415) 855-2163
Fax (415) 855-1069

Eugene Shelar Jr.
1379 Los Arboles Avenue
Sunnyvale, CA 94087
Phone (415) 855-2163
Fax (415) 855-1069

Lee Siegel
The Salt Lake Tribune
P.O. Box 867
Salt Lake City, UT 84117
Phone (801) 237-2045
Fax (801) 521-9418

Mary Kate Sinclair
DRA Engine Systems
c/o D. Ibberson
Cm(5)2B, Room 136
Pinesgate East
Bath BAI 5AB
United Kingdom
Phone 44-252-54441 x4245
Fax 44-252-372477

James F. Sisler
Colorado State University
CIRA
Foothills Campus
Ft Collins, CO 80523-0001
Phone (303) 491-8406
Fax (303) 491-8598

Marek A. Sitarski
Kentucky Wesleyan College
Department of Mathematics,
Physics & Computer Science
Owensboro, KY 42301-1039

Christine Sloane
General Motors
Research & Develmt Center
Bldg 1-3 RTP
30500 Mound Road
Warren, MI 48090-9055
Phone (810) 986-1734
Fax (810) 986-0294

Alexander Smimov
CARTEL
Universite de Sherbrooke
Sherbrooke, PQ JIK 2RI
Canada
Phone (819) 821-7956
Fax (819) 821-7944

V.V. Smimov
Institute of Exp Meteorology
Lenin Street 82
Obnisk, Kaluga Region
249020 Russia
Fax 0952552225

Lucinda R. Smith
ESTC
2401 Research Blvd. #205
Fort Collins, CO 80526
Phone (303) 221-4871
Fax (303) 491-2207

V. Ye. Smorodin
Lomonosov State University
Lab of Radiation Chemistry
Departinent of Chemistry
Moscow 119899
Russia
Fax 095-292-6511

Ken Snell
USFS/ERWA
P.O. Box 3623
Portland, OR 97208
Phone (503) 326-5425
Fax (503) 326-3050

Pierre Sokolsky
University of Utah
Physics Department
Salt Lake City, UT 84112
Phone (801) 581-5398

Christopher M. Sor
Kansas State University
Department of Physics
Cardwell Hall
Manhattan, KS 66506-2601
Phone (913) 532-6786
Fax (913) 532-6806

Gustavo Sosa
lmtituto Mexicano del Pet.
Ricarte 99-1
Col. Tepeyac Insurgentes
C.P. 07020, Mexico, D.F.
Mexico
Phone 525-567-9426
Fax 525-587-0009

Steve St. Clair
c/o Victoria Evans
384 Bel Marin Keys Blvd, B
Novato, CA 94949-5638
Phone (415) 382-7521
Fax (415) 883-5214

Arthur W. Stelson
Earth & Atmos Sciences
Georgia Tech
Atlanta, GA 30332-0340
Phone (404) 894-1755
Fax (404) 894-1106

Roger A. Stocker
Colorado State University
Dept of Atmospheric Science
Fort Collins, CO 80523
Phone (303) 491-8318

Larry Stone
LTRG Corporation
118 E. Main Street
Carrboro, NC 27510
Phone (919) 942-2753
Fax (919) 942-3522

Shere Stone
URG Corporation
118 E. Main Street
Carrboro, NC 27510
Phone (919) 942-2753
Fax (919) 942-3522

Larry Svoboda
U.S. EPA Region VIII
8ART-TO
999 18th Stree, Suite 500
Denver, CO 80202-2466
Phone (303) 293-0962
Fax (303) 293-0988

Ignatius N. Tang
Brookhaven National Lab
Dept of Applied Science,
Bldg. 815
Upton, NY 11973
Phone (516) 282-4517
Fax (516) 282-7905

Michael L. Teague
Hunton & Williams
2000 Pennsylvania Ave NW
P.O. Box 19230
Washington, DC 20006
Phone (202) 955-1527
Fax (202) 778-2201

Ina Tegen
Columbia University
2880 Broadway
New York, NY 10025
Phone (212) 678-5561
Fax (212) 678-5552

G.M. Teptin
State University of Kazan
Radioastronomy Department
Faculty of Physics
Lenin Street 18
Kazan 420008 Russia
Fax 843-238-0994

Jill Thompson
US Army Battlefield Env Div
AMSRL-BE-E
White Sands, NM
88002-5501
Phone (505) 678-2434
Fax (505) 678-2432

John R. Tiiston
DRA Engine Systems
c/o P. Boxhall,
Training Liaison Officer
P 16 1, DRA Famborough
Hants
United Kingdom
Phone 44-252-54441 x4245
Fax 44-252-372477

Ivar H. Tombach
ENSR Consulting & Eng
1220 Avenida Acaso
Camarillo, CA 93012-8727
Phone (805) 388-3775
Fax (805) 388-3577

Saulius Trakumas
Institute of Physics
2600 Vilnius
A. Gostauto 12 Lithuania
Phone 370-264-1872
Fax 370-261-7070

Edward C. Trexler
8713 Bevan DTive
Fairfax, VA 22030
Phone (202) 586-8493
Fax (202) 586-1188

B. Turpin
University of Minnesota
125 Mechanical Engineering
111 Church Street SE
Minneapolis,MN 55455-0111

Cynthia Twohy
National Center for
Atmospheric Research
Atmospheric Technology Div
P.O. Box 3000
Boulder, CO 80307-3000
Phone (303) 497-1017
Fax (303) 497-1092

Marek Uliasz
Colorado State University
Atmospheric Sciences
Fort Collins, CO 80523
Phone (303) 491-8318

Marc P. Valdez
Sierra Research, Inc.
1801 J Street
Sacramento, CA 95814-3009
Phone (916) 444-6666
Fax (916) 444-8373

L.B. van den Hoek
De Boelelaan 1081
NL-1081 HV
Amsterdam, The Netherlands
Phone 31-20-44447959
Fax 31-20-6461459

Luis A. Vasconcelos
Washington University
Department of Chemistry
Box 1134
St. Louis, MO 63130-4899
Phone (314) 935-6570
Fax (314) 935-6184

Joseph K. Vaughan
Washington State University
Dept of Civil & Envi Eng
Sloan 101
Pullman, WA 99164-2910
Phone (509) 335-2381
Fax (509) 335-8674

Akula Venkatram
University of Califomia
College of Engineering
Riverside, CA 92521
Phone (909) 787-2195
Fax (909) 787-3188

John C. Vimont
National Park Service
Air Quality Division
P.O. Box 25287
Denver, CO 80225-0287
Phone (303) 969-2808
Fax (303) 987-6699

Hester Volten
De Boelelaan 1081
NL-1081 HV
Amsterdam, The Netherlands
Phone 31-20-44447959
Fax 31-20-6461459

Paul H. Wakabayashi
University of Califomia
Crocker Nuclear Laboratory
Davis, CA 95616-8569
Phone (916) 752-1120
Fax (916) 752-4107

Kris Wardrup (Andress)
Department of Chemistry
Brigham Young University
Provo, UT 84602
Phone (801) 378-5257
Fax (801) 378-5474

Ann M. Watkins
U.S. EPA
Acid Rain Division
OAP/OAR (6204G)
Washington, DC 20460
Phone (202) 233-9113
Fax (202) 233-9585

John G. Watson
Desert Research Institute
P.O. Box 60220
Reno, NV 89506-0220
Phone (702) 677-3166
Fax (702) 677-3157

Robert Watson
Exec Office of the President
Old Executive Office
Building, Room 443
17th & Pennsylvania NW
Washington, DC 20500
Fax (202) 456-6025

Michael Wendorf
T. G. Soda Ash, Incorporated
P.O. Box 100
Granger, WY 82934-0100
Phone (307) 872-4192
Fax (307) 872-4233

Barbara White
6840 Waterman Avenue
St. Louis, MO 63130
Phone (314) 726-6941
Fax (314) 935-4481

Warren H. White
6840 Waterman Avenue
St. Louis, MO 63130
Phone (314) 726-6941
Fax (314) 935-4481

Gretchen S. Wilson
c/o William E. Wilson
U.S. Envi Protection Agency
MD 75
Res Tri Park, NC 27711
Phone (919) 541-2551
Fax (919) 541-7588

William E. Wilson
U.S. Envil Protection Agency
MD 75
Res Tri Park, NC 27711
Phone (919) 541-2551
Fax (919) 541-7588

Julie Winchester
3312 Rawhide Drive
LaPorte, CO 80535
Phone (303) 491-8443
Fax (303) 491-8598

Leonard Winchester
CW Optics, Inc.
117 Quantico Loop
Yorktown, VA 23693-2611
Phone (804) 867-7893
Fax (804) 868-9309

Thomas Wiscomb
Pacific Power
1407 W. North Temple St.,
Suite 270
Salt Lake City, UT 84140
Phone (801) 220-2373
Fax (801) 220-4307

Jim Wolf
The Salt River Tnbune
P.O. Box 867
Salt Lake City, UT 84117

Maohong Wu
ENSR Consulting & Eng
132O Harbor Bay Parkway
Alameda, CA 94502
Phone (510) 865-1888
Fax (510) 748-6799