

# Susan Solomon Symposium

*Ozone, Climate, and Policy: Susan's Contributions  
Then and Now*



American Meteorological Society  
Boston, Massachusetts

Monday, January 13<sup>th</sup>, 2020

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## Foreword

This symposium honors the career of Professor Susan Solomon, Massachusetts Institute of Technology, Lee and Geraldine Martin Professor of Environmental Studies. Professor Solomon has been a leader on the scientific frontier of the world's most important environmental challenges and instrumental in the advancement of atmospheric chemistry, climate, and environmental policy. She is best known for identifying the reason for the Antarctic Ozone hole, innovations on climate change irreversibility, co-chairing the first Working Group of the Intergovernmental Panel on Climate Change's Fourth Assessment Report, and advances in our understanding of stratospheric impacts on climate, ozone layer healing, and the influences of volcanoes on the ozone layer and global climate. She has been recognized for accomplishments by innumerable honors that include election to the US National Academy of Sciences, the French Academy of Sciences, the Royal Society (London), the Royal Society of Chemistry (London), and the Academeia Europaea. Her many accolades include the 1999 National Medal of Science (the highest scientific honor in the US), the Grande Medaille (highest award of the French Academy of Sciences), the Blue Planet Prize in Japan, the Volvo Environment Prize, and recently the prestigious 2018 Royal Swedish Academy of Sciences Crafoord Prize. She even has pieces of Antarctica named after her: the Solomon Glacier (78°23'S, 162°30'E) and Solomon Saddle (78°23'S, 162°39'E).

Prof. Solomon received a bachelor's degree in chemistry from Illinois Institute of Technology in 1977. She received her Ph. D. in chemistry from the University of California, Berkeley in 1981, where she specialized in atmospheric chemistry. Solomon was the head of the Chemistry and Climate Processes Group within the National Oceanic and Atmospheric Administration (NOAA) Chemical Sciences Division and the former Aeronomy Laboratory until 2011. In 2011, she joined the faculty of the Department of Earth, Atmospheric and Planetary Sciences at the Massachusetts Institute of Technology.

Prof. Solomon has also been an inspiration and a mentor to numerous early career scientists, extending far beyond just her students and postdoctoral associates. She has been extremely supportive of scientists from under-represented groups, and in particular women. She was recently involved in the creation of the AMS Women in Science Fund that will provide fellowship, scholarship and travel funds for early career women.

This symposium aims to honor Prof. Solomon's past achievements in and ongoing contributions to atmospheric science. Sessions will highlight the history and future of environmental policy and assessments, breakthroughs in middle atmospheric and ozone science, and provide perspectives on our changing climate - one of the greatest challenges of our time.

Each of these three topics will be communicated through invited talks and solicited posters. The organizing committee (Daniel Gilford, Rutgers University; A. R. "Ravi" Ravishankara, Colorado State University; Karen Rosenlof, NOAA/ESRL; Douglas Kinnison, NCAR) would like to thank all the invited and contributing authors for their oral and poster presentations. We also thank the AMS, the chair of the 2020 Annual Meeting, the AMS Director of Meetings Claudia Gorski, and AMS Meetings Coordinator Ricky Sidla for making the symposium possible. We are grateful to NASA for supporting the travel of some of the participants at the symposium.

## Photo Gallery



Susan in 1978, Louisville Colorado.



Susan with her favorite part of the globe, 2004.



With John Daniel in Thessaloniki, Greece, 1995.





With A. R. “Ravi” Ravishankara (center) and Alan Thomas (right) receiving a NOAA best paper award.



Being awarded the Grande Médaille from the Institute of France's Academy of Sciences for her contributions to both ozone chemistry and climate by Academy Vice President Jean Salençon.



Presentation of the 2018 Crafoord Prize with Syukuro Manabe (center) by the King of Sweden (left) for fundamental contributions to understanding the role of atmospheric trace gases in the Earth's climate system.



Receiving a National Medal of Science from President Clinton in 1999.





with Stephan Borrmann



with Marie-Lise Chanin



Image of Susan due to appear in the forthcoming app, 'cranky uncle'.





Image of Susan relaxing with the Queen Mother (top) and sightseeing with Gabi Hegerl (bottom).





Interacting with tomorrow's scientists.



with Kasturi Shah (graduate student, MIT)





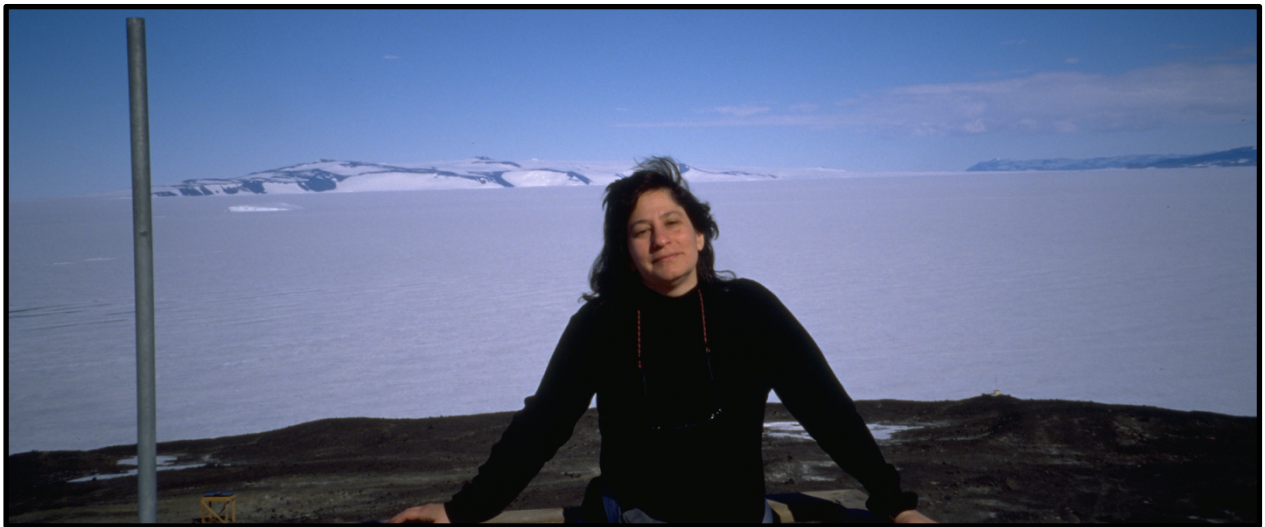
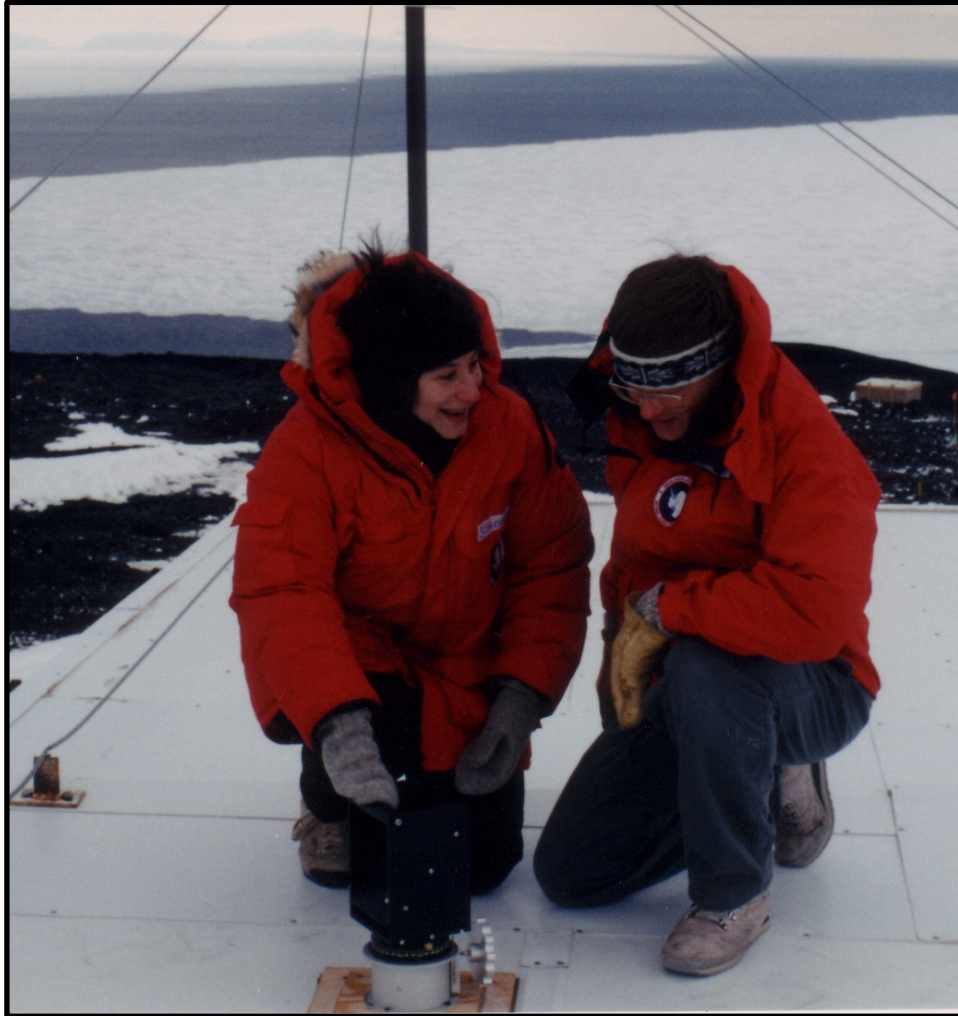
Posing with IPCC publications (bottom) and enjoying at day by the sea with husband Barry Sidwell (top and middle).





Susan at the Geographic South Pole (top) and with the local population at McMurdo Station (bottom).





Susan and Ryan Sanders working on instrumentation to study causes of the Antarctic ozone hole (top) and enjoying a beautiful Antarctic day (below).



Personally interacting with the atmosphere.

**The PSC (Polar Stratospheric Cloud) Song**  
Lamont Poole (AASE, Norway, January 1989)

Growing, growing, growing  
As the vapor's flowing.  
Larger sizes showing - Type 1s.  
As the sun is falling,  
More subroutines we're calling.  
Relaxing to equilibrium.  
Bring it in, soak it up, add it up, and send it back.  
Make some more Type 1s.

Freezing, freezing, freezing.  
Our results are pleasing.  
Water vapor squeezing - Type 2s.  
Rod and Susan sit there placid  
Making brand new nitric acid  
Heterogeneously.  
Bring it in, soak it up, add it up, and send it back.  
Make some more Type 2s.

PSCs will surely titrate  
HCl and chlorine nitrate,  
Which in the sun will make more ClO.  
We've discovered in Stavanger  
Arctic ozone is in danger.  
And this year is likely not atypical.  
Our results do not lie.  
Do we want to all die?  
Get rid of CFCs.

# Symposium Program

## Monday, January 13, 2019

**Session 1 — Wisdom of Solomon: History and Successes in Environmental Policy**  
**Chair: Daniel Gilford**

**1.1 – 8:30 AM**     [Introductory Remarks](#)

**Daniel Gilford**, Rutgers Univ., New Brunswick, NJ

**1.2 – 8:45 AM**     [The Contribution of Women Scientists to Ozone Research in the last 100 years.](#)

**Guy Brasseur**, NCAR, Boulder, CO

**1.3 – 9:00 AM**     [The Role of Assessments in the Science-Policy Interface](#)

**Robert Tony Watson**, UEA, UK, Norwich, United Kingdom

**1.4 – 9:15 AM**     [The \*Indomitable\* Solomon Spirit: \*Unequivocal\* Science and \*Impeccable\* Leadership](#)

**Venkatachalam Ramaswamy**, NOAA, Princeton, NJ

**1.5 – 9:30 AM**     [Contributions by Emissions from Various Regions to the Global Energy Budget](#)

**Daniel Murphy**, NOAA, Boulder, CO

**1.6 – 9:45 AM**     [International Ozone Assessments: the Contributions of Susan Solomon](#)

**John A. Pyle**, University of Cambridge and National Centre for Atmospheric Science, Cambridge, United Kingdom

**Session 2 — Ozone and the Middle Atmosphere: Past, Present and Future**  
**Chair: Doug Kinnison**

**2.1 – 10:30 AM**    [The Antarctic Ozone Hole: Past, Present, and Future](#)

**Paul A. Newman**, NASA GSFC, Greenbelt, MD

**2.2 – 10:45 AM**    [Response of the Middle Atmosphere to Energetic Particle Production](#)

**Charles H. Jackman**, NASA/GSFC, Greenbelt, MD

**2.3 – 11:00 AM**    [Comprehensive Modeling of Dynamics and Chemistry in the Middle Atmosphere](#)

**Rolando R. Garcia**, NCAR, Boulder, CO

**2.4 – 11:15 AM**    [Changes in Brewer-Dobson Circulation Seen from Satellite MSU/AMSU Observations](#)

**Qiang Fu**, Univ. of Washington, Seattle, WA

**2.5A – 11:30 AM**    [Dynamical Drivers of Recent Boreal Winter Ozone Trends in the Northern Hemisphere Lower Stratosphere](#)

**Clara Orbe**, NASA, New York, NY

**2.6 – 11:45 AM**    [Understanding the Role of QBO-Driven Variability in Observed Changes in Ozone from the Middle Stratosphere to the Troposphere and Across Multiple Timescales](#)

**Jessica L. Neu**, JPL, Pasadena, CA



**Session 3 — Climate Change: The Challenge of the Twenty-First Century**  
**Chair: Karen Rosenlof**

- 3.1 – 2:00 PM**     [The Influence of the Lower Stratosphere and Tropical Tropopause Layer on Tropical Cyclones](#)  
**Kerry Emanuel**, MIT, Cambridge, MA
- 3.2 – 2:15 PM**     [Adventures in Signal Detection With Susan Solomon](#)  
**Benjamin D. Santer**, LLNL, Livermore, CA
- 3.3 – 2:30 PM**     [Radiative constraints on the extratropical stormtracks under climate change](#)  
**David W. J. Thompson**, Colorado State University, Fort Collins, CO
- 3.4 – 2:45 PM**     [What can we learn about climate of the 21<sup>st</sup> century from historical observations?](#)  
**Gabriele Hegerl**, Univ. of Edinburgh, Edinburgh, Scotland
- 3.5 – 3:00 PM**     [Extreme Weather, Climate Change, and Attribution](#)  
**Dale Durrán**, Univ. of Washington, Seattle, WA
- 3.6 – 3:15 PM**     [Some Remarks & Introducing Susan Solomon](#)  
**A. R. Ravishankara**, Colorado State Univ., Fort Collins, CO
- 3.7 – 3:30 PM**     [One Scientist's Adventures in Science and Policy](#)  
**Susan Solomon**, MIT, Cambridge, MA

## Poster Session

4:00–6:00 PM

**Poster #1**    [Constraining the Quantity of Tropospheric Air Irreversibly Transported to the Lower Stratosphere via Tropopause-Penetrating Convection with In Situ Observations](#)

**Jessica B. Smith**, Harvard University, Cambridge, MA

**Poster #2**    [The Impact of Sudden Stratospheric Warmings \(SSWs\) on Stratosphere-Troposphere Exchange \(STE\) of Ozone \(O<sub>3</sub>\) and Water Vapour \(H<sub>2</sub>O\)](#)

**Ryan S. Williams**, University of Reading, UK, Reading, United Kingdom

**Poster #3**    [Uncertainty in Ozone Trend Detection](#)

**Marianna Linz**, Harvard University, Cambridge, MA

**Poster #4**    [The history of stratospheric ozone research: from the first atmospheric measurements to current developments](#)

**Rolf Mueller**, Forschungszentrum Jülich, Jülich, Germany

**Poster #5**    [Evaluation of the emissions provided by the RCPs and SSPs emission scenarios](#)

**Claire Granier**, CNRS and NOAA/CIRES, Toulouse, France

**Poster #6**    [On the Chlorofluorocarbons Banked in Equipment: Contributions to Emissions and Impacts on the Ozone Layer and the Climate](#)

**Megan Lickley**, MIT, Cambridge, MA

**Poster #7**    [Characterizing and explaining mesospheric ozone](#)

**Anne K. Smith**, NCAR, Boulder, CO

**Poster #8**    [What's Next for U.S. Air Quality Management?](#)

**Tracey Holloway**, Univ. of Wisconsin–Madison, Madison, WI



**Poster #9** [Aviation footprint in a warming future climate](#)

**Diandong Ren**, Curtin Univ. of Technology, Perth, Australia

**Poster #10** [The ABCs of Ozone Depletion and Global Warming: The Wisdom of Solomon](#)

**Ross J. Salawitch**, Univ. of Maryland, College Park, College Park, MD

**Poster #11** [Lessons from Montreal for Global Environmental Negotiations](#)

**Noelle Selin**, MIT, Cambridge, MA

**Poster #12** [Stratospheric Ozone in the Last Glacial Maximum](#)

**Mingcheng Wang**, Univ. of Washington, Seattle, WA

**Poster #13** [Transport-radiation feedback due to ozone in the tropical tropopause layer](#)

**Thomas Birner**, Ludwig-Maximilians-Univ. of Munich, Munich, Germany

**Poster #14** [Understanding Drivers of Southern Ocean Climate Trends](#)

**John Marshall**, NASA, Cambridge, MA

**Poster #15** [Stronger stratospheric temperature changes simulated with interactive ozone scheme](#)

**Pu Lin**, GFDL, Princeton, NJ

**Poster #16** [Using Earth's Entropy Production Rate as a Global Climate Change Metric](#)

**Goodwin Gibbins**, Imperial College London, London, United Kingdom

**Poster #17** [Observations of Elevated CFC-11 and CFC-12 over Hebei Province, China](#)

**Sarah Benish**, University of Maryland, College Park, MD

**Poster #18** [Revising the Ozone Depletion Potentials Metric for Short-Lived Chemicals such as CF<sub>3</sub>I and CH<sub>3</sub>I](#)

**Donald J. Wuebbles**, Univ. of Illinois, Urbana, IL

**Poster #19** [Is interactive Ozone Chemistry important to represent Polar Cap Stratospheric Temperature Variability in Earth-System Models?](#)

**Harald E. Rieder**, University of Natural Resources and Life Sciences (BOKU), Vienna, Austria

**Poster #20** [Seasonal evolution of the quasi-biennial oscillation impact on the Northern Hemisphere polar vortex in winter](#)

**Jiankai Zhang**, Lanzhou University, Lanzhou, China

**Poster #21** [Space Climate into the 21<sup>st</sup> Century](#)

**Stanley C. Solomon**, NCAR, Boulder, CO

**Poster #22** [An Exceptional Summer during the South Pole Race of 1911-1912](#)

**Ryan L. Fogt**, Ohio Univ., Athens, OH

**Poster #23** [Comparison of Total NO<sub>2</sub> Vertical Column Density between WRF-Chem Simulation and the Observations from Pandora Spectrometer and Ozone Monitoring Instrument during the Lake Michigan Ozone Study in 2017.](#)

**Chuan Feng**, Saint Louis University, Saint Louis, MO

**Poster #24** [Response of the Brewer Dobson circulation to an abrupt CO<sub>2</sub> increase](#)

**Natalia Calvo**, Univ. Complutense de Madrid, Madrid, Spain

**Poster #25** [Climate Change Impacts of Antarctic Ozone Recovery](#)

**Brian Zambri**, MIT, Cambridge, MA

**Poster #26** [Long-term Stratospheric Ozone Changes and Associated Climate impacts in CMIP6 Simulations](#)

**Birgit Hassler**, DLR, Wessling, Germany

**Poster #27** [Ozone Variability in the Tropical TTL Derived from SHADOZ Profiles \(1998-2017\): Role of Convective Processes](#)

**Anne M. Thompson**, NASA GSFC, Greenbelt, MD

**Poster #28** [The Role of Heterogeneous Chemistry in Ozone Depletion and Recovery](#)

**Catherine A Wilka**, MIT, Cambridge, MA

**Poster #29** [Climate Metrics for C3-C4 Hydrofluorocarbons \(HFCs\) Lacking Fundamental Experimental Measurements](#)

**James B. Burkholder**, NOAA, Boulder, CO

**Poster #30** [Spatiotemporal Variations in the Relationship between Total Ozone and Meteorological factors in the Antarctic Stratosphere](#)

**Dha Hyun Ahn**, Yonsei Univ., Seoul, Korea, Republic of (South)

**Poster #31** [Modelling the Potential Impacts on Total Column Ozone Recovery of the Recent, Unexpected Increases in CFC-11 emissions](#)

**James Keeble**, University of Cambridge, Cambridge, United Kingdom

**Poster #32** [Temporal Evolution of the Bromine Alpha Factor in Future Atmospheres](#)

**J. Eric Klobas**, Harvard John A. Paulson School of Engineering and Applied Sciences, Cambridge, MA

**Poster #33** [Prediction of Northern Hemisphere Regional Surface Temperatures and the Cryosphere using Stratospheric Ozone Information](#)

**Kane A. Stone**, MIT, Cambridge, MA

**Poster #34** [The Asian Tropopause Aerosol Layer Mystery: Chemical and Physical Properties inferred from Aircraft-borne In-situ Measurements](#)

**Stephan Borrmann**, Max Planck Institute for Chemistry, Mainz, Germany

**Poster #35** [The Enigmatic Growth of Atmospheric Methane](#)

**Lori Bruhwiler**, NOAA, Boulder, CO

**Poster #36** [Better Quantification of the Recent Unexpected Emission of CFC-11](#)

**Robert W. Portmann**, NOAA, Boulder, CO

**Poster #37** [PSC Distributions and Composition Based on CALIOP Measurements From 2006-2018](#)

**Michael C. Pitts**, NASA Langley Research Center, Hampton, VA

**Symposium Banquet: 7:00 PM – 9:00 PM, BCEC, 205C**