

Ralph Kahn, Ph.D.

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Education

- Ph.D. Applied Physics, Harvard University, 1980.
- M.S. Applied Physics, Harvard University, 1975.
- B.S. Physics and Geology with highest honors, University of Rochester, 1973.

Current Employment

Senior Research Scientist (GS15-10), NASA Goddard Space Flight Center
Aerosol Scientist, Multi-angle Imaging SpectroRadiometer, NASA Earth Observing System
Discipline: Atmospheric Physics and Remote Sensing, with focus on Aerosols

Married, Two children: Sasha Hillel (18); Alina Robin (13)

Work Experience

- **Co-Chair, AeroSat** – International Satellite Aerosol Science Network, 2013-present
- **Adjunct Professor**, Department of Atmospheric & Oceanic Science, University of Maryland College Park, 2016-present
- **Special Appointment to the Graduate Faculty, Purdue University**, 2010-2015
- **Senior Research Scientist**, NASA Goddard Space Flight Center, 2007-present
- **Lead Scientist and Group Supervisor**, Earth and Planetary Atmospheres Research Element, Jet Propulsion Laboratory, California Institute of Technology, 1998-2005
- **Group Supervisor**, JPL Multi-angle Imaging Sciences Research Element, 2006-2007
- **Aerosol Scientist and Co-Investigator**, NASA Earth Observing System Multi-angle Imaging SpectroRadiometer (MISR), 1995-present
- **Principal Scientist**, Jet Propulsion Laboratory, California Institute of Technology, 1998-2007
- **Principal Investigator**, NASA Earth Science Radiation & Climate and Atmospheric Composition Programs, 1996-present
- **Principal Investigator**, NOAA Office of Global Programs, 2000-2003
- **Freelance writer**, *The Los Angeles Times*, *The Denver Post*, *Smithsonian Air & Space*, *Sky & Telescope*, *MS-NBC*, 1995-1998
- **Consultant**, Atmospheric Sciences issues, VideoDiscovery, Seattle WA, 1993 - 1995.
- **Visiting Instructor**, University of California, Los Angeles, Atmospheric Sciences Department, Winter 1994
- **Instructor**, California Institute of Technology, Earth & Planetary Sciences, Fall 1993
- **Instructor**, University of California, Los Angeles, Sociology Department, Spring 1993

- **Special Lecturer on Global Change**, Joint Sciences Department, Claremont Colleges, 1992 – 1994
- **Principal Investigator**, Earth Science Interdisciplinary Program, NASA Code SE, 1989 - 1992.
- **Team leader**, JPL Exploratory Data Analysis Team, 1988-1992.
- Research Scientist, Jet Propulsion Laboratory, California Institute of Technology, 1988-1998
- Visiting Scientist, NASA Goddard Space Flight Center, 1987 – 1988
- Visiting Senior Scientist and Deputy Program Scientist, EOS Project, NASA Headquarters, 1986 – 1987
- **Visiting Scientist**, National Weather Service Field Office, St. Louis, MO, 1986.
- **Principal Investigator**, Mars Observer Synoptic-Scale Camera Proposal, NASA Code SL, 1985.
- **Research Scientist**, Washington University, St. Louis, Department of Earth and Planetary Sciences and McDonnell Center for the Space Sciences, September 1984 - August 1988. (on leave, September 1986 - September 1988).
- Principal Investigator, NASA Planetary Atmospheres Research & Analysis Program, Solar System Exploration Division 1984 -1988.
- **Visiting Lecturer**, Tel Aviv University, Department of Geophysics, Spring 1982.
- **Visiting Scientist**, Planetary Exploration Division, NASA Headquarters, Washington, D.C., December 1981 - January 1982.
- **Instructor**, Department of Astronomy, Cornell University, 1981.
- **Research Associate**, Center for Radiophysics and Space Research, Cornell University, September 1980 - August 1984.
- **Post-doctoral Research Fellow**, Center for Earth and Planetary Physics, Harvard University, January - August 1980.
- Participant, **Jupiter Observing Program**, Agassiz Station 61" Telescope and Echelle spectrograph, Harvard University, Fall 1977 - Spring 1978.
- Team Member, **Viking Lander Imaging Team**, Jet Propulsion Laboratory, Pasadena, California, May 1976 - January 1979.
- **Research Associate**, NASA Ames Research Center, Moffett Field, California, March 1975 – January 1979.
- **Teaching Fellow**, Division of Applied Physics, Harvard University, Physics and Chemistry of Atmospheres I, Fall, 1975.

Selected Professional Community Service

- **Commission A Chair, COSPAR** (Committee on Space Research) 2016-20; vice-chair, 2008-16
- **Advisory Panel**, European Commission **ACTRIS-2** (Aerosol, Clouds, and Trace gas Research InfraStructure), 2015-2019
- **Lead Scientist/Mentor – AeroCom Wildfire Smoke Injection Height & Source Strength Experiment**, with Mariya Petrenko, Maria Val Martin, and Mian Chin, September 2013 – present
- **Initiated and Leading – MISR Active Aerosol Plume-Height (AAP) project**; partnered with U. Maryland to digitize smoke, dust, & volcanic plumes day-by-day in MISR data, 2015-present
- **Guest Editor**, Advances in Meteorology Special issue: “Desert Dust Properties: Modeling & Monitoring,” 2011-2012
- **Interagency Arctic Research Policy Committee (IARPC)**, NASA Representative, 2012-present
- **Science Steering Committee, iLEAPS/ IGAC/ GEWEX ACPC** (Aerosol-Cloud-Precipitation-Climate) Panel, 2011-present

- **Initiated and Leading** – Systematic Aircraft Measurements to Characterize Aerosol Air Masses (*SAM-CAAM*) effort, 2011-present
- Fellow, *University of Colorado/NASA-Goddard Sun-Climate* Research Center, 2011-2014
- **Advisory Board**, *George Mason University* Dept. of Statistics, 2010 – 2014
- *NASA PACE Mission* Science Definition Team, 2011-2012
- **Co-Editor, Lead Author** and Co-author, US Climate Change Science Program (CCSP) Synthesis and Assessment Product (SAP) 2.3, 2009
- **Expert Reviewer**, *IPCC* (Inter-governmental Panel on Climate Change) *Working Group 1* Assessment Report 4 (AR4); Assessment Report 5 (AR5), 2006-2013
- **Invited Testimony**. “Monitoring Aerosols From Space: What We Can Say, and What We Can’t.” *National Research Council Panel on GeoEngineering*, National Academy of Sciences, Washington DC, September 10, 2013.
- **Remote-sensing scientist for Project Surya** –V. Ramanathan, lead; aimed at distributing efficient, low-cost cook-stoves in India, and monitoring the impact on air quality and health.
- *NASA ACE Decadal Survey Mission* Science Definition Team, 2006-present
- *NASA Goddard Science Vision definition team*, 2011-2012
- *ESA Research Community Response team* for the Eyjafalajokl Volcano eruption, Frascati, Italy, May 2010
- *NASA Goddard Deputy Director’s Council on Science*, 2009-2011
- *NASA GLORY Mission* Science Advisory Panel, 2006-2009
- *Committee on Atmospheric Radiation*, American Meteorological Society, 2001-2003
- **Chairman**, Earth Science and Applications Data Systems Users Committee, 1987 - 1989.
- **Originator and director**, The DataLab at JPL, an organization that sponsors seminars, visitors, and workshops on topics related to all aspects of exploratory data analysis, Jet Propulsion Laboratory, 1988-1998.
- **Chairman**, Earth Science and Applications Data Systems Workshop, Easton, Maryland, February 24 - 26, 1987.
- **Special Symposium organizer**, “Combining Multiple Data Sources and Models to Create an Accurate, Global-Scale Aerosol Picture,” American Association of Aerosol Researchers (AAAR) Annual Meeting, Austin TX, October 18, 2005.
- **Technical session organizer and session chair**: AGU, AMS, COSPAR, IAMAS, NASA- and NOAA-sponsored meetings. (List available upon request)
- **Journal Article Peer-Reviewer**: *J. Geophysical Research*, *Geophysical Research Lett.*, *Atmosph. Chemistry & Physics*, *Atmosph. Meas. Techniques*, *J. Atmosph. & Ocean Technology*, *Atmosph. Research*, *J. Climate*, *Climate*, *Am. J. of Climate Change*, *J. Applied Meteorology & Climatology*, *Science*, *Annales Geophysicae*, *Proc. Nat. Academy Sci.*, *Quart. J. Royal Met. Soc.*, *Tellus*, *Remote Sensing of Environment*, *IEEE Transact. On Geosci. & Remt. Sensing*, *Geosci. & Remt. Sensing Lett.*, *Int. J. of Remt. Sensing*, *J. Applied Remt. Sensing*, *Atmosph. Environment*, *Light Scattering Reviews*, *J. Environmental Protection*, *J. Volcanology*
- **Proposal Peer-Reviewer**: NASA, NOAA, NSF, U.S. State Dept., Naval Res. Lab., Israel Space Agency, Netherlands Office of Scientific Research
- **Review Panels**: *NASA ICESat & Cryosat*, 2005; *NASA ROSES*, 2007; *NASA AURA*, 2007; *NASA Earth Sci. Fellowship*, 2008; *NASA Langley Atmospheric Composition Program (Panel Chair)*, 2008; *Naval Research Laboratory*, Monterey Marine Meteorology Division, 2009 & 2011; *NASA Atmospheric Composition Program*, 2014;

Selected Education- and Outreach-Related Activities

- **Editor and Founder, *Practical Uses of Math And Science (PUMAS)*** pre-college Education journal (<http://pumas.nasa.gov>), 1996-present.
- **Science Advisory Board, NASA Earth Observatory** (<http://earthobservatory.nasa.gov/>), 2001-present.
- **Science Advisory Panel, *Earth & Sky Radio***, 2000-2013.
- **Briefing to Senate Staffers:** “What We Know About Climate Change.” NASA Goddard Space Flight Center, 13 January 2012.
- **NASA Day on Capitol Hill**, Earth Observations and Climate presentation, 15 June 2011.
- **Initiator and Lead Scientist, JPL Student Independent Research Internship (SIRI)** and JPL Research Apprenticeship programs, which aim to bring high-quality local college students to JPL to gain research experience, 2003-2007.
- **Lead Organizer and Contributor**, JPL support of the *California State K-12 Science Education Standards* Peer Review, 1997.
- **Project Scientist, *Windows on Global Change***, an interactive, computer-based program of laboratory activities designed to give middle and high school students the attitudes, experience, and tools needed to study real data, including spacecraft images. Consortium for International Earth Science Information Network (CIESIN), 1991 – 1993.
- Numerous **Public Lectures, Print and Radio Interviews, School Talks, Hyperwall Presentations, etc.** (List available upon request)

Aircraft Field Campaign Participation

- **NASA SEAC4RS Field Campaign**, Houston, TX, August 2013, *MISR Lead and AirMSPI Co-Investigator*.
- **NASA PODEX Field Campaign**, Armstrong Center CA, *AirMSPI Science Team*, January 2013.
- **NASA ARCTAS Field Campaign**, Fairbanks, Alaska and Cold Lake, Alberta, Spring-Summer 2008, *Co-Investigator and MISR Team PI*.
- **NOAA/TexAQS GoMACCS Field Campaign**, Houston, TX, August-September 2006, *Co-Investigator and MISR Team PI*.
- **German consortium SAMUM Field Campaign**, Ouarzazate, Morocco, May-June 2006, *Co-Investigator and MISR Team PI*.
- **NASA INTEX-B/MIRAGE/MILAGRO Field Campaign**, Veracruz, Mexico, March 2006, *MISR Team PI*.
- **NASA/ONR UAE-2 Field Campaign**, United Arab Emirates, Summer 2004, *Satellite Component Co-Leader, and MISR Team PI*.
- **NASA INTEX-A/ICARTT/NEAQS Field Campaign**, Gulf of Maine, Summer 2004, *MISR Team PI*.
- **NASA CRYSTAL-FACE Field Campaign**, Key West, FL, Summer 2002, *MISR Team PI*.
- **Co-Leader, NASA-EOS CLAMS** (Chesapeake Lighthouse Aerosol Measurements for Satellites) **Field Campaign**, NASA Earth Observing System, 2001 – 2002.
- **NASA ACE Asia** (International Aerosol Characterization Experiment) **Field Campaign**, National Science Foundation, 2000 – 2004, *Co-Investigator and MISR Team PI*.

Professional Memberships, Awards, Honors

- American Geophysical Union
- American Meteorological Society
- American Astronomical Society/Division of Planetary Sciences
- *NASA Robert H. Goddard Award*, 2016, “For unveiling the mysteries of aerosols in innovative research efforts that made us understand better their importance in climate and everyday life”
- *NASA Outstanding Leadership Medal*, 2013
- *Editor’s Citation for Excellence in Refereeing*, *Journal of Geophysical Research*, 2013
- *NASA Distinguished Performance Awards*: 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016
- *Kaufman Award*, “For broad influence in atmospheric science through exceptional creativity, inspiration of younger scientists, mentoring, international collaboration, and unselfish cooperation in research,” *American Geophysical Union*, 2009
- *Distinguished Visiting Lecturer*, NASA Goddard Space Flight Center, March 2005
- *Outstanding Accomplishment Level B Award*, *Jet Propulsion Laboratory*, “For leading the effort to create the Student Independent Research Internship (SIRI) and JPL Research Apprenticeship (RA) programs, bringing students from local colleges to JPL for first-hand research experiences,” 2004.
- *NASA Exceptional Service Medal*, 2003
- *NASA Goddard Achievement Award* for contributions to the EOS Terra Mission, 2000
- *Outstanding Education Product Award*, *NASA Office of Earth Science*, “For the *Practical Uses of Math And Science* (PUMAS) on-line journal,” 1999
- *Outstanding Accomplishment Level B Award*, *Jet Propulsion Laboratory*, “For contributions to the Multi-angle Imaging SpectroRadiometer (MISR) instrument,” 1999
- *NOVA Award in Leadership*, *Jet Propulsion Laboratory*, “For leading the JPL component of the California State K-12 Science Education Standards Peer Review,” 1997
- *Danforth Fellowship*, 1973 – 1978
- *New York State Regents Scholarship*, 1969 – 1973
- *Phi Beta Kappa*

NASA Group Achievement Awards

- *NASA Group Achievement Award* for contributions to the *SEAC⁴RS Field Campaign*, 2014
- *NASA Group Achievement Award* for the *PODEX / AirMSPI Field Campaign*, 2014
- *NASA Group Achievement Award* for contributions to the *ARCTAS Field Campaign*, 2009
- *NASA Group Achievement Award* for contributions to the *INTEX-A Field Campaign*, 2005
- *NASA Group Achievement Award*, contributions to *CRYSTAL-FACE Field Campaign*, 2003
- *NASA Group Achievement Award* for contributions to the *MISR project*, 2001

Digital Background

- **ResearchGate Profile:** https://www.researchgate.net/profile/Ralph_Kahn
- **LinkedIn Profile:** <https://www.linkedin.com/in/ralph-kahn-25899911>
- **NASA “Maniac” talk** (personal career history lecture), 01 February 2016:
<http://atmospheres.gsfc.nasa.gov/ext/maniacs/index.php?year=2016>

Students, Post-Docs, & Junior Scientists Mentored Since 2000

- **Ryan Bolt** and **CJ Vernon**, U. Maryland College Park, student interns, Active Aerosol Plume-height (AAP) project, 2015-present.
- **Verity Flower**, NPP post-doc with me, April 2016-present. Publications: *Flower and Kahn*, 2016; one in preparation.
- **Preethi Manoharan**, Programmer/Data Analyst, February 2016-present.
- **Mariel Friberg**, Graduate Student, GA Tech., NASA Harriett G. Jenkins Graduate Fellow, February 2014-present. Publications: *Friberg, Kahn et al.*, 2017, one in preparation.
- **Lauren Zamora**, NPP post-doc with me, February 2014-present. Publications: *Zamora, Kahn, et al.*, 2016a, b, one in preparation.
- **Jim Limbacher**, Programmer/Data Analyst, December 2010-present. Publications: *Kahn & Limbacher*, 2012; *Limbacher & Kahn*, 2014; 2015; 2016, several in preparation.
- **Mariya Petrenko**, Purdue University graduate student (under Harshvadan; Kahn supervised her thesis project), 2009-Spring 2012; NPP post-doc and research scientist with me, Spring 2012-present. Publications: *Petrenko et al.*, 2012; 2017, one in preparation.
- **Michael DeFreytas**, U. Maryland Baltimore County, student intern, Fall 2010-Fall 2012
- **Michael Kim**, U. Maryland Baltimore County, student intern, Spring 2010-Spring 2012
- **Falguni Patadia**, U. Maryland & GESTAR, postdoctoral fellow, April 2010 – October 2012. Publication: *Patadia et al.*, 2013.
- Scientific mentor to scientists at NASA Goddard: **Dr. Charles Gatebe**, 2009-2013; **Dr. Dong Wu**, 2011-2013; **Dr. Robert Levy**, 2013-2015.
- **John Kilby**, U. Maryland Baltimore County, student intern, Fall 2009-Winter 2010
- **Allison Hoy**, U. Maryland Baltimore County, student intern, Fall 2009-2010; Feb.-Aug. 2013
- **Matthew Davis**, Programmer/Data Analyst, 2008-2011
- **Jeffrey Pierce**, NASA NPP Post-Doctoral Fellow, 2008-2009. Publication: *Pierce et al.*, 2010.
- **Maria Val Martin**, Harvard University Post-Doctoral Fellow (with J. Logan), 2007-2009; GSFC Visiting Postdoctoral Scientist, 2011. Publications: *Val Martin et al.*, 2010; 2012.
- **Pierre Lallart**, JPL Visiting Junior Scientist, 2007-2008. Publication: *Lallart et al.*, 2008.
- **Yang Chen**, JPL/Caltech Post-Doctoral Fellow, 2006-2008. Publications: *Kahn, Y. Chen, et al.*, 2008; *Y. Chen et al.*, 2009a, b.
- **Yang Liu**, Harvard Post-Doctoral Fellow, 2006-2008. Publications: *Y. Liu et al.*, 2007a; b; c; 2009a; b.
- **Michael Garay**, UCLA Department of Atmospheric Sciences, graduate student (under Kuo-Nan Liou), November 2005 – 2007. Publications: *Kahn, Garay, et al.*, 2007; 2009.
- **David Reidmiller**, University of Washington, Seattle, graduate student (under Peter Hobbs; Kahn helped supervise thesis work, especially after Hobbs passed away, 2004-2005. Publication: *Reidmiller, Hobbs, and Kahn*, 2006.
- **Anne (Wei-Ting) Chen**, Caltech, graduate student, 2003-2007, under J. Seinfeld; Kahn supervised one part of her thesis – Published as *W-T. Chen, R. Kahn, et al.*, 2008.
- **Olga Kalashnikova**, National Research Council Post-Doctoral Fellow, 2002-2004; Publications: *Kalashnikova et al.*, 2005; *Kalashnikova and Kahn*, 2006; 2008.
- **Mariam Boghos**, Glendale College, SIRI (*Student Independent Research Intern*), Fall 2006.
- **Aaron Katona**, San Antonio College, SIRI intern, Fall 2006.
- **Shirley Mims**, Glendale College, SIRI intern, Spring 2005; JPL Research Apprentice, Summer 2005-2009. Publication: *Mims, Kahn, et al.*, 2008.
- **Erin Schumacher**, student intern, Summer 2005.

- **David Fox**, Glendale College, SIRI intern, Spring 2004; JPL Research Apprentice, Summer 2004-Fall 2006. Publication: *Fox, Gonzalez, Kahn, et al.*, 2007.
- **Enrique Gonzalez**, Glendale College, SIRI intern, Fall 2003; JPL Research Apprentice, Winter 2004 - Fall 2006. Publication: *Fox, Gonzalez, Kahn, et al.*, 2007.
- **Brenda Valdovinos**, California State University Los Angeles, 2002-2003
- **Amy Braverman**, UCLA graduate student, Dept. of Statistics (under R. Berk), 1998-2002. Publication: *Kahn & Braverman*, 1999.
- **Celia Smith**, student intern, California State University Northridge, 2000-2002

Peer-Reviewed Publications

(About 200 to date; H-Index 56)

* Lead author student or post-doc

2015 - present

* Petrenko, M., **R.A. Kahn**, M. Chin, J.A. Limbacher, 2017. Refined use of satellite aerosol optical depth snapshots to constrain biomass burning emissions in the GOCART model. *JGR (submitted)*

* Friberg, M.D., **R.A. Kahn**, H.A. Holmes, H.H. Chang, M.J. Strickland, S.E. Sarnat, P.E. Tolbert, A.G. Russell, and J.A. Mulholland, 2016. Evaluation of Spatiotemporally-resolved Daily Ambient Air Pollution Metric Estimates and Uncertainties for Five-cities Developed Using a Fusion Method. *Atm. Env. (submitted)*

* Flower, V., and **R.A. Kahn**, 2016. Assessing the altitude and dispersion of volcanic plumes using MISR multi-angle imaging: Sixteen years of volcanic activity in the Kamchatka Peninsula, Russia. *J. Volcanology (submitted)*

Kahn, R.A., T. Berkoff, C. Brock, G. Chen, R. Ferrare, S. Ghan, T. Hansico, D. Hegg, J.V. Martins, C.S. McNaughton, D.M. Murphy, J.A. Ogren, J.E. Penner, P. Pilewskie, J. Seinfeld, and D. Worsnop, 2016. *SAM-CAAM*: Systematic Aircraft Measurements to Characterize Aerosol Air Masses. *Bull. Am. Meteor. Soc. (submitted)*

Li, J., X. Li, B.E. Carlson, **R.A. Kahn**, A.A. Lacis, O. Dubovik, and T. Nakajima, 2016. Reducing Multi-sensor Monthly Mean Aerosol Optical Depth Uncertainty Part II: Optimal Locations for Potential Ground Observation Deployments. *J. Geophys. Res. (submitted)*

* Zamora, L.M., **R.A. Kahn**, Sabine Eckhardt, Allison McComiskey, Patricia Sawamura, Richard Moore, and Andreas Stohl, 2016. Aerosol net indirect effects on mid-altitude thin, liquid-containing clouds over the Arctic Ocean. *Atmos. Chem. Phys. Discuss.*, doi:10.5194/acp-2016-1037

* Limbacher, J.A., and **R.A. Kahn**, 2016. MISR Empirical Calibration Corrections, with Application to Combined Aerosol and Ocean Surface Chlorophyll-a Retrievals. *Atmos. Meas. Tech. Discuss.*, doi:10.5194/amt-2016-360.

Li, J., X. Li, B.E. Carlson, **R.A. Kahn**, A.A. Lacis, O. Dubovik, and T. Nakajima, 2016. Reducing Multi-sensor Monthly Mean Aerosol Optical Depth Uncertainty Part I: Objective Assessment of Current AERONET Locations. *J. Geophys. Res. 21*, doi:10.1002/2016JD025469.

Snider, G., C.L. Weagle, K.K. Murdyomootoo, A. Ring, Y. Ritchie, A. Walsh, C. Akoshile, N.X. Anh, J. Brook, F.D. Qonitan, J. Dong, D. Griffith, K. He, B.N. Holben, **R.A. Kahn**, N. Lagrosas, P. Lestari, Z. Ma, A. Misra, E.J. Quel, A. Salam, B. Schichtel, L. Segev, S.N. Tripathi, C. Wang, C. Yu, Q. Zhang, Y. Zhang, M. Brauer, A. Cohen, M.D. Gibson, Y. Liu, J. Vanderlei Martins, Y. Rudich, and R.V. Martin, 2016. Variation in Global Chemical Composition of PM_{2.5}: Emerging

Results from SPARTAN, 2016. *Atmos. Chem. Phys.* *16*, 9629–9653, doi:10.5194/acp-16-9629-2016.

* Lee, H., O.V. Kalashnikova, K. Suzuki, A. Braverman, M.J. Garay, and **R.A. Kahn**, 2016. Climatology of the aerosol optical depth by components from the Multiangle Imaging SpectroRadiometer (MISR) and chemistry models. *Atm. Chem. Phys.* *16*, 6627–6640, doi:10.5194/acp-16-6627-2016.

Kahn, R.A., A. M. Sayer, Z. Ahmad, and B. Franz, 2016. How Aerosol Amount and Type Affect SeaWiFS Ocean Color Retrievals. *J. Atm. Ocean Tech.* *33* (6), doi:10.1175/JTECH-D-15-0121.1.

Seinfeld, J.H., C.S. Bretherton, K.S. Carslaw, H. Coe, P.J. DeMott, E.J. Dunlea, G. Feingold, S.J. Ghan, A.B. Guenther, **R.A. Kahn**, I.P. Kraucunas, S.M. Kreidenweis, J.J. Molina, A. Nenes, J.E. Penner, K.A. Prather, V. Ramanathan, V. Ramaswamy, P.J. Rasch, A.R. Ravishankara, D. Rosenfeld, G. Stephens, and R. Wood, 2016. Improving Our Fundamental Understanding of the Role of Aerosol-Cloud Interactions in the Climate System. *Proc. Nat. Academy Sci.* *113* (21), 5781–5790, doi:10.1073/pnas.1514043113.

Van Donkelaar, A., R.V. Martin, M. Brauer, N.C. Hsu, **R.A. Kahn**, R.C. Levy, A. Lyapustin, A.M. Sayer, and D.M. Winker, 2016. Global Estimates of Fine Particulate Matter using a Combined Geophysical-Statistical Method with Information from Satellites, Models, and Monitors. *Env. Sci. Tech.* *50*, 3762–3772, doi:10.1021/acs.est.5b05833.

* Zamora, L. M., **R.A. Kahn**, M. J. Cubison, G. S. Diskin, J. L. Jimenez, Y. Kondo, G. M. McFarquhar, A. Nenes, K. L. Thornhill, A. Wisthaler, A. Zelenyuk, and L. D. Ziemba, 2016. Aircraft-measured indirect cloud effects from biomass burning smoke in the Arctic and subarctic. *Atmos. Chem. Phys.*, *16*, 715-738, doi:10.5194/acp-16-715-2016.

Solomos, S., V. Amiridis, P. Zanis, E. Gerasopoulos, F.I. Sofiou, T. Herekakis, J. Brioude, A. Stohl, **R.A. Kahn**, and C. Kontoes, 2015. Smoke dispersion modeling over complex terrain using high-resolution meteorological data and satellite observations – The FireHub platform. *Atmosph. Env.* *119*, 348-361.

* Limbacher, J.A., and **R.A. Kahn**, 2015. MISR Empirical Stray Light Corrections in High-Contrast Scenes. *Atmos. Meas. Tech.* *8*, doi: 10.5194/amt-8-1-2015.

Kahn, R.A., and B. J. Gaitley, 2015. An analysis of global aerosol type as retrieved by MISR. *J. Geophys. Res. Atmos.* *120*, doi:10.1002/2015JD023322.

Taylor, M., S. Kazadzis, V. Amiridis, and **R.A. Kahn**, 2015. Global aerosol mixtures and their multiyear and seasonal characteristics. *Atmosph. Env.*, *116*, 112-129.

Snider, G., C.L. Weagle, R.V. Martin, A. van Donkelaar, K. Conrad; M. Zwicker; C. Akoshile, P. Artaxo, N.X. Anh, J. Brook, J. Dong, R. Greenwald, K. He, B.N. Holben, **R.A. Kahn**, I. Koren, N. Lagrosas, P. Lestari, Z. Ma, V.J. Martins, E.J. Quel, Y. Rudich, A. Salam, S.N. Tripathi, C. Yu, Q. Zhang, Y. Zhang; M. Brauer, A. Cohen, M.D. Gibson, Y. Liu, 2015. SPARTAN: A Global Network to Evaluate and Enhance Satellite-Based Estimates of Ground-

level Aerosol for Global Health Applications. *Atm. Meas. Tech.* 8, 505-521, doi:10.5194/amt-8-505-2015.

Kahn, R.A., 2015. Satellites and Satellite Remote Sensing: Aerosol Measurements. In: Gerald R. North (editor-in-chief), John Pyle and Fuqing Zhang (editors). *Encyclopedia of Atmospheric Sciences*, 2nd edition, Vol. 5, pp. 51–66.

* Li, S., **R.A. Kahn**, M. Chin, M.J. Garay, and Y. Liu, 2015. Improving MISR retrieved aerosol microphysical properties using GoCART data. *Atm. Meas. Tech.*, 8, 1157–1171, doi:10.5194/amt-8-1157-2015.

2012 - 2014

Schwartz, S.E., R.J. Charlson, **R.A. Kahn** and H. Rodhe, 2014. Earth's climate sensitivity: Apparent Inconsistencies in recent analyses. *Earth's Future*, doi:10.1002/2014EF000273.

* Limbacher, J.A., and **R.A. Kahn**, 2014. MISR Research-Aerosol-Algorithm: Refinements For Dark Water Retrievals. *Atm. Meas. Tech.* 7, 1-19, doi:10.5194/amt-7-1-2014.

Nelson, D.L., and **R.A. Kahn**, 2014. Stereoscopic Retrieval of Smoke Plume Heights and Motion from Space-Based Multi-angle Imaging, using the MISR INteractive eXplorer (MINX). The Canadian Smoke Newsletter, pp. 10-17.

Colarco, P. R., **Kahn, R.A.**, Remer, L. A. and Levy, R. C., 2014. Impact of satellite viewing-swath width on global and regional aerosol optical thickness statistics and trends. *Atmos. Meas. Tech.* 7, 2313–2335, doi:10.5194/amt-7-2313-2014.

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- Head of the JPL Exploratory Data Analysis Team, and leader in the development of a methodology for the validation of large, geophysical data sets, 1988-1992.
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Teaching Experience

Presently, I give 15-20 external talks per year at scientific meetings, plus a half-dozen or so public and student lectures. Details available upon request. Also, since the beginning of my work on the MISR mission around 1995, my teaching efforts have focused mostly on mentoring junior scientists (see section on *Students, Post-Docs, & Junior Scientists Mentored* above), and on giving occasional class lectures when requested.

Winter, 1994 Air Pollution Atmospheric Sciences Dept., UCLA

This course was taught at the entering undergraduate level for science and non-science majors. The class had about 200 students. Emphasis was placed on the basic physical and chemical principles needed to understand local, regional and global scale environmental issues, including global warming, acid rain, the ozone hole, and photochemical smog. Underlying principles include the uses of budgets and taxonomies, numbers in context, and global cycles of energy, water, and other constituents. Environmental policy issues were discussed toward the end of the course.

Fall, 1993 GE152A - Principles of Atmospheric Physics Graduate Level, Cal. Tech.

This course was team-taught by Richard Goody (my former thesis advisor) and me, stressing the basic physical principles of thermodynamics, light scattering, radiative transfer, and cloud physics, and their application to the atmosphere of Earth. I gave the lectures on cloud physics and aerosol light scattering. This course is given at the level of Houghton (1977), but is based on a text by Goody, to which I also contributed.

Spring, 1993 Global Warming and Public Policy Dept. of Sociology, UCLA

I created this course for advanced undergraduates; it was taught to social science majors. I began with a review of the scientific aspects of global warming: what is known, what is conjectured, and what could be learned (measured or modeled) relating to Global Warming. Topics included: (1) **measurements and uncertainties** in the concentrations of atmospheric greenhouse gasses, (2) global-scale **budgets** (reservoirs and cycles) of carbon and water on Earth, with comparisons to Mars and Venus, (3) the basics of **radiative transfer** as it relates to the "greenhouse effect," (4) **theories and models** of global climate, with emphasis on the "cloud-climate feedback", and (5) **observations** and uncertainties in the global temperature record. The second part of the course emphasized policy issues having societal impact: an examination of "engineering countermeasures," "adaptation strategies," and "mitigation strategies" for several examples, such as the deforestation/global biomass question. Arguments made by different sides were examined critically, in light of the material presented in the first part of the course. Main

references were the International Panel on Climate Change (IPCC) Report (1990), and selected articles from Scientific American, Nature, and Science.

1992-1994 Special Lectures on Global Change Senior Undergraduate level
Claremont Colleges

I present a series of lectures on the basic physical principles useful in organizing information about planetary-scale systems, and in making quantitative deductions about global change issues (such as conservation laws, scaling laws, and budget calculations). Each lecture begins with an overview of the key ideas and the basic mathematics required to apply the principle, followed by three or four examples that use the underlying principle in different disciplines (chemistry, biology, physics, geology, sociology). I generally ask other members of the faculty to present some of the examples in their areas of expertise.

1987-1988 Graphing Data Research Seminar Post graduate level, NASA
Goddard Space Flight Center

I led this informal seminar, which is attended weekly by between one and two dozen Goddard research scientists. The focus of the presentations and discussions was to develop effective tools for data analysis, in anticipation of vast amounts of Earth Science and other spacecraft data in the 1990's. As part of the seminar, I gave a series of lectures on visualization of data for scientific analysis, based on books by Cleveland, Tukey, and other sources, as well as some original work.

1985-1986 Topics Seminar Graduate level, Washington U.

Between 7 and 14 students participated in this weekly seminar, which provided students with an opportunity to present and critically assess current research topics. In addition to oral presentations, one article per week was assigned for background reading and critical analysis. From time to time throughout the semester I gave lectures on background material in subjects ranging from spectroscopy to mathematical methods.

Spring 1984 Martian Climate Graduate level, Cornell U.

I covered our current understanding of the interlocking roles of dust, water, and CO₂ in shaping the climate of Mars, emphasizing the physical processes that govern the behavior of each. Given as guest lecture series in a course led by C. Sagan.

Fall 1983 Intro. to Atmospheres Junior level, Cornell U.

I gave a short course introducing the barometric law, radiative transfer and the greenhouse effect, and the adiabatic lapse rate at the level of Goody and Walker. I used as a focus for the presentations the interpretation of a stellar occultation of Mars, and discussed the runaway greenhouse on Venus. Given as guest lecture series in a course led by S. Ostro.

Fall 1982 Intro. to Atmospheres Junior level, Cornell U.

Similar to Fall 1983, but with an additional set of lectures on the colors of the planets, stressing light scattering by particles and the spectra of gasses and solid surfaces. Given as guest lecture series in a course led by S. Ostro.

Spring 1981 Chemical Evolution of the Solar System Graduate level, Cornell U.

Solar elemental abundances and discussion of the radiative transfer required to interpret the solar spectrum, compressed and uncompressed densities of planets and the thermodynamic models required to derive these quantities, a critical assessment of the Lewis model for solar system evolution, and meteorite isotopic compositions and their implications for solar system history.

Fall 1980 The Chemical Evolution of Atmospheres Junior level, Cornell U.

I did a comparison of the sources, sinks, and reservoirs of volatiles for the inner planets, using essentially the material in Walker's book on the Evolution of Atmospheres, updated with Pioneer Venus and Viking results. Given as a guest lecture series in a course led by S. Ostro.