This document presents information and data in support of the review of the Chemical Sciences Division covering the period 2008 – 2014. The document was developed and edited by Christine A. Ennis with input from John S. Daniel, Cathy Burgdorf Rasco, Debra Dailey-Fisher, Libby Samuelson, Jeanne S. Waters, and the scientific staff of CSD.

March 2015
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Staff Information

**Staff Listing**

### Director’s Office

**Director:** David W. Fahey  
**Deputy Director, Management:** John S. Daniel  
**Deputy Director, Planning:** Eric J. Williams  
**Executive Administrative Assistant:** Suzette Milano-Schoser (STC Contractor)  
**Instrument Design/Fabrication Support:** Richard J. McLaughlin (CIRES)  
**Scientific and Technical Assistant:** Christine A. Ennis (CIRES)  
**Webmaster:** Catherine Burgdorf Rasco (CIRES)  
**Outreach/Writer/Editor:** Debra A. Dailey-Fisher  
**Emeritus Scientists:** Dan Albritton, Fred Fehsenfeld, “Ravi” Ravishankara

### Cloud and Aerosol Processes  
**Program Leader: Daniel M. Murphy**

**Administrative Support: Ronda Knott (STC Contractor)**

- Gabriela Adler (CIRES)  
- Frank Erdesz (CIRES)  
- Graham Feingold  
- Timothy D. Gordon (CIRES)  
- Daniel C. Law (CIRES)  
- Jin Liao (CIRES)  
- Ann Middlebrook  
- Elisa Sena (Guest Researcher)  
- Takanobu Yamaguchi (CIRES)  
- Charles A. Brock  
- Barbara Ervens (CIRES)  
- Karl Froyd (CIRES)  
- Jan Kazil (CIRES)  
- Zachary Lebo (CIRES)  
- Bernard Mason (CIRES)  
- Mathews Richardson (CIRES)  
- Nicholas Wagner (CIRES)

### Atmospheric Remote Sensing  
**Program Leader: W. Alan Brewer**

**Administrative Support: Ronda Knott (STC Contractor)**

- Raul J. Alvarez, II  
- Robert M. Banta  
- Aditya Choukulkar (CIRES)  
- R. Michael Hardesty (CIRES)  
- Andrew O. Langford  
- Brandi J. McCarty (CIRES)  
- Scott P. Sandberg  
- Ann M. Weickmann (CIRES)  
- Sunil Baidar (Guest Researcher)  
- James H. Churnside  
- Wynn Eberhard (CIRES)  
- Guillaume Kirgis (CIRES)  
- Richard D. Marchbanks (CIRES)  
- Yelena Pichugina (CIRES)  
- Christoph J. Senff (CIRES)
Regional Chemical Modeling
Program Leader: Michael K. Trainer
Administrative Support: Jane August
Ravan Ahmadov (CIRES) Wayne M. Angevine (CIRES)
Owen R. Cooper (CIRES) Yuyan Cui (CIRES)
Gregory J. Frost Eirh Yu Hsie (CIRES)
Si-Wan Kim (CIRES) Hyo-Jung Lee (CIRES)
Rokjin Park (Guest Researcher) Stuart A. McKeen (CIRES)

Chemical Processes and Instrument Development
Program Leader: James B. Burkholder
Administrative Support: Madeline Sturgill
François Bernard (CIRES) Yong Liu (CIRES)
Max R. McGillen (CIRES) Dimitrios Papanastasiou (CIRES)
James M. Roberts Ranajit K. Talukdar (CIRES)
Bartek Witkowski (CIRES)

Atmospheric Composition and Chemical Processes
Program Leader: Ru-Shan Gao
Administrative Support: Madeline Sturgill
Steven J. Ciciora Joseph Katich (CIRES)
Anne E. Perring (CIRES) Ellis Robinson (CIRES)
Andrew Rollins (CIRES) Joshua P. Schwarz
Hagen Telg (CIRES) Troy Thornberry (CIRES)
Laurel A. Watts (CIRES)

Chemistry and Climate Processes
Program Leader: Karen Rosenlof
Administrative Support: Madeline Sturgill
Amy Butler (CIRES) John Daniel
Sean M. Davis (CIRES) Charles S. Eubank (CIRES)
Claire Granier (CIRES) Birgit Hassler (CIRES)
Erik Larson (CIRES) H. Leroy Miller (CIRES)
Ryan Neely (CIRES) Robert W. Portmann
Eric Ray (CIRES)
Computing and Networking Resources

Senior Information Technology Manager: Joan M. Brundage

Gabrielle Accatino (CIRES)  Jennifer Fox
Kenneth Jamieson  Richard J. Tisinai (CIRES)

Tropospheric Chemistry

Program Leader: Thomas Ryerson

Administrative Support: Jane August

Kenneth C. Aikin (CIRES)  Steven S. Brown
Joost A. de Gouw (CIRES)  William P. Dubé (CIRES)
Scott Eilerman (CIRES)  Dorothy L. Fibiger (NSF Postdoctoral Fellow)
Jessica Gilman (CIRES)  John Holloway (CIRES)
Maxwell Holloway (CIRES)  Gerhard F.W. Hübner (CIRES)
Abigail Koss (CIRES)  William C. Kuster (CIRES)
Brian M. Lerner (CIRES)  Erin McDuffie (CIRES)
Sarah Monks (CIRES)  J. Andrew Neuman (CIRES)
David D. Parrish (CIRES)  Jeff Peischl (CIRES)
Steven Sjostedt (CIRES)  Chelsea Thompson (NSF Postdoctoral Fellow)
Travis Tokarek (Guest Researcher)  Patrick Veres (CIRES)
Carsten Warneke (CIRES)  Rebecca Washenfelder (CIRES)
Robert Wild (CIRES)  Bin Yuan (CIRES)
Kyle Zarzana (CIRES)

Administrative Office

Administrative Officer: Angela Nyul

Dorothea Cowan (STC Contractor)  Samantha Grauberger
Nanette Serkes (STC contractor)  Jeanne S. Waters

Names without an affiliation above (e.g., STC Contractor, CIRES) are federal employees. CIRES is the NOAA and University of Colorado-Boulder Cooperative Institute for Research in Environmental Sciences. STC is the Science and Technology Corporation. The previous listing is current as of March 2015. All subsequent analysis is based on our February 2015 staff composition.
Staff Numbers and Affiliation Since 2004

The number of federal employees has declined from 50 in 2006 to 32 today. Nevertheless, the total number of people working at CSD has remained relatively constant since CSD was formed in 2006. “Other” includes students, postdoctoral fellows, and visitors.

CRES is the Cooperative Institute for Research in Environmental Sciences. STC is the Science and Technology Corporation.

Staff Analysis by Job Function

A large majority of our staff perform scientific or engineering/technical work.
Age Distribution of CIRES and Federal Staff

The average age of the total work force in FY2014 was 47.8 years. This average was 40 and 45 years in FY1998 and FY2008, respectively.

Composition of Staff: Gender and Ethnicity

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<thead>
<tr>
<th>Gender Composition</th>
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<tr>
<td></td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>All Federal</td>
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<tr>
<td>All CIRES</td>
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<tr>
<td>STC Contractors</td>
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<tr>
<td>Other</td>
</tr>
<tr>
<td>Federal Scientists</td>
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<tr>
<td>CIRES Scientists</td>
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The percent of women in CSD’s staff in FY2014 and FY2008 was 31 and 35%, respectively.

<table>
<thead>
<tr>
<th>Ethnicity Composition (in percentages)</th>
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<tbody>
<tr>
<td></td>
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<tr>
<td>Whites not of Hispanic or Latin Origin</td>
</tr>
<tr>
<td>Asian</td>
</tr>
<tr>
<td>Hispanic</td>
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<tr>
<td>Other</td>
</tr>
</tbody>
</table>
Budget Information

Income Evolution and Attribution Since FY2008

Sources of CSD income since 2008. In FY2013, some income that had been classified as “Other NOAA” was moved into our “Weather and Air Quality Base”.

Sources of CSD income since 2008, converted to “2008 dollars” using the consumer price index for all urban consumers. Notice that “real income” in these terms has shown no increase since FY2010.
Attribution of Expenses in FY2014

Labor, federal and CIRES overhead, travel expenses, and rent represent 87% of our FY2014 expenses.

FY14 Expenses: Total = $21.6 million
Recognition

Honorary and Prestigious Memberships


Awards

International Awards

James Churnside, George W. Goddard Award, International Society for Optics and Photonics, for creativity and leadership in developing and advancing the airborne fish lidar technique, and for wide-ranging contributions to optical propagation in the atmosphere and ocean, 2011.
Susan Solomon, Volvo Environment Prize, for pioneering scientific contributions that have had major impacts on crucial environmental policies, 2009.
David Parrish, Harold Schiff Memorial Lecturer, University of York, Canada, 2009.
Sean Davis, scholarship to attend the Cargèse International School on Water Vapor in the Climate System, Cargèse, France, 2009.
Susan Solomon, Grande Medaille, French Academy of Sciences, for groundbreaking work on stratospheric ozone depletion and for leadership of the Intergovernmental Panel on Climate Change, 2008.


Susan Solomon, John Scott Award, John Scott Foundation Trust, for discoveries related to the Antarctic ozone hole, 2008.

A.R. Ravishankara, Crandell Lecturer, University of Texas, 2013; Harold Schiff Memorial Lecturer, University of York, Canada, 2012; Hinshelwood Lecturer, University of Oxford, United Kingdom, 2011; Morino Foundation Fellow and Morino Lecturer, Tokyo Institute of Technology and the National Institute for Environmental Studies, Japan 2009; Welch Foundation Lecturer, Texas, 2009; Centenary Lecturer, Indian Institute of Science, 2008.

Presidential Awards

Rebecca Washenfelder, Presidential Early Career Award for Scientists and Engineers, for pioneering work in developing and applying new measurement techniques to study atmospheric chemistry related to climate and air quality and for commitment to science education and outreach, 2012.

Susan Solomon, DOC Distinguished Presidential Rank Award, for work on the global environmental challenges related to climate change and the depletion of the Earth's ozone layer, for leadership of the science working group of the international Intergovernmental Panel on Climate Change, and for over 25 years of pioneering research at NOAA, 2008.

DOC/NOAA/OAR Awards

A.R. Ravishankara, NOAA Distinguished Career Award, for excellence in managing and providing scientific vision for NOAA’s atmospheric research programs, and in leading international science and assessment, 2015.

A.R. Ravishankara and Graham Feingold, NOAA Administrator’s Award, for work on the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report, 2014.

R. Michael Hardesty, NOAA Distinguished Career Award, for his scientific achievement and leadership in the field of atmospheric remote sensing throughout 37 years of service to NOAA, 2014.


Jim Churnside and Jim Jordan, award from OAR’s Office of Research and Technology Applications, for their patent on “Detection of Transient Signals in Doppler Spectra,” 2012.

James Meagher, NOAA Distinguished Career Award, for extraordinary leadership of NOAA’s Air Quality Program and the Chemical Sciences Division of the Earth System Research Laboratory, 2011.


Several CSD scientists, NOAA Award for Exceptional Efforts in the Deepwater Horizon disaster, 2011.


Dan Murphy, Chuck Brock, and Tom Ryerson, NOAA Bronze Medal, for leadership of the Aerosol, Radiation, and Cloud Processes affecting Arctic Climate (ARCPAC) field mission, 2010.

David Fahey, NOAA/OAR Daniel L. Albritton Outstanding Science Communicator Award, for extraordinary work in communicating scientific information about the ozone layer to decision makers, educators, and
the public worldwide through his leadership of a document known as Twenty Questions and Answers About the Ozone Layer, 2009.

Richard McLaughlin, NOAA Distinguished Career Award, for sustained, outstanding, and diverse contributions to the success of airborne sampling instruments requiring creative design skills and mechanical craftsmanship, 2009.


Debra Wilson, NOAA Distinguished Career Award, for sustained excellence in administrative and budgetary leadership for the Aeronomy Lab and Chemical Sciences Division throughout 25 years of service to NOAA, 2008.

Debra Wilson, OAR Employee of the Year Award, for sustained and cumulative contributions to administrative and budgetary management that are absolutely vital to the functioning and success of the Chemical Sciences Division, 2008.


CIRES Awards

Yelena Pichugina, CIRES Outstanding Performance in Science and Engineering, for groundbreaking research focusing on dynamic atmospheric processes at the heights of modern wind turbine rotors, work that has helped to characterize the atmospheric phenomena, turbulence, and boundary layer processes important to the wind energy industry, 2014.

Carsten Warneke, CIRES Outstanding Performance in Science and Engineering, for coordinating and leading the instrumentation of NOAA’s WP-3D research aircraft for the very successful SENEX 2013 field study, which will advance the understanding of secondary pollution formation in the southeastern U.S., 2014.


Dan Lack, CIRES Outstanding Performance in Science and Engineering Award, for his work putting black carbon emissions inventories for shipping on a sound scientific basis, which has had a major impact on policy decisions for regulation of international shipping, 2012.

Troy Thornberry, Andrew Rollins, and Laurel Watts, CIRES Outstanding Performance in Science and Engineering Award, for designing and demonstrating an airborne chemical ionization mass spectrometer (CIMS) for ultra-low water vapor measurements in the lower stratosphere, that will advance our understanding of water vapor in the climate system, 2012.

Kenneth Aikin, CIRES Outstanding Performance in Service Award, for development of the data archive for 27 field missions involving the Tropospheric Chemistry Program of CSD, 2012.

John Holloway, CIRES Outstanding Performance in Science and Engineering Award, for developing and applying an instrument using vacuum UV florescence to measure CO from an aircraft, 2009.

Eric Williams, CIRES Bronze Award, for leadership of the International Polar Year Field Mission ICEALOT, 2009.

Christine Ennis, CIRES Director’s Award, for outstanding leadership and dedication to U.S. Climate Change Science Program (CCSP) Synthesis and Assessment Products, 2009.

Allison McComiskey, CIRES Outstanding Performance in Science and Engineering Award, for leadership of observational efforts in the field of aerosol-cloud interactions and their impacts on climate change, for the DOE Atmospheric Radiation Measurements project, 2008.


**CIRES Innovative Research Program competitive grants awardees**

- **Barbara Ervens** and Veronica Vaida, “Modification of aerosol air/water interfaces due to aqueous and surface chemical reactions,” 2014.
- Noah Fierer, Joanne Emerson, **Anne Perring**, **Joshua Schwarz**, and **David Fahey**, “Are microbes a significant component of free tropospheric aerosol,” 2013.
- Christopher Williams, Laura Bianco, Paul Johnston, **Daniel Law**, and Scott Palo, “Developing a lower boundary layer radar for renewable energy research,” 2011.
- Xinzhao Chuy, John Smith, and Wentao Huang, with collaborators **R. Michael Hardesty** and Hanli Liu, “Marrying two novel lidar technologies to profile the whole atmosphere,” 2011.
Other U.S. Awards


Nanette Serkes, Unsung Hero in Federal Service Award, Rocky Mountain Region of Federally Employed Women, for her accomplishments as CSD’s Administrative Officer and in her prior federal service, 2013.

Colorado Governor’s Award for High-Impact Research, to a team of 34 federal and CIRES CSD scientists, for providing exceptional scientific service, in a time of urgent national need, by assessing the potential air quality risks posed by the 2010 oil spill in the Gulf of Mexico, and calculating independent estimates of the oil leak rate and analyses of the fate of the leaked oil in the environment, 2012. [Awarded to: Kenneth C. Akin, Ravan Ahmadov, Wayne M. Angervine, Raya Bahreini, Jerome Brioude, Charles A. Brock, Joost A. de Gouw, Barbara Ervens, David W. Fahey, Fred C. Fehsenfeld, Gregory J. Frost, Ru-Shan Gao, John S. Holloway, Daniel A. Lack, Justin M. Langridge, Stuart A. McKeen, James F. Meagher, Ann M. Middlebrook, Daniel M. Murphy, J. Andrew Neuman, John B. Nowak, David D. Parrish, Jeffrey Peischl, Anne E. Perring, Ilana B. Pollack, A.R. Ravishankara, James M. Roberts, Thomas B. Ryerson, Joshua P. Schwarz, Ryan Spackman, Harald Stark, Michael Trainer, Carsten Warneke, and Laurel A. Watts]

Steven Ciciora, David W. Fahey, Karl D. Froyd, Ru-Shan Gao, Mary Gutierrez, Gerd Hübler, Richard J. McLaughlin, Daniel M. Murphy, Anne Perring, Andrew Rollins, Karen H. Rosenlof, Joshua P. Schwarz, J. Ryan Spackman, Troy Thornberry, and Laurel A. Watts, NASA Group Achievement Award, for outstanding accomplishments by the successful Mid-latitude Airborne Cirrus Properties Experiment (MACPEX) to better understand the role of cirrus clouds in climate models, awarded 2012.


Brandi McCarty, “How will global climate changes affect ocean productivity in the tropics,” 2009.


Laurel Watts, NASA Group Achievement Award, for outstanding accomplishments for NASA and Earth science during the Genesys and Rapid Intensification Processes (GRIP) Airborne Earth Science Mission in 2010, awarded in 2011.

Susan Solomon, Career Achievement Award, Samuel J. Heyman Service to America Medals of the Partnership for Public Service, 2010.


Joshua Schwarz, Laurel Watts, and Ru-Shan Gao, NASA Group Achievement Award, for the successful completion of this “first of its kind,” innovative flight test program for airborne earth science instruments in Newley-Operating and Validated Instruments Comparison Experiment (NOVICE), awarded 2009.


David Fahey and John S. Daniel, Co-recipients of the 2008 Level II Scientific and Technological Achievement Award (STAA) from the U.S. Environmental Protection Agency (EPA), for synthesis and communication of stratospheric ozone and climate science, awarded 2009.


David Fahey, John Daniel, and others, group award, U.S. Environmental Protection Agency Stratospheric Ozone Protection Award, for coauthoring a groundbreaking 2007 paper that calculated the climate benefits of the Montreal Protocol, 2008.

David Fahey, individual award, U.S. Environmental Protection Agency Stratospheric Ozone Protection Award, for his work on many aspects of stratospheric ozone depletion and the impact of aviation on ozone and climate, 2008.

Dan Murphy, Benjamin Liu award for aerosol instrumentation, American Association for Aerosol Research, 2008.

Susan Solomon, Time Magazine’s 100 World’s Most Influential People, 2008.

Susan Solomon, American Geological Institute Award for Outstanding Contribution to Public Understanding of the Geosciences, 2008.

Robert Banta, American Meteorological Society, first Mountain Meteorology Award by the Mountain Meteorology Committee of the AMS, for outstanding contributions to mountain meteorology, 2008.
Refereeing/Reviewing Awards

Amy Butler, Editor’s Citation for Excellence in Refereeing, Journal of Geophysical Research-Atmospheres, 2014.

Owen Cooper, Editor’s Citation for Excellence in Refereeing, Journal of Geophysical Research-Atmospheres, 2014.


Barbara Ervens, Editors’ Citation for Excellence in Refereeing for Environmental Science and Technology, 2013.

Dan Murphy, Editors’ Appreciation Award for reviewing, American Chemical Society, 2011.

Ilana Pollack, Editors’ Appreciation Award for reviewing, American Chemical Society, 2011.

Recognition from Academia

Steve Brown and Joost de Gouw, elected as Professor Adjoint in the Department of Chemistry and Biochemistry at the University of Colorado Boulder, 2014.

Abigail Koss, Carol B. Lynch Graduate Fellowship, University of Colorado-Boulder, 2014.

David Fahey, Distinguished Alumni Award, University of Wisconsin-Madison Physics Department, 2013.


Recognition of Publications

Individuals: Highly Cited

Daniel Murphy and Ann Middlebrook are among the Most Highly Cited Researchers in the geosciences over the 2000-2012 period, according to Thompson Reuters. The list covers the top 1% of cited papers published in that time period. Eight others in NOAA are also on the geosciences list.

Specific Publications: Highly Cited/High Impact

Geophysical Research Letters, selection as one of the 40 most cutting-edge papers over the 1974-2014 period, for the journal's 40th Anniversary special section:


Atmospheric Science and Technology, most highly cited papers of 2011-2013: CSD scientists are authors on 2 of the top 5 papers:


Elsevier publishers, number 14 of the top-25 most downloaded articles published in Atmospheric Environment for the first half of 2013, and one of the top-50 most cited articles published in Atmospheric


New Hot Paper in the field of Geosciences (one of the most cited papers in its discipline in the last two years), Thomson Reuters Essential Science IndicatorsSM: Irreversible Climate Change Due to Carbon Dioxide Emissions, S. Solomon, G.-K. Plattner, R. Knutti, and P. Friedlingstein, Proceedings of the National Academy of Sciences, 106, 6, 2009. Awarded in 2010.


**Publication Awards**


**Editor’s Highlight**


Recognition of Posters/Presentations

Abigail Koss, American Geophysical Union Outstanding Student Paper Award (Atmospheric Sciences category), for "Derived Emission Rates and Photochemical Production Rates of Volatile Organic Compounds (VOCs) Associated with Oil and Natural Gas Operations in the Uintah Basin, UT During a Wintertime Ozone Formation Event,” AGU Fall Meeting, 2014.

Alexis Attwood, Outstanding Poster Award, DOC Boulder Laboratories Postdoctoral Poster Symposium, 2014.

Shona Smith, Outstanding Poster Award, DOC Boulder Laboratories Postdoctoral Poster Symposium, 2012.

Tara Kahan, Outstanding Poster Award, DOC Boulder Laboratories Postdoctoral Poster Symposium, 2011.

Ryan Neely, American Geophysical Union, Outstanding Student Paper Award, for “Initial Results of the Cloud, Aerosol Polarization and Backscatter Lidar at Summit, Greenland,” AGU Fall Meeting, 2011.

Awards for outstanding oral and poster presentations by students and early-career scientists at the October 2011 World Climate Research Program (WCRP) Climate Conference in Denver, Colorado:

- Ryan Neely, a University of Colorado student and CIRES scientist in CSD’s Chemistry and Climate Processes Program, received an award for his oral presentation, “Trends and Annual Cycles in the Background Stratospheric Aerosol Layer” [coauthored with Susan Solomon, John Barnes, and Ellsworth Dutton]

- Irina Mahlstein, a CIRES scientist in CSD’s Chemistry and Climate Processes Program, for “September Arctic sea ice predicted to disappear for 2°C global warming above present” [poster coauthored with Reto Knutti]

- Andrew Rollins, a CIRES scientist in CSD’s Atmospheric Composition and Chemical Processes Program, for “SPARC Water Vapor Assessment: Measurements of water vapor in the upper troposphere and lower stratosphere with CIMS during the 2011 MACPEX mission” [poster coauthored with Troy D. Thornberry, Ru-Shan Gao, David W. Fahey, Emrys G. Hall, Allen F. Jordan, Dale F. Hurst, Cornelius Schiller, Nicole Spelten, Martina Kraemer, Jessica B. Smith, Maryann R. Sargent, and David S. Sayres]

- Paul J. Young, a CIRES scientist in CSD’s Chemistry and Climate Processes Program, for “Modeling the impact of late 20th century stratospheric ozone changes: Sensitivity to different ozone forcing data sets” [poster coauthored with Susan Solomon, Birgit Hassler, Greg Bodeker, Robert W. Portmann, and Jean- Francois Lamarque]

- Birgit Hassler, a CIRES scientist in CSD’s Chemistry and Climate Processes Program, for “Twenty-five years of ozonesonde measurements at South Pole: An assessment of changing loss rates” [poster coauthored with Susan Solomon, John S. Daniel, Samuel J. Oltmans, and Bryan Johnson]


Rebecca Washenfelder, Outstanding Poster Award, DOC Boulder Laboratories Postdoctoral Poster Symposium, 2009.

Armin Sorooshian, Outstanding Poster Award, DOC Boulder Laboratories Postdoctoral Poster Symposium, 2009.
Patrick Veres, American Geophysical Union Outstanding Student Paper Award, AGU Fall Meeting, 2009.

Rebecca Washenfelder, Outstanding Poster Award, DOC Boulder Laboratories Postdoctoral Poster Symposium, 2008.

Hailong Wang, Outstanding Poster Award, DOC Boulder Laboratories Postdoctoral Poster Symposium, 2008.

Jeff Peischl, Outstanding Poster Award, DOC Boulder Laboratories Postdoctoral Poster Symposium, 2008.

Recognition of Outreach/Education/EEO/Diversity Efforts

Debra Dailey-Fisher, for helping to lead NOAA’s efforts in providing opportunities to high school and college students, State of Colorado, “Governor’s Summer Job Hunt 2012,” awarded 2012.

MacKenzie Metcalfe, high school student intern at CSD, for her initiative and contributions as a summer intern working for NOAA, State of Colorado, “Governor’s Summer Job Hunt 2012,” awarded 2012.

MacKenzie Metcalfe, high school student intern at CSD, Greenhouse Scholar, program to support high-performing, under-resourced college students, 2012.
Leadership Roles

NOAA Roles

Stu McKeen, Member, design review committee for updates to the National Centers for Environmental Prediction (NCEP) air quality forecast program (2005-present).

Robert Banta, Coordinator, for CSD’s activities in ESRL’s new multi-laboratory, multi-agency Renewable Energy Program (2008-present).

Yelena Pichugina, Member, NOAA Renewable Energy Team, (2009-Present).


David Fahey, Member, NOAA OAR Geoengineering Working Group (2012-present).


Co-lead, Atmospheric Composition, Carbon Cycle, and Climate Program of the NOAA Climate Program Office: A.R. Ravishankara (2011-2013) and David Fahey (2014-present).


David Fahey, Member, NOAA Unmanned Aircraft System (UAS) Team and High-Altitude Long-Endurance (HALE) Working Group (2008-2010).

CIRES Roles

Joost de Gouw, CIRES Co-Associate Director for Environmental Chemistry, (2013-present).

Fred Fehsenfeld, CIRES Associate Director for Environmental Chemistry, (1998-2013).


Allison McComiskey (Chair), Jessica Gilman (Vice-Chair), Rick Tisinai (Vice-Chair), Brandi McCarty (Member), Anne Perring (Member), Ken Aikin (Member), CIRES Members Council, various terms, (2008-2015).

Other Federal Roles


**Allison McComiskey**, Member, Science and Infrastructure Steering Committee, Department of Energy Atmospheric Radiation Measurement (ARM) and Atmospheric System Research (ASR), (2009-present).


**Andrew Langford**, Principal Investigator, NASA Tropospheric Ozone Lidar Network (TOLNet), (2011-present).


### U.S. Non-Federal Roles

**J. Andrew Neuman**, Member, Scientific Advisory Board, Texas Air Research Center (2009-present).

**David Parrish** and **Fred Fehsenfeld**, Members, Independent Technical Advisory Committee (ITAC), Texas Air Quality Research Program (2010-present).

**Allison McComiskey**, Member, American Meteorological Society (AMS) Committee on Radiation (2012-present).

**Yelena Pichugina**, Member, American Meteorological Society (AMS) Renewable Energy Committee (2012-present).

**Chuck Brock**, member, ACCORD Aircraft Inlet Committee, National Science Foundation, (2015-present).


**Wayne Angevine**, Chair, American Meteorological Society Committee on Boundary Layers and Turbulence (2009-2012).

**R. Michael Hardesty**, Councilor (2010-2012) and Member of the Executive Committee (2011-2012) of the American Meteorological Society.

**Yelena Pichugina**, Member, Colorado Research and Education in Wind (CREW), (2009-2011).


International Roles


Owen Cooper, Member and sub-project leader, United Nations Task Force on Hemispheric Transport of Air Pollution (TF HTAP), established by the Executive Body of the UNECE (United Nations Economic Commission for Europe) (2006-present).


David Fahey, Steering Committee, Stratospheric Processes and their Role in Climate program (SPARC) (2007-present).

Graham Feingold, Cochair, Aerosols, Clouds, Precipitation, and Climate (ACPC), Project of the International Global Atmospheric Chemistry Project of IGBP, and Scientific Steering Committee member (2008-present).


Christoph Senff, Member, International Coordination Group on Laser Atmospheric Studies (2008-present).

James B. Burkholder, Member of WMO Absorption Cross Sections of Ozone (ASCO) Experts Committee, 2009-Present.

Amy Butler, Committee Member, SPARC Dynamics and Variability (DynVar) working group (2010-present).

A.R. Ravishankara, Member, Board of the International Atmospheric Chemistry Society (2010-present).

Claire Granier, Member, Steering Committee of the International Global Atmospheric Chemistry Project (IGAC) of the International Geosphere-Biosphere Programme (2011-present).

David Fahey, Member, Impacts and Science Group (ISG) of the Committee on Aviation Environmental Protection (CAEP) of the International Civil Aviation Organization (ICAO) (2011–present).

Greg Frost, Cochair, GEIA (Global Emissions Initiative) of the International Geosphere-Biosphere Programme (IGBP) (2012-present).

Claire Granier, Databases Director, GEIA (Global Emissions Initiative) of the International Geosphere-Biosphere Programme (IGBP) (2012-present).

Si-Wan Kim, Member, Task Force on Hemispheric Transport of Air Pollutants (HTAP), established by the Executive Body of the UNECE (United Nations Economic Commission for Europe) (2012–present).

Tom Ryerson (Lead); David Fahey and Ken Aikin (Members), IGAC/SPARC Chemistry-Climate Model Initiative (CCMI) working group on improved evaluation of chemistry-climate models using in-situ research aircraft data (2012-present).

Tom Ryerson, Scientific Steering Committee Member, IGAC/SPARC Chemistry-Climate Model Initiative, (2013-present).


Tom Ryerson, Member, EU Monitoring Atmospheric Composition and Climate – Interim Implementation (MACC-II) User Advisory Board (2014-present).

David Fahey, Member, International Commission on Atmospheric Chemistry and Global Pollution (ICACGP) of International Association of Meteorology and Atmospheric Science (IAMAS) (2014-present).


David Fahey, Member, Steering Committee, Chemistry Climate Model Validation program, Stratospheric Processes and their Role in Climate (2003–2008).

Karen Rosenlof, Member, Advisory Board of the European Space Agency SPARC Initiative (SPIN) (2013).


Graham Feingold, Member, Scientific Steering Committee of the International Global Atmospheric Chemistry project (IGAC) of IGBP (2008-2013).


Jim Meagher, Member and Cochair, Executive Committee of NARSTO (international U.S.-Canada-Mexico research coordinating organization for air quality) (2008-2012).


David Parrish, Member, Task Force on Hemispheric Transport of Air Pollutants (HTAP), established by the Executive Body of the UNECE (United Nations Economic Commission for Europe) (2006–2011).

Claire Granier, Member, Scientific Steering Committee, Analysis, Integration, and Modeling of the Earth System (AIMES) project of the International Geosphere-Biosphere Programme (IGBP) (2005-2010).


Graham Feingold, Member, WMO/IUGG International Aerosol-Precipitation Scientific Assessment Group (IAPSAG) (2004–2008).


Fred Fehsenfeld, Co-founding group of NARSTO (international U.S.-Canada-Mexico research coordinating organization for air quality) and past Steering Committee member.

Field Mission Leadership Roles

Joost de Gouw (Principal Investigator), Shale Oil and Natural Gas Nexus (SONGNEX), 2015.


David Fahey (Co-Platform Scientist), the NASA Global Hawk Unmanned Aircraft System (UAS) in the NASA Airborne Tropical TrOposphere Experiment (ATTREX), (2010-2015).


Tom Ryerson (Science Team Leader) and David Fahey (Science Team Member), Atmospheric Tomography Mission (ATom), (2015-2019).


Joost de Gouw (Mission Lead), Southeast Nexus: Studying the Interactions Between Natural and Anthropogenic Emissions at the Nexus of Climate Change and Air Quality (SENX) field mission, 2013.

Andrew Langford (Principal Investigator), Las Vegas Ozone Study (LVOS), 2013.

Karen Rosenlof (Member, leadership team), Studies of Emissions and Atmospheric Composition, Clouds and Climate Coupling by Regional Surveys (SEAC4RS) field mission, 2013.


Jessica Gilman, (Lead Organizer), Summer Ozone Near Natural gas Emissions (SONNE) field experiment, Boulder Atmospheric Observatory, summer 2012.

Owen Cooper (Steering Committee member), NCAR’s Deep Convective Clouds and Chemistry (DC3) experiment, (2005-2012).

Tom Ryerson (Principal Investigator), NOAA NO2 instrument on the NASA DC-8, SEAC4RS, (2012-2013).

Bob Banta, Alan Brewer, and Yelena Pichugina (Co-Leads), Turbine Wake and Inflow Characterization Study (TWICS), 2011.

Steve Brown (Co-Principal Investigator), Nitrogen Aerosol Composition and Halogens on a Tall Tower (NACHTT), 2011.

David Fahey (Co-Project Scientist), the NASA Global Hawk Pacific (GloPac) Mission using the NASA Global Hawk Unmanned Aircraft System (UAS), 2010.

Tom Ryerson, Dan Murphy, David Parrish, Eric Williams, Joost de Gouw (Co-Leads), CalNex field mission, California, 2010.

Owen Cooper, Principal Investigator, IONS 2010 Ozonesonde Experiment during CALNEX, California, 2010.

Dan Murphy, Tom Ryerson, and Chuck Brock (Co-Leads), the Aerosol, Radiation, and Cloud Processes affecting Arctic Climate (ARCPAC) Mission, 2008.

Conferences (Chair, Convener, Session Organizer, etc.)


Owen Cooper (Planning Committee), Transboundary Ozone Pollution Conference, Yosemite, California, 2015.


Steve Brown (Chair) and Rebecca Washenfelder (Organizing Committee), 11th International User Meeting and Summer School on Cavity Enhanced Spectroscopy, Boulder, Colorado, summer 2015.


Mike Hardesty (Session Chair), American Meteorological Society Annual Meeting, 2013 and 2015.


Stu McKeen (Organizing Committee), U.S. Weather Research Program (USWRP) Air Quality Program Workshop sponsored by NOAA’s Office of Weather and Air Quality, Greenbelt, Maryland, 2014.


Sean Davis (Session Convener and Chair), “Reanalysis: Evaluation and Intercomparison,” Fall Meeting of the American Geophysical Union, 2014.

Steve Brown (Convener) and David Parrish (Chair), “Air Quality in Asia,” Fall Meeting of the American Geophysical Union, 2014.

Jan Kazil (Chair and Primary Convener), “Warm Boundary Layer Clouds and Climate Change from the Cloud- to the Global Scale,” Fall Meeting of the American Geophysical Union, 2014.

Troy Thornberry (Chair, Convener), “Processes Controlling Upper Troposphere/Lower Stratosphere Composition and Structure,” Fall Meeting of the American Geophysical Union, 2014.
Joost de Gouw (Chair, Convener), “Atmospheric Gas-Phase and Aerosol Chemistry over the Southeastern United States,” Fall Meeting of the American Geophysical Union, 2014.


Barbara Ervens (Workshop Organizer), Aerosols and Clouds: Connections from the Laboratory to the Field to the Globe, Telluride Science Research Center, Telluride, Colorado, 2014.


Steve Brown (Chair), Gordon Research Conference on Atmospheric Chemistry, Vermont, 2013.


Christoph Senff (Session Chair), Annual Meeting of the American Meteorological Society, Austin, Texas, 2013.


Jan Kazil (Chair and Session Convener), “Wet Scavenging and Deposition: Quantification, Mechanistic Understanding, and Impacts,” Fall Meeting of the American Geophysical Union, 2013.


James Roberts (Session Co-Convener), “Atmospheric Impacts of Oil and Gas Development,” Fall Meeting of the American Geophysical Union, 2013.

Jim Churnside (Program Committee Member and Session Chair), SPIE Conference on Ocean Sensing and Monitoring III and IV, 2012 and 2013.


Mike Hardesty (Session Chair) International Symposium on Tropospheric Profiling, 2012.


Christoph Senff (Session Chair), 26th International Laser Radar Conference, Porto Heli, Greece, 2012.

Robert Banta (Facilitator and Discussion Group Leader), Department of Energy Complex Flow Workshop (became the template for DOE’s second Wind Forecast Improvement Program, currently in the planning stages), 2012.


Jan Kazil (Chair and Session Convener), ”Nanoparticles in the Earth's Atmosphere," Fall Meeting of the American Geophysical Union, 2012.
Mike Hardesty (Symposium Cochair and Session Chair), 16th International Symposium for the Advancement of Boundary-Layer Remote Sensing, Colorado, 2012.


Mike Hardesty (Session Chair), International Laser Radar Conference, 2010 and 2012.


Steve Brown (Vice-Chair), Gordon Research Conference on Atmospheric Chemistry, Vermont, 2011.


Mike Hardesty (Organizer), NOAA/NSF Workshop on Tropospheric Profiling Technologies, 2011.


Jan Kazil (Chair and Session Convener), "Coupled Ocean Atmosphere Land Processes in Tropical Eastern Oceans," Fall Meeting of the American Geophysical Union, 2011.


Ru-Shan Gao (Session Chair), “Aerosol Modeling I,” 7th Asian Aerosol Conference, Xi’an, China, 2011.

David Fahey (Member, Organizing Committee), NOAA Climate Variability and Change Science Challenge Workshop, Boulder, Colorado, 2011.


Yelena Pichugina (Session Organizer, Chair, and Judge of student presentations), “Weather-driven Renewable Energy session,” Fall Meeting of the American Geophysical Union, 2011.


Graham Feingold (Session Convener), Fall Meeting of the American Geophysical Union, 2010 and 2011.

Tom Ryerson (Convener), Boulder Deepwater Horizon Joint Chemical Analysis meeting, 2011.

Owen Cooper (Session Convener), “Impact of Baseline Ozone and Particulate Matter on Surface Air Quality,” Fall Meeting of the American Geophysical Union, 2011.

David Parrish (Session Convener), “Climate Change, Air Quality and Their Interrelations at the North American West Coast,” Fall Meeting of the American Geophysical Union, 2010.


Karen Rosenlof and Sean Davis (Conveners), special session on tropical extent, Fall Meeting of the American Geophysical Union, 2010.


Chuck Brock (Session Convener), "Composition of the Arctic Atmosphere: Sources, Transport, Chemistry, and Impacts on Clouds and Climate," Fall Meeting of the American Geophysical Union, 2009.

Chuck Brock (Workshop Convener), ARCPAC Data Workshop, 2009.


Christoph Senff (Steering Committee Member and Cochair of the Program Committee), 24th International Laser Radar Conference (under the auspices of the International Radiation Commission, International Association of Meteorology and Atmospheric Physics), 2008.

Karen Rosenlof (Member, Organizing Committee), Chapman Water Vapor Conference, 2008.


R. Michael Hardesty (General Cochair), 24th International Laser Radar Conference (under the auspices of the International Radiation Commission, International Association of Meteorology and Atmospheric Physics), 2008.


Robert Banta (Session Chair), AMS Boundary Layers and Turbulence, Stockholm, Sweden, 2008.
Service to the Scientific Community

Editorships


Jim Churnside, Associate Editor, *Optics Express* (2011-present).


Greg Frost, Guest Editor, *Atmospheric Chemistry and Physics* (2013-present)


Owen Cooper, Associate Editor, *Elementa* (2013-present).


Chuck Brock, Panel Member, National Center for Atmospheric Research (NCAR) Observing Facilities Assessment Panel (OFAP), 2015-2018.

Barbara Ervens, Editor, Inter-Journal Special Issue: *Atmospheric Chemistry and Physics/Atmospheric Measurement Techniques*, Results from the Ice Nucleation Research Unit (INUIT) (2014).


Barbara Ervens, Member, Editorial Board, *Atmospheric and Climate Sciences* (2011-2012).


Christoph Senff, Associate Editor, *Journal of Atmospheric and Oceanic Technology* (2008-2011).


R. Michael Hardesty, Chief Editor, Atmospheres, AMS *Journal of Atmospheric and Oceanic Technology* (2006-2010).


Dan Murphy, Editor, *Aerosol Science and Technology* (2004-2008).

Reviewer for Programs/Organizations

Barbara Ervens, Reviewer, INUIT program (Ice Nucleation Research Unit), German Research Foundation, 2014.

Birgit Hassler, Reviewer, NASA, focused on Suomi National Polar-Orbiting Partnership (Suomi NPP) Science Team (ST) research, 2014.

Aditya Choukulkar, Reviewer, INUIT program (Ice Nucleation Research Unit), German Research Foundation, 2014.


Allison McComiskey, Reviewer, Argonne National Laboratory, 2013.

Barbara Ervens, Reviewer, European Research Area (ERA) “Chemistry” (European Commission), 2013.


Joost de Gouw, Panel Reviewer, Department of Energy, Brookhaven National Laboratory Science Focus Area Review, Influences of Aerosols and Clouds on Climate and Climate Forcing, 2013.


A.R. Ravishankara, Chair, panel on “Atmosphere and Climate,” reviewing research of Germany’s Helmholtz Association, 2012-2013.


J. Andrew Neuman, Reviewer, National Science Foundation (NSF) Office of Polar Programs Arctic Natural Sciences Program (2009-2013).

Karen Rosenlof, Reviewer, SHARP Program (German stratospheric research program), Berlin, 2012.

Anne Perring, Reviewer, NOAA Climate Program’s Earth System Science AC4 proposals, 2012.


R. Michael Hardesty, Member, NCAR Earth Observing Laboratory External Advisory Committee, 2010-2014; Chair, 2013-2014.

Barbara Ervens, Reviewer, France’s National Research Agency (Agence Nationale de la Recherche), 2011-2013.

David Fahey, Reviewer, Cooperative Institute for Climate Science (CICS) at Princeton University and the NOAA Geophysical Fluid Dynamics Laboratory at the invitation of the NOAA/OAR Cooperative Institutes Program, 2012.

Robert Banta, Team Leader, two Department of Energy proposal evaluation sessions, 2011.

Joost de Gouw, Panel Reviewer, EPA Star Grant Program, Graduate Student Fellowships, 2011.


Barbara Ervens, Reviewer, National Science Foundation (NSF) Atmospheric Chemistry Program, 2009-2012.

David Fahey, Member, Observing Facilities Assessment Panel (OFAP), National Center for Atmospheric Research, Boulder, Colorado, 2007-2011.


Graham Feingold, Review Committee Chair, Department of Energy, Pacific Northwest National Laboratory, 2006-2011.

Karen Rosenlof, Reviewer, SPARC Data Initiative, 2011.


Barbara Ervens, Reviewer, Netherlands’ Organisation for Scientific Research (Council Earth and Life Sciences), 2009.


Karen Rosenlof, Review Panelist, for the NOAA Atmospheric Composition & Climate Program external proposals, Silver Spring, Mardland, 2009.
Education and Mentorship

Mentors for Graduate, Undergraduate, or High School Students

**Greg Frost**, Mentor, high school student, So-Yun Kim (Fairview High School, Boulder), 2014.

**Henry LeRoy Miller, Jr.**, Mentor, high school graduate and incoming freshman Annie Davis (Miami University of Ohio), 2014.


**Debra Dailey-Fisher**, Mentor, Jessica Lucas (Pima Medical School, Denver), Adrienne Bauduit (Spelman College), Zita Toth (Colorado College, Colorado Springs), Mackenzie Metcalfe (University of Northern Colorado, Greeley), Annie Davis (Boulder High School, Boulder), Libby Samuelson and Scout Ennis (University of Colorado, Boulder), Eli Lane (Regis University), various terms, 2008-present.


**Robert Banta**, Mentor/Sponsor, Thomas Damian (Karlsruhe Institute of Technology) for three months of “study abroad” at ESRL, 2014.


**Andrew Langford** and **David Parrish**, Mentors, high school student Melody Dong (Poudre High School), High School Internship and Research Opportunities (HIRO) program of the National Center for Atmospheric Research, 2011.


**Joost de Gouw**, Mentor, Hollings Undergraduate Scholars (Abigail Koss, Massachusetts Institute of Technology, 2011; Rosemary Kanters, Ohio University, 2012; Megan Dumas, Stonehill College, 2013; Luis Martinez, University of Texas Brownsville, 2014).


**Steve Brown**, Mentor, Hollings Undergraduate Scholars (Reed Womack, Dartmouth University, 2013; Thomas Langel, University of Wisconsin, 2010).

**Rebecca Washenfelder**, Mentor, Hollings Undergraduate Scholar (Taylor Brownlee, Arizona State University, 2011).

**Ru-Shan Gao**, Mentor, graduate school student Alexander Ting (Georgia Tech), 2014.

**Rebecca Washenfelder**, Mentor, graduate students Jessica Axson (University of Colorado, 2010-2011) and Ryan Thalman (University of Colorado, 2008).

**Jim Churnside** and **Brandi McCarty**, Mentors, Hollings Undergraduate Scholar (Emmitt Perl, University of San Diego, 2011).

**Chuck Brock**, Mentor, John Trytko, undergraduate research assistant in electrical engineering, 2010-2013.

**Jessica Gilman**, Mentor, 3 undergraduate students, 2013 SENEX field mission.

**Joost de Gouw** and **Carsten Warneke**, Mentor of Visiting Graduate Students (Kanako Sekimoto, Yokohama City University, Japan, 2009; Yuan Bin, Peking University, China, 2010; Trevor Vandenboer,
Toronto University, Canada, 2010; Warda Ait-Helal, University of Lille, France, 2011; Felix Geiger, Karlsruhe Institute of Technology, Germany, 2011.

**Christoph Senff** and **Brandi McCarty**, Mentors, high school student Kevin Marrero (Colegio San Benito, Puerto Rico), High School Internship and Research Opportunities (HIRO) program of the National Center for Atmospheric Research, 2011.


**Christine Ennis**, Mentor, high school student, High School Internship and Research Opportunities (HIRO) program of the National Center for Atmospheric Research, 2010.


**Advisor or Defense Committee for Ph.D. Candidates**

**Joost de Gouw**, advisor for Ph.D. candidates at the University of Colorado (Dan Bon, 2004-2011; Patrick Veres, 2005-2011; Rui Li, 2011-present; and Abigail Koss, 2013-present).


**Greg Frost**, Member of Ph.D. comprehensive exam committee, Kristen Brown, University of Colorado, Boulder, 2014.


**Graham Feingold**, member of Ph.D. thesis committees of three students at the University of Colorado, and external examiner for one student at the University of Warsaw, Poland, 2013.

**Carsten Warnke**, member of Ph.D. thesis committee of Elena Crespo, University of Nijmegen, the Netherlands (2012).


**Graham Feingold**, member of Ph.D. thesis committees of three students at the University of Colorado, and external examiner for student at the University of Warsaw, Poland (2013), University of Oslo (2014) and Wageningen University (2014).

## Other Education Contributions


**Anne Perring**, Presenter, NOAA 8th Grade Science Days at the NOAA Earth System Research Laboratory, Boulder, Colorado (2011-2014).


**Anne Perring**, Scientific Reviewer of various resources of CLEAN (Climate Literacy & Energy Awareness Network), CIRES Education and Outreach (2012-2014).

**Scott Sandberg**, Presenter, ozone lidar, for tour of 400 7th graders during DISCOVER-AQ mission, Houston, Texas (July 2014).

**David Parrish**, Mentor, high school science teacher, STEM Teacher and Researcher (STAR) Program (2013).


**Anne Perring**, Reviewer, NOAA Hollings Scholarship applications (2012-2013).


**Jessica Gilman**, Contributor, Earth Explorers middle school science project (April 2012).


Barbara Ervens, Scientific Reviewer, various resources of CLEAN (Climate Literacy & Energy Awareness Network), CIRES Education and Outreach (2012).

Robert Banta, Invited Lecturer, academic Mountain Meteorology class lecture on “Measurement Techniques: Sampling the Mountain Atmosphere,” University of Utah, Salt Lake City (2012).

Raul Alvarez, Scientist Participant/Contributor, NOAA Teacher at Sea program during the DYNAMO Experiment aboard the NOAA Ship R/V Ronald H. Brown (2011).

John S. Daniel, General public talk on climate change to Westminster 7:10 Rotary Club (September, 2011).


Robert Banta, Distinguished Lecturer, AMS Short Course on Mountain Meteorology, Mountain Weather Workshop (2008).


James B. Burkholder, ISET Summer Student Mentor, Chris Ware, PI S. Bililign, U. of North Carolina A&T.
Collaborations

As noted in the Publications Metrics section of this document (see page 53), CSD’s research is highly collaborative. In the January 2008-February 2015 time period, a large fraction (86%) of CSD’s journal publications involved external coauthors, and CSD collaborations cross national boundaries to involve international researchers 44% of the time. In addition to these scientist-to-scientist collaborations, CSD partners with many national and international organizations on research projects, field missions, scientific assessments, and other endeavors.

This section lists some of our major collaborations and partnerships.

Major Research Collaborations

NOAA and Cooperative Institutes

CSD’s peer-reviewed journal articles involve coauthors from CIRES 79% of the time, and coauthors from other NOAA Laboratories and Programs 20% of the time.

Cooperative Institute for Research in Environmental Sciences (CIRES)

Office of Oceanic and Atmospheric Research Laboratories:
  • Air Resources Laboratory
  • Atlantic Oceanographic and Meteorological Laboratory
  • Earth System Research Laboratory (Global Monitoring Division, Physical Sciences Division, and Global Systems Division)
  • Geophysical Fluid Dynamics Laboratory
  • Great Lakes Environmental Research Laboratory
  • National Severe Storms Laboratory
  • Pacific Marine Environmental Laboratory

NOAA Programs:
  • Climate Program Office
  • Office of Weather and Air Quality

Other NOAA relationships:
  • Office of Marine and Aviation Operations (including the Aircraft Operations Center)
  • National Environmental Satellite, Data, and Information Service
  • National Marine Fisheries Service
  • National Weather Service

U.S. Federal

CSD’s peer-reviewed journal articles involve coauthors from other Federal agencies 28% of the time.

Air Force Weather Research Agency

Department of Agriculture (National Forest Service (Fire Science Laboratory))

Department of Commerce (National Institute of Standards and Technology)

Department of Energy (including Pacific Northwest National Laboratory; Lawrence Livermore National Laboratory; Argonne National Laboratory; Brookhaven National Laboratory; Atmospheric Radiation Measurement Program, National Renewable Energy Laboratory)

Department of Interior (including Bureau of Land Management; Bureau of Ocean Energy Management (Louisiana); National Park Service (IMPROVE network))

Department of Labor (Occupational Health and Safety Administration)
Department of State
Environmental Protection Agency
National Aeronautics and Space Administration (including Ames Research Center, Goddard Space Flight Center, Jet Propulsion Laboratory, Langley Research Center)
National Science Foundation
U.S. Navy

U.S. State or Municipal Agencies
California Air Resources Board
California Energy Commission
Clark County (NV) Department of Air Quality
Colorado Department of Public Health and Environment
Denver Regional Air Quality Council
Texas Commission on Environmental Quality
Utah Department of Environmental Quality

U.S. Research Organizations
National Center for Atmospheric Research
Scripps Institution of Oceanography

International Research Organizations
Multi-National
European Space Agency
International Geosphere-Biosphere Programme (IGBP) – International Global Atmospheric Chemistry Project (IGAC)
World Climate Research Programme (WCRP) – Stratosphere-troposphere Processes and their Role in Climate (SPARC)
World Meteorological Organization

National
Alfred Wegener Institute of Polar and Marine Research (Germany)
Centre National de la Recherche Scientifique (France)
Chinese Academy of Sciences (China)
Deutsches Zentrum fuer Luft- und Raumfahrt (DLR) (Germany)
Environment Canada (Canada)
Forschungszentrum Jülich (Germany)
Karlsruhe Institute of Technology (Germany)
Royal Netherlands Meteorological Institute (KNMI) (The Netherlands)
Laboratorie d’Aerologie (France)
Laboratoire de l’Atmosphère et des Cyclones/Maido Observatory at La Réunion (France)
Max Planck Institute for Biochemistry (Germany)
Max Planck Institute for Chemistry (Germany)
Max Planck Institute for Meteorology (Germany)
Meteorological Research Institute (Japan)
Norwegian Institute for Air Research (NILU) (Norway)
National Institute for Public Health and the Environment (RIVM) (The Netherlands)
Swiss Federal Institute of Technology (ETH) (Switzerland)
UK Facility for Airborne Atmospheric Measurements (UK)

Academia
CSD’s peer-reviewed journal articles involve coauthors from academia 72% of the time.

California Institute of Technology (U.S.)
Cambridge University (U.K.)
Carnegie Mellon University (U.S.)
Colorado State University (U.S.)
Columbia University (U.S.)
Dalhousie University (Canada)
Danish Technical University (Denmark)
Georgia Institute of Technology (U.S.)
Harvard University (U.S.)
Hebrew University (Israel)
Hendrix College (U.S.)
Hiram College (U.S.)
Hokkaido University (Japan)
Johns Hopkins University (U.S.)
Kyoto University (Japan)
Leipzig University (Germany)
Massachusetts Institute of Technology (U.S.)
Memorial University (Canada)
Montana State University (U.S.)
Oregon State University (U.S.)
Oxford University (U.K.)
Peking University (China)
Pennsylvania State University (U.S.)
Reading University (U.K.)
Rutgers University (U.S.)
Saint Louis University (U.S.)
State University of New York-Stony Brook (U.S.)
Texas A&M University (U.S.)
Texas Technical University (U.S.)
University of Alabama in Huntsville (U.S.)
University of Arizona (U.S.)
University of Bern (Switzerland)
University of Calgary (Canada)
University of California (Berkeley, Davis, Irvine, Los Angeles, San Diego, Santa Cruz) (U.S.)
University of Colorado-Boulder (U.S.)
University of Hohenheim (Germany)
University of Houston (U.S.)
University of Lancaster (U.K.)
University of Leeds (U.K.)
University of Maryland (U.S.)
University of Miami (U.S.)
University of Minnesota (U.S.)
University of Montana (U.S.)
University of New South Wales (Australia)
University of North Carolina (U.S.)
University Pierre and Marie Curie (France)
Universitat Politecnica de Catalunya (Spain)
University of Rhode Island (U.S.)
University of Southern Mississippi (U.S.)
University of Texas (U.S.)
University of Toronto (Canada)
University of Utah (U.S.)
University of Warsaw (Poland)
University of Washington (U.S.)
University of Wisconsin (U.S.)
University of Wyoming (U.S.)
Utah State University (U.S.)
Weizmann Institute of Science (Israel)
Yale University (U.S.)
York University (Canada)

Private Sector, Industry, and Industry Groups
CSD’s peer-reviewed journal articles involve coauthors from the private sector 11% of the time.

Aerodyne Research, Inc. (U.S.)
Airborne Technologies, Inc. (U.S.)
Aerosol Dynamics Inc. (U.S.)
Alion Science and Technology (U.S.)
Atmospheric and Environmental Research, Inc. (U.S.)
AURAIA, LLC. (U.S.)
Ball Aerospace (U.S.)
Baron Advanced Meteorological Systems, LLC. (U.S.)
Bodeker Scientific (New Zealand)
Colorado Oil and Gas Conservation Commission (U.S.)
Droplet Measurement Technologies (U.S.)
DuPont Chemicals & Fluoroproducts (U.S.)
Electric Power Research Institute (U.S.)
HNO Green Fuels, Inc. (U.S.)
Honeywell (U.S.)
Iberdrola (U.S.)
International Civil Aviation Organization (ICAO)
International Maritime Organization (IMO)
Lockheed Martin (U.S.)
Maersk Line (international)
NorthWest Research Associates (U.S.)
Questar Energy Products (U.S.)
RTI International (U.S. Headquarters; international)
Science and Technology Corporation (U.S.)
Sharply Focused (U.S.)
Siemens (U.S. and global)
Southern Company (U.S.)
Western Energy Alliance (U.S.)
Western Regional Air Partnership (U.S.)
Wet Labs (U.S.)

Collaboration on National and International Assessments

The Chemical Sciences Division works with several national and international organizations on Assessments of climate, the stratospheric ozone layer, air quality, and focused topics in atmospheric science:

United Nations Environment Programme
World Meteorological Organization
Intergovernmental Panel on Climate Change
European Commission
United Nations Economic Commission for Europe (UNECE), Hemispheric Transport of Air Pollutants (HTAP) Stratosphere-troposphere Processes And their Role in Climate (SPARC) Programme (WCRP)
International Global Atmospheric Chemistry (IGAC) Project (IGBP)
National Aeronautics and Space Administration
U.S. National Academy of Sciences
U.S. Global Change Research Program (formerly U.S. Climate Change Science Program)
Patents and Technology Transfer Activities

Patents

Existing
    This device uses a pair of single-wavenumber spatial filters to profile wind and turbulence from the ground using a star as the source of light. Measurement heights are selected by adjusting the positions of the filters relative to the focus of the collecting telescope.

    This patent describes a design for a fence to reduce the level of acoustic or radio energy on the ground near an acoustic sounding system or radar. The top of the fence is shaped such that diffraction directs energy horizontally instead of toward the ground.

    This patent describes a three-mirror laser system with the third mirror at some distance in the atmosphere. Operated near threshold, it is very sensitive to absorbing gasses within the extended laser cavity.

    This patent describes a novel signal processing scheme to detect brief bursts of signal buried in noise in the Doppler spectra of a Doppler radar or lidar.

In Development or Under Consideration
    Steven S. Brown, William P. Dubé, and Robert Wild, A Cavity Ring Down Instrument for Ambient Measurements of Total Reactive Nitrogen (NOy) Together with Nitrogen Oxides (NO, NO2) and Ozone (O3): a sensitive, compact detector that measures total reactive nitrogen (NOy), as well as NO2, NO, and O3.
    Declaration submitted April 2014.

    Ru-Shan Gao, Printed Optical Particle Spectrometer (POPS): A novel, low-cost lightweight scientific instrument suitable for aerosol measurements both at ground sites and on balloons. The NOAA Technology Partnership Office is currently choosing the best way of the transfer of technology.

    Daniel M. Murphy, Open Path Optical Cell with Zero and Calibration Purge for Cavity Ring-Down and Other Techniques: A technique to achieve the need to calibrate and zero an optical path that is widely open to air for sampling. Declaration submitted in 2013, however it is unlikely to be pursued as a patent.

Technology Transfer

    Daniel M. Murphy, Pumped Counterflow Impactor and design for a Differential Mobility Analyzer Column: Technology transfer to Brechtel Manufacturing in ~2008; both products remain in production.
Assessment Contributions


A.R. Ravishankara
Cochair, Scientific Assessment Panel; Scientific Steering Committee
Christine A. Ennis
Coordinating Editor; Reviewer
James B. Burkholder
Coauthor, Chapter 1 (Ozone-Depleting Substances and Other Gases of Interest to the Montreal Protocol); Contributor, Chapter 5 (Scenarios and Information for Decision-Makers)
John S. Daniel
Coauthor, Chapter 5 (Scenarios and Information for Decision-Makers); Reviewer
David W. Fahey
Coauthor, Twenty Questions and Answers About the Ozone Layer: 2014 Update; Reviewer
Birgit Hassler
Contributor, Chapter 2 (Update on Global Ozone: Past, Present, and Future); Contributor, Chapter 3 (Update on Polar Ozone: Past, Present, and Future); Reviewer
Robert W. Portmann
Contributor, Chapter 4 (Stratospheric Ozone Changes and Climate)
Amy Butler
Reviewer


A.R. Ravishankara
Cochair, Scientific Assessment Panel; Author
Christine A. Ennis
Coordinating Editor; Reviewer
John S. Daniel
Contributor; Reviewer
David W. Fahey
Reviewer


A.R. Ravishankara
Cochair, Scientific Assessment Panel
Christine A. Ennis
Coordinating Editor; Reviewer
John S. Daniel
Coordinating Lead Author, Chapter 5 (A Focus on Information and Options for Policymakers); Reviewer
David W. Fahey
Coordinating Lead Author, Twenty Questions and Answers About the Ozone Layer: 2010 Update; Lead Author, Chapter 3 (Future Ozone and Its Impact on Surface UV); Reviewer
Susan Solomon
Lead Author, Chapter 4 (Stratospheric Changes and Climate); Reviewer
Robert W. Portmann
Lead Author, Chapter 3 (Future Ozone and Its Impact on Surface UV); Reviewer
Karen Rosenlof
Lead Author, Chapter 4 (Stratospheric Changes and Climate)
James B. Burkholder
Coauthor, Chapter 2 (Stratospheric Ozone and Surface Ultraviolet Radiation)
Dimitrios Papanastasiou
Contributor, Chapter 2 (Stratospheric Ozone and Surface Ultraviolet Radiation)
Daniel L. Albritton
Reviewer
Birgit Hassler
Reviewer


A.R. Ravishankara
Review Editor, Chapter 8 (Anthropogenic and Natural Radiative Forcing); Reviewer
Graham Feingold
Lead Author, Chapter 7 (Clouds and Aerosols); Contributing Author, Chapter 10 (Detection and Attribution of Climate Change: from Global to Regional); Reviewer
Owen Cooper  Contributing Author, Chapter 2 (Observations: Atmosphere and Surface); Reviewer
John Daniel  Contributing Author, Chapter 8 (Anthropogenic and Natural Radiative Forcing); Reviewer
Sean Davis  Contributing Author, Chapter 2 (Observations: Atmosphere and Surface)
Claire Granier  Contributing Author, Chapter 7 (Clouds and Aerosols)
Daniel M. Murphy  Contributing Author, Chapter 11 (Near-term Climate Change: Projections and Predictability); Reviewer
David W. Fahey  Reviewer
Birgit Hassler  Reviewer
David Parrish  Reviewer
Robert Portmann  Reviewer
Karen Rosenlof  Reviewer
Michael Trainer  Reviewer

A.R. Ravishankara  Steering Committee; Co-Coordinator; Lead Author, Chapter 1 (Introduction); Lead Author, Chapter 2 (N₂O: Its Role in Climate Change and Ozone Layer Depletion); Editor
John S. Daniel  Lead Author, Chapter 1 (Introduction); Lead Author, Chapter 2 (N₂O: Its Role in Climate Change and Ozone Layer Depletion)

A.R. Ravishankara  Lead Author
John S. Daniel  Contributor of Information/Data; Reviewer
David W. Fahey  Contributor of Information/Data; Reviewer

Graham Feingold  Editor, whole report; Author, Executive Summary; Lead Author, Chapter 2 (Remote Sensing and In Situ Measurements of Aerosol Properties, Burdens, and Radiative Forcing); Lead Author, Chapter 3 (Modeling the Effects of Aerosols in Climate); Author, Chapter 4 (The Way Forward); Contributing Author, Chapter 1 (Introduction)
Susan Solomon  Reviewer

A.R. Ravishankara  Agency Lead; Report Editor; Convening Lead Author, Executive Summary; Convening Lead Author, Chapter 1 (Introduction); Convening Lead Author, Chapter 6 (Implications for the United States)
David W. Fahey  Convening Lead Author, Chapter 4 (How Do Climate Change and Stratospheric Ozone Loss Interact?); Lead Author, Executive Summary; Lead Author, Chapter 6 (Implications for the United States)
John S. Daniel  Lead Author, Executive Summary; Lead Author, Chapter 2 (Current Trends, Mixing Ratios, and Emissions of Ozone-Depleting Substance and Their Substitutes); Lead Author, Chapter 5 (The Future and Recovery); Lead Author, Chapter 6 (Implications for the United States)
Robert Portmann  Reviewer
Susan Solomon  Reviewer

A.R. Ravishankara
Author Panel

[Susan Solomon
Overall Committee Member, America’s Climate Choices]


Susan Solomon
Committee Chair; Lead Author


Owen Cooper
Lead Author, Chapter 1 (Conceptual Overview of Hemispheric or Intercontinental Transport of Ozone and Particulate Matter)

David Parrish
Lead Author, Chapter 2 (Observational Evidence and Capabilities Related to Intercontinental Transport of Ozone and Particulate Matter)


David Parrish
Contributing Author


David Parrish
Lead Author, whole report; Coordinating Lead Author, Chapter 5 (North America); Lead Author, Chapter 8 (Key Issues and Outlook), Contributing Author, Chapter 1 (Introduction); Contributing Author, Chapter 7 (Overview of International Collaborative Research Activities)


David W. Fahey
Coordinating Lead Author (full report); Lead Author, Section 10 (Synthesis)

Joshua Schwarz
Contributing Author, Section 3 (Measurements and Microphysical Properties)

Lifetimes of Stratospheric Ozone-Depleting Substances, their Replacements, and Related Species, Stratosphere-troposphere Processes And their Role in Climate, World Climate Research Programme, 2013.

James B. Burkholder
Lead Author, Chapter 3 (Evaluation of Atmospheric Loss Processes); Coauthor, Chapter 6 (Recommended Values for Steady-State Lifetimes); Mail and Meeting Reviewer

John S. Daniel
Principal Reviewer, Chapter 2 (The Theory of Estimating Lifetimes Using Models and Observations); Mail and Meeting Reviewer

David W. Fahey
Mail and Meeting Reviewer

A.R. Ravishankara
Mail and Meeting Reviewer


James B. Burkholder
Author

The Role of Halogen Chemistry in Polar Stratospheric Ozone Depletion, Stratosphere-troposphere Processes And their Role in Climate (SPARC) report, 2009.

David W. Fahey
Steering Group, Atmospheric Measurements

Ru-Shan Gao
Steering Group, Atmospheric Measurements; Reviewer

James B. Burkholder
Reviewer

Robert W. Portmann
Reviewer

David W. Fahey Lead Author
Ru-Shan Gao Coauthor
Sean M. Davis Coauthor

Regional Assessments from CSD Field Studies:

Synthesis of Policy Relevant Findings from the CalNex 2010 Field Study (California research at the Nexus of Air Quality and Climate Change), NOAA ESRL CSD report to the California Air Resources Board, 2014.

Air Chemistry in the Gulf of Mexico Oil Spill Area NOAA WP-3D Airborne Chemical Laboratory Flights of 8 and 10 June 2010, CSD report to OSHA, EPA, and other stakeholders during 2010 Deepwater Horizon oil spill, 2010.
Publication Metrics

Overview

CSD has published 773 peer-reviewed journal articles since the January 2008 CSD Review; an additional 53 are in submitted or “discussion” status. A list of these publications begins on page 57.

Additional publications during this time period include 2 reports, 15 book chapters or sections, and 43 contributions to Assessment reports. Lists of these publications are found on pages 115-120. Further information on Assessment contributions is given on pages 49-52.

Measures of Collaboration

The affiliations of the coauthors of CSD publications give a good measure of CSD’s highly collaborative research endeavor. As a percentage of peer-reviewed journal articles published since January 2008:

- Internal collaboration (more than 1 CSD Program Area): 196/773 = 25%
- External collaboration: 662/773 = 86%
- Collaboration with other NOAA labs: 156/773 = 20%
- Collaboration with Universities: 555/773 = 72%
- Collaboration with NASA: 125/773 = 16%
- Collaboration with NCAR: 137/773 = 18%
- Collaboration with the private sector: 87/773 = 11%
- International collaboration: 338/773 = 44%

(as of 5 March 2015)
The Hirsch Index: A Measure of Impact

Individual Staff: Career Hirsch Indices

The Hirsch Index gives a measure of the impact of publications and is computed using citation data. For this Review, current CSD researchers who have had their Ph.D. for at least 10 years computed their career Hirsch Indices. The graph below shows the results as of February 2015.

![Distribution of Hirsch Indices in CSD](image)

**CSD Results**
- Median = 29
- Geometric Mean = 26
- Range = 3 to 85
- No. of Scientists Considered = 49

**Definition:** A scientist has index h if h of his or her Np papers have at least h citations each and the other (Np – h) papers have sh citations each.

“Typical” values of Hirsch Index, h:
- ~12 = Faculty at major research universities
- ~18 = Advancement to full professor
- ~15–20 = Considered for fellowship in APS
- ~35 = Nobel Prize winners
- ~46 = Membership in NAS

The Aggregate “CSD” Hirsch Index: 2008 to Present

In addition, the Hirsch Index was calculated using Web of Science for 719 CSD journal articles, books, reports, and book sections published since the last CSD review (2008 to present) and that have citation data available. This is equivalent to calculating a “career” Hirsch Index as above, considering “CSD” to be a single researcher who began publishing in 2008.

The results for the aggregate CSD Hirsch Index since the last CSD Review are shown below. CSD’s work published since 2008 has been cited 16,858 times to date, giving a “CSD” Hirsch Index of 56.
Citation Distribution by year

Total Articles in Publication List: 824
Articles With Citation Data: 719
Sum of the Times Cited: 16858
Average Citations per Article: 23.45
h-index: 56
Last Updated: 03/10/2015 23:14 GMT
List of Publications

(as of 5 March 2015)

Peer Reviewed Journal Articles: 773 published or accepted
53 submitted or in discussion
Reports 2
Book Chapters or Sections 15
Assessments or Assessment Chapters 43

Journal Articles: Submitted or In Discussion (53 total)

2015


Kaiser, J., G.M. Wolfe, K.E. Min, S.S. Brown, C.C. Miller, D.J. Jacob, J.A. de Gouw, M. Graus, T.F. Hanisco, J.S. Holloway, J. Peischl, I.B. Pollack, T.B. Ryerson, C. Warneke, and F.N. Keutsch, Reassessing the ratio of glyoxal to...


2014


2014


Cui, Y.Y., A. Hodzic, J.N. Smith, J. Ortega, J. Brioude, H. Matsui, E.J.T. Levin, A. Turnipseed, P. Winkler, and B. de


Murphy, D.M., Rare temperature histories and cirrus ice number density in a parcel and a one-dimensional model, *Atmospheric Chemistry and Physics*, 14, 10701-10723, doi:10.5194/acp-14-13013-2014, 2014.


2013

null


Physics, 13(17), 8955-8971, doi:10.5194/acp-13-8955-2013, 2013.


Weiss-Penziás, P.S., E.J. Williams, B.M. Lerner, T.S. Bates, C. Gaston, K. Prather, A. Vlasenko, and S.M. Li, Shipboard measurements of gaseous elemental mercury along the coast of Central and Southern California,


2012


Baasandorj, M., B.D. Hall, and J.B. Burkholder, Rate coefficients for the reaction of O(^1D) with the atmospherically long-lived greenhouse gases N_2, SF_6, CF_3, CHF_3, C_2F_6, C_3F_8, n-C_6F_{12}, and n-C_8F_{14}, Atmospheric Chemistry and Physics, 12(23), 11753-11764, doi:10.5194/acp-12-11753-2012, 2012.


ESRL/CSD Laboratory Review


Lee, S.-S., G. Feingold, and P.Y. Chuang, Effect of aerosol on cloud-environment interactions in trade cumulus,


2011


Talukdar, R.K., L. Zhu, K.J. Feierabend, and J.B. Burkholder, Rate coefficients for the reaction of methylglyoxal (CH3COCHO) with OH and NO3 and glyoxal ([HCO2] with NO3, Atmospheric Chemistry and Physics, 11(21), 10837-10851, doi:10.5194/acp-11-10837-2011, 2011.


95
2010


Pike, R.C., J.D. Lee, P.J. Young, G.D. Carver, X. Yang, N. Warwick, S. Moller, P. Misztal, S.B. Langford, D. Stewar, C.E. Reeves, C.N. Hewitt, and J.A. Pyle, NOx and O3 above a tropical rainforest: an analysis with a global and


2009


Lance, S., A. Nenes, C. Mazzoleni, M.K. Dubey, H. Gates, V. Varutbangkul, T.A. Rissman, S.M. Murphy, A. Sorooshian, R.C. Flagan, J.H. Seinfeld, G. Feingold, and H.H. Jonsson, Cloud condensation nuclei activity, closure, and droplet growth kinetics of Houston aerosol during the Gulf of Mexico Atmospheric Composition and Climate Study (GoMACCS), Journal of Geophysical Research, 114(D00F15), doi:10.1029/2008JD011699,
2009.


**2008**


Churnside, J.H., Polarization effects on oceanographic lidar, Optics Express, 16(2), 1196-1207, doi:10.1364/OE.16.001196, 2008.


Gensch, I.V., H. Bunz, D.G. Baumgardner, L.E. Christensen, D.W. Fahey, R.L. Herman, P.J. Popp, J.B. Smith, R.F. Troy, C.R. Webster, E.M. Weinstock, J.C. Wilson, T. Peter, and M. Krämer, Supersaturations, microphysics and...


### Book Chapters or Sections (15) and Reports (2)


**Assessments and Assessment Chapters (43)**


Parrish, D.D., Synthesis of Policy Relevant Findings from the CalNex 2010 Field Study (California research at the Nexus of Air Quality and Climate Change), NOAA ESRL Chemical Sciences Division, 210 pp., 2014.


Invited Talks
Listing is for 2013-present, for current staff only

Ravan Ahmadov, Invited Presentation, “Understanding High Wintertime Ozone Events over an Oil and Natural Gas Production Region from Air Quality Model Perspective,” Fall Meeting of the American Geophysical Union, 2014.


Chuck Brock, Invited Speaker, "Arctic Haze: Results from Airborne Field Projects During the International Polar Year 2008," Toronto NetCare Workshop, 2014.


Amy H. Butler, Invited Speaker, “Toward a Consistent Definition of Sudden Stratospheric Warmings,” Colorado State University Department of Atmospheric Sciences, 2013.

Aditya Choukulkar, Invited Seminar, “Coherent Doppler Lidar for Wind Energy – Retrieval Algorithms and
Uncertainty,” ATOC Seminar, University of Colorado Boulder, February 2014.


David Fahey, Invited Talk, “Pursuing Climate Science: From Small Particles to Large Airplanes,” School of Earth, Atmospheric and Environmental Sciences, University of Manchester, Manchester, U.K., September 2013.


Graham Feingold, Invited Speaker, “Aerosol Influences on Warm Cloud Precipitation and Why it is so Difficult to Provide Observational Constraints,” Telluride Science Research Center workshop, 2014.


Si-Wan Kim, Invited Talk, “Impact of a Priori Information on Satellite NO2 and HCHO Retrievals Over the Los Angeles Basin,” the 5th GEMS Science Team Meeting in October 2014.


David D. Parrish, Invited Talk, "How Complete Is Our Knowledge of Tropospheric Ozone? (at least as it is Currently Incorporated into Chemistry-Climate Models)," American Geophysical Union Fall Meeting, December 2014.


Ranajit Talukdar, Invited Speaker, “Henry’s Law Solubility Coefficients and Hydrolysis Rate Coefficients of Some Atmospheric Trace Gases Using a Newly Developed Method,” Department of Chemistry, University of Warsaw, Poland, November 2013.


