

Christopher Allen Cantrell

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Senior Scientist and Scientific Executive
Conducting, promoting and enabling scientific inquiry and discovery

Accomplished scientist with more than 20 years' experience in conducting, planning, leading, and participating in cutting-edge scientific projects.

Managed several multi-institution projects involving research aircraft and state-of-the art scientific instrumentation and numerical models. Interfaced with funding agencies to successfully secure grants for programs. Led groups of scientists in support of institutional mission and goals. Managed program at the National Science Foundation that distributed \$17 million to enable research in atmospheric chemistry. Successfully acquired grants for research group to participate in dozens of observational campaigns. Adept at operating a variety of commercial analytical instruments. Designed, developed, and deployed several research-grade analytical instruments that led to important findings on atmospheric composition.

- Published more than 125 scientific papers in peer-reviewed journals
- Received Ph.D. in Analytical Chemistry; B.A. in Chemistry & Mathematics
- Planned and managed scientific projects. Activities included securing funding for needed facilities, developing interest within the community, and getting commitments from participants and federal funding agencies
- Filled community scientific needs by designing new instruments that led to improved understanding of atmospheric chemistry
- Supported and mentored junior staff members to enable success in their scientific careers

Scientific Project Management • Federal Agency Program Management • Development and Deployment of New Instrumentation • New and Important Scientific Findings from Research • Scientific Leadership and Mentoring • Securing Grants for Scientific Activities • Community and Institutional Service to Enable Scientific Activities and Mission

Professional Experience

University of Colorado, Boulder, Colorado

Senior Research Associate (Current Position)

Leads and performs research on the oxidizing capacity of the troposphere; deploys instrumentation for quantification of tropospheric peroxy radicals and other species; publishes papers in reputable journals describing this research; makes presentations at national and international meetings.

National Center for Atmospheric Research, Boulder, Colorado

Senior Scientist (final position), Section Head, Group Leader, Scientist III, II, I, Visiting Scientist (multiple promotions through the scientist ladder, equivalent to tenure-track, and to leadership roles).

Leads and performs research on the oxidizing capacity of the troposphere; deploys instrumentation for quantification of tropospheric peroxy radicals and other species; performs research on the kinetics, spectroscopy and photochemistry of important processes relevant to the chemistry of the atmosphere; publishes papers in reputable journals describing this research; makes presentations at national and international meetings; supports corporate mission through community service, education and outreach activities; plans, develops and leads complex community field campaigns.

National Science Foundation, Arlington, Virginia

Associate Program Director

Manages proposals from researchers, arrange reviews, recommends award actions; oversees Atmospheric Chemistry program; participates in development and implementation of cross-divisional initiatives; temporary leave was taken during this period.

National Center for Atmospheric Research, Boulder, Colorado

Postdoctoral Fellow

Performs directed research on the kinetics, spectroscopy and photochemistry of important processes relevant to the chemistry of the atmosphere in support of ACD/NCAR mission; fellowship was awarded through the prestigious NCAR Advanced Study Program. Mentor: Jack G. Calvert

Scientific and Technical Accomplishments

1. PERCA (PEroxy Radical measurement by Chemical Amplification) Instrument Development and Deployment: Initial concept demonstrated using opto-acoustic spectroscopy; application of luminol-based chemiluminescence detection of NO₂; inlet design; computer interface and control; extension to dual channel instrument; deployment in ground-based campaigns in US and Europe; participation in international intercomparisons; technology transfer to other groups in US, Europe and Japan.
2. Laboratory Kinetics and Spectroscopy of Atmospheric Relevance: Laboratory measurement of kinetics and mechanism of reaction of NO₃ radicals; determination of temperature dependent equilibrium coefficient and rate coefficients for N₂O₅/NO₃/NO₂ system; quantification of visible and ultraviolet temperature and wavelength dependent absorption cross sections; determination of photolysis quantum yields for NO₂ near the dissociation threshold; measurement of the temperature dependence of j(NO₂); measurement of temperature dependent infrared absorption cross sections; measurement of absorption cross sections for water vapor near the 184.9 nm mercury emission line; measurement of the temperature dependence of the carbon kinetic isotope effect in the reaction of OH with methane; determination of the hydrogen kinetic isotope effect in the reaction of OH with H₂; measurement of the branching ratio in the reaction of O(¹D) with nitrous oxide.
3. Theoretical and Numerical Studies: Experimental and theoretical assessment of the NO/NO₂/O₃ photostationary state and its relation to peroxy radicals; calculations of the energetics of photolysis processes near the dissociation threshold; calculations of kinetic isotope effects; assessment of nighttime free radical chemistry; development and application of a constrained steady state box model to estimate OH, HO₂, RO₂ and radical reservoir concentrations; development and application of a simple, parameterized model for photolysis rate coefficients; assessment of wavelength errors in photolysis rate coefficient calculations; calculation of pressures and flow dynamics in medium and low pressure vacuum systems; statistical methods for comparing quantities measured by two instruments including linear regression methods; theoretical and experimental (field and laboratory) assessment of interactions of peroxy radicals with aerosols and cloud droplets; reviews of current state of understanding of atmospheric NO_x, atmospheric hydrogen compound chemistry, and hydrogen radical measurement techniques.
4. PeRCIMS (Peroxy Radical measurement by Chemical Ionization Mass Spectroscopy) Instrument Development and Deployment: design, construction, and testing of a new, single channel mass spectrometer for laboratory tests and ground-based measurements; design, construction, and testing of an inlet for airborne and ground-based sampling; laboratory optimization of inlet reagent concentrations; development of schemes to separate HO₂ and RO₂ including oxygen dilution modulation; deployment in national and international airborne and ground-based observation campaigns; participation in national and international intercomparisons.

Honors and Awards

A sampling of awards related to organizational and leadership activities. There are six more during employment and an additional ten during undergraduate and graduate school.

- Incentive Award: Coordination of the divisional Seminar Program, NCAR.
- Group Achievement Award: INTEX-B Intercontinental Chemical Transport Experiment Science Team, Field experiment to study transport of pollutants from Asia to North America, NASA.
- Group Achievement Award: ARCTAS Arctic Research of the Composition of the Troposphere from Aircraft and Satellites, Field experiment to study impacts on composition of air over North America from local sources and long-range transport, NASA.
- Incentive Award: Appointments Review Group Bylaws committee service, small working group did a complete rewrite of the committee's bylaws, NCAR.
- Incentive Award: Leadership of Deep Convective Clouds and Chemistry (DC3) project, Field campaign to study the role of convective storms on the composition and chemistry of the upper troposphere, NCAR.

Research Grants

29 Research Grants

Field Measurement Campaigns

29 Field Measurement Campaigns

Education

Ph. D. Chemistry, Dissertation: Peroxy Radical Measurement by Chemical Amplification,
Advisor: Donald H. Stedman
University of Michigan, Ann Arbor, Michigan

M.S. Chemistry
University of Michigan, Ann Arbor, Michigan

B.A. Chemistry and Mathematics Major, Physics Minor
Kansas Wesleyan University, Salina, Kansas

Citizenship

United States of America

Other Activities

Ballroom and Round Dancing: participating and teaching.

Computer programming skills: Fortran, Visual Basic, C, LabView, Matlab.

Foreign languages: German, basic reading and speaking

Professional Organization memberships: American Geophysical Union, American Meteorological Society, Phi Lambda Upsilon Honorary Chemistry Society

Publications

1. Dissertation

Cantrell, C. A., Peroxy Radical Measurement by Chemical Amplification, 1983, Department of Chemistry, University of Michigan, Ann Arbor, Michigan, [DAI, 44, no. 06B, (1983): 1812].

2. Refereed Journal Articles (*publications arising from graduate work)

1. *Cantrell, C. A. and D. H. Stedman, A possible technique for the measurement of atmospheric peroxy radicals, *Geophys. Res. Lett.*, 9, 846-849, 1982.
2. *Wendel, G. J., D. H. Stedman, C. A. Cantrell, and L. Damrauer, A luminol-based nitrogen dioxide detector for ambient air studies, *Analy. Chem.*, 55, 937-940, 1983.
3. *Cantrell, C. A., D. H. Stedman, and G. J. Wendel, Measurements of atmospheric peroxy radicals with chemical amplification, *Analy. Chem.*, 56, 1496-1502, 1984.
4. Perner, D., A. Schmeltekopf, R. H. Winkler, J. G. Calvert, C. A. Cantrell, W. R. Stockwell, and H. S. Johnston, A laboratory and field study of the equilibrium, $\text{N}_2\text{O}_5 \leftrightarrow \text{NO}_3 + \text{NO}_2$, *J. Geophys. Res.*, 90, 3807-3812, 1985.
5. Cantrell, C. A., W. R. Stockwell, L. G. Anderson, K. L. Busarow, D. Perner, A. Schmeltekopf, J. G. Calvert, and H. S. Johnston, Kinetic study of the $\text{NO}_3\text{-CH}_2\text{O}$ reaction and its possible role in nighttime tropospheric chemistry, *J. Phys. Chem.*, 89, 139-146, 1985; Addition and Correction, *J. Phys. Chem.*, 89, 4160, 1985.
6. Calvert, J. G., A. Lazrus, G. L. Kok, B. G. Heikes, J. G. Walega, J. Lind, and C. A. Cantrell, Chemical mechanisms of acid generation in the troposphere, *Nature*, 317, 27-35, 1985.
7. *Stedman, D. H., J. G. Walega, C. A. Cantrell, J. P. Burrows, and G. Tyndall, Ambient radical concentrations in the presence of airborne liquid water, in NATO ASI Series, Chemistry of Multiphase Atmospheric Systems, W. Jaeschke, Ed., Springer-Verlag Berlin Heidelberg, 1986.
8. Johnston, H. S., C. A. Cantrell, and J. G. Calvert, Unimolecular decomposition of NO_3 to form NO and O_2 , and a Review of $\text{N}_2\text{O}_5/\text{NO}_3$ Kinetics, *J. Geophys. Res.*, 91, 5159-5172, 1986.
9. Cantrell, C. A., J. A. Davidson, K. L. Busarow, and J. G. Calvert, The $\text{CH}_3\text{CHO-NO}_3$ reaction and possible nighttime PAN generation, *J. Geophys. Res.*, 91, 5347-5353, 1986.
10. Davidson, J. A., C. A. Cantrell, S. C. Tyler, R. E. Shetter, R. J. Cicerone, and J. G. Calvert, The carbon kinetic isotope effect in the reaction of CH_4 with OH , *J. Geophys. Res.*, 92, 2195-2199, 1987.
11. Cantrell, C. A., J. A. Davidson, R. E. Shetter, B. A. Anderson, and J. G. Calvert, The temperature invariance of the NO_3 absorption cross section in the 662 nm region, *J. Phys. Chem.*, 91, 5858-5863, 1987.
12. Shetter, R. E., J. A. Davidson, C. A. Cantrell, and J. G. Calvert, Temperature variable long path cell for absorption measurements, *Rev. Scientific Instr.*, 58, 1427-1428, 1987.
13. Cantrell, C. A., J. A. Davidson, R. E. Shetter, B. A. Anderson, and J. G. Calvert, Reactions of NO_3 and N_2O_5 with molecular species of possible atmospheric interest, *J. Phys. Chem.*, 91, 6017-6021, 1987.
14. Davidson, J. A., C. A. Cantrell, R. E. Shetter, A. H. McDaniel, and J. G. Calvert, Absolute infrared absorption cross sections for ClONO_2 at 296 and 223 K, *J. Geophys. Res.*, 92, 10921-10926, 1987.
15. Massie, S. T., J. A. Davidson, C. A. Cantrell, A. H. McDaniel, J. C. Gille, V. G. Kunde, J. C. Brasunas, B. J. Conrath, W. C. Maguire, A. Goldman, and M. M. Abbas, Atmospheric Infrared Emission of ClONO_2 Observed by a Balloon-Borne Fourier Spectrometer, *J. Geophys. Res.*, 92, 14806-14814, 1987.
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18. McDaniel, A. H., J. A. Davidson, C. A. Cantrell, R. E. Shetter, and J. G. Calvert, Enthalpies of formation of dinitrogen pentoxide and the nitrate free radical, *J. Phys. Chem.*, 92, 4172-4175, 1988.
19. Davidson, J. A., C. A. Cantrell, A. H. McDaniel, R. E. Shetter, S. Madronich, and J. G. Calvert, Visible-ultraviolet absorption cross sections for NO_2 as a function of temperature, *J. Geophys. Res.*, 93, 7105-7112, 1988.
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25. Cantrell, C. A., R. E. Shetter, A. H. McDaniel, and J. G. Calvert, The rate coefficient for the reaction, NO₂ + NO₃ → NO + NO₂ + O₂, from 273 to 313 K, *J. Geophys. Res.*, 95, 20531-20537, 1990.
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41. Cantrell, C. A., R. E. Shetter, T. M. Gilpin, J. G. Calvert, F. L. Eisele, and D. J. Tanner, Peroxy radical concentrations measured and calculated From trace gas measurements in the Mauna Loa Photochemistry Experiment 2, *J. Geophys. Res.*, 101, 14653-14664, 1996.
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49. Cantrell, C. A., Insights into the Federal Funding of Scientific Research (invited), ACD Seminar with Access Grid broadcast to Millersville University, May 2004.
50. Cantrell, C. A., Lessons learned as an NSF program officer (invited), ASP Brown Bag Lunch Presentation, May 2004.
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54. Cantrell, C. A., Measurement-model comparison of radical measurements from several recent airborne studies (invited), ACCENT meeting, University of Leeds, UK, April 2005.
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81. Cantrell, C., L. Mauldin, N. Schardt, A. Mukherjee, NOMADSS and FRAPPE Science Teams, HOx Radical Behavior in Urban, Biogenic and Mixed Environments, Fall AGU Meeting, San Francisco, December 2014.
82. Cantrell, C., Calibration of HOx Instruments (invited), HOx Measurements Workshop, Juelich, Germany, March 2015.
83. Cantrell, C., L. Mauldin, and A. Mukherjee, Photochemistry During FRAPPE, FRAPPE/DISCOVER-AQ Workshop, Boulder, Colorado, May 2015.
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Contributed to an additional 94 presentations.