Dr. Anne M. Thompson

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RESEARCH EXPERTISE:

Atmospheric Chemistry & Climate Change: Modeling and measurements of trace gases, air-sea gas exchange, ozone and convective systems, lightning, biomass burning. Global Change: Simulation of future and pre-industrial troposphere. Remote Sensing. Applications and validation.

EDUCATION:

1970 - B.A., Chemistry (Honors), Swarthmore College
1972 - M.A., Chemistry, Princeton University
1978 - Ph.D., Physical Chemistry, Bryn Mawr College

POSITIONS:

1978 - 1979 Woods Hole Oceanographic Institution, Woods Hole, MA, Postdoctoral Scholar
1979 - 1981 UC-SD - Scripps Institution of Oceanography, LaJolla, CA, Postgraduate Marine Chemist
1981 - 1984 National Center for Atmospheric Research (NCAR), Boulder, CO, Visiting Scientist; ASP Postdoctoral Fellow
1984 - 1986 Applied Research Corporation, Landover, MD, Contract Scientist at NASA/GSFC
1986 - 2004 Physical Scientist, Atmospheric Chemistry and Dynamics Branch, Lab. for Atmospheres, NASA/Goddard Space Flight Center, Greenbelt, MD
1995 - Adjunct Faculty, Univ. Maryland-College Park, Atmospheric & Oceanic Sciences Dept.
2005 - Professor, Penn State University, Meteorology Department

MEMBERSHIPS:

AAAS, AMS, AGU -- Member and Fellow; Assn Women in Science (AWIS); Am. Chemical Society

AWARDS:

1970 BA with Honors (External Examination), Phi Beta Kappa, Sigma Xi, Phila. Chapter ACS Best Student Award; NSF Predoctoral Fellowship
1987, 1989, 1995, 2003 GSFC Director's Discretionary Fund;
1990-1996, 1998-2002 GSFC Performance Awards;
1992 Goddard Equal Opportunity Award;
1993, 2001 GSFC Lab. for Atmospheres Peer Award for Outstanding Leadership
1995 NASA Exceptional Achievement Medal.
1995 Fellow, American Meteorological Society (AMS)
1998 Nordberg Medal, COSPAR (Committee for Space Research)
2002 Fellow, American Association for Advancement of Science (AAAS)
2003 Fellow, American Geophysical Union (AGU)
2004 Women in Aerospace, International Achievement Award
2004 NASA Honor Award (SHADOZ Group Achievement)
2004 ISI - Highly Cited Author (Geosciences)
2007 William T. Pecora Award for Satellite Achievement (NASA/Dept. Interior to TOMS Team)
2007 Wilson Award for Excellence in Research (Penn State Univ, College of Earth and Mineral Sciences)
2007 NOAA OAR Outstanding Paper Award for IONS-04 (Cooper et al, *JGR*, 2006)
2007 UNEP/WMO Recognition Letter (for Nobel Peace Prize IPCC Contributions)
2009 Penn State College of Earth and Mineral Sciences Faculty Mentoring Award

SPECIAL EXPERIENCE: **Research & Projects**

1. PI on NASA Project: "Tropospheric Photochemical Modeling" 1984-present. Also PI on EPA and NOAA Interagency Agreements, 1985-present.

2. EOS-IDS Teams: Stratospheric Chemistry and Dynamics (M. Schoeberl, PI); Biogeochemical Fluxes at Air-Sea Interface (P. Brewer, PI); Chemistry-Climate Interaction (D. Jacob, PI), 1988-1995.
3. NASA Satellite & Aircraft Science Teams: TOMS Satellite, 1994-2004; GTE/TRACE-A; PEM-Tropics-B, TRACE-P; UARP/ STRAT, POLARIS, ACCENT, SAFARI-2000; INTEX-NA (2004), INTEX-B (2006), TC4 (2007), ARCTAS (2008)
4. Oceanographic cruises, *Knorr 73/7*, 1978; Soviet-American Gases and Aerosols (SAGA 3), 1990; Aerosols99 Cruise, *R/V R H Brown,* 1-2/99; NEAQS, July 2004
5. Co-Mission Scientist, SONEX (SASS Ozone and Nitrogen Experiment), 1997
6. NASA HQ Detail: Project Scientist, AEAP/Subsonic Assessment, HQ Office of Aeronautics, 1993-1994
7. SHADOZ PI (Southern Hemisphere Additional Ozonesondes, 1997-present) and Field Work - Aerosols99 Cruise, PAUR II, 1999 (Crete); SAFARI-2000, Zambia
8. IONS (INTEX Ozonesonde Network Study) PI, 2004; 2006. Ozonesonde Field work at INTEX-B/Milagro in Mexico City & Richland, Washington, 2006, TC4 at Panama, 2007; NWTerritories, Canada, 2008.

Service & Committees

1. AGU: Education and Human Resource Committee, 1986-1988; Editorial Advisory Board, *Earth in Space*, 1988-1990; Secretary, AGU Atmospheric Sciences Section, 1990-1992; AGU Publications Committee, 1994-1996; Associate Editor, *Journal of Geophysical Research*, 1992-1996; Chair, GRL Editors Search Committee, 1995-1996; Member, JGR-Atmospheres Editors Search Committee, 1996; Chair, 1999-2000.
2. AMS: Atmos. Chemistry Committee, 1996-1998; AMS Council and Executive Council, 2001-2004; Nomination Committee, 2004-2007; Subject Matter Editor, *Bull. Am. Meteorological Society,* 2005-2008
3. International Societies: (A) Commission on Atmospheric Chemistry and Global Pollution (CACGP), 1994-2002. President, 2002-2006. (B) Member, International Ozone Commission, 1996-2004; (C) IGBP/IGAC Steering Committee (2000-2002); (D) WCRP/SPARC Scientific Steering Comm., 2007-2009; (E) Vice-President, ICSU/Intl Association for Meteorology and Atmospheric Science, 2007-2011
4. Global Change and Assessments: Rapporteur, Workshop on UV Effects on Aquatic Systems, 1989; Working Group 1, IPCC (Intergov. Panel on Climate Change) 1989; Rapporteur, NASA/NOAA /EPA Workshop on Global Warming Potentials, 1990; Lead Author, Tropospheric Ozone Chapter, UNEP/WMO 1998 Ozone Assessment.
5. NSF-NAS/NRC: Chair, NSF, NCAR-Atmos. Chemistry Div. Review Panel, 1996. NAS/NRC Committee - Major Ocean Programs (1996-1998); NAS/NRC Climate Research Committee (1996-2000): NAS/NRC Earth from Space Committee (2006-2007)
6. AAAS: Member-at-Large (2002-2005); Council (Section W, 2005-2007); Chair-Elect (Section W, 2007-2008)
7. UCAR/NCAR, University Relations Committee, 2005-2006; Board of Trustees, 2007-2009
8. WMO: Committee on Atmospheric Science, Management Advisory Council, 2006-2008

Education & Outreach

1. Adjunct Professor - University of Maryland Earth Systems Science Interdisciplinary Center (ESSIC), 2000-present; previously JCESS Fellow, 1995-2000. Course Taught: Atmospheric Chemistry & Physics, 2002.
2. Adjunct Research Professor (Thesis Committees): U. Miami (Rosenstiel School), NC State, Florida State U.
3. Students Advised/Co-advised: PhD -- C. Herbster, Florida State Univ. (1998), S. A. Yvon, U. Miami (1990-95); J-H Kim, U. Maryland (1996), D. J. Allen (1998); Masters -- C. Phelps, U. Maryland (1995), R. M. Todaro, U. Maryland (1997), H. Guo, U. Maryland (1999); M. G. Seybold, NC State (1999); J B. Stone, PSU (2006); S. M. Michaels, PSU (2006); A. Loucks, PSU (2007), D. Giles (U. Md., 2007); J. E. Yorks, PSU (MS, 2007), K. M. Dougherty (MS, 2007), W-C Hui, PSU (MS, 2007), A M Luzik (MS, 2009)
4. External Examiner or Student Host/Co-author: G. Bodeker (U. Natal, So. Africa, 1995), D. Jeker (ETH-Zürich, 1999), K. Longo (U. Sao Paulo, 1998), W. Peters (U. Utrecht, Netherlands, 2002)
5. GSFC Programs: Summer Institute Atmos. Sciences, Coordinator 1987-1989; Education Office, Public Affairs Speaker, 1988-Present; Summer Advisor: 1989, D. Davidoff, Yale; 1996, N. Dang, UNH; 1993-94, K. Patterson, Salisbury State and UCSB; 1996, M. Lakin, UC-Irvine; 2003 E. Deviatova, UMCP
6. Courses Taught: Penn State - Meteo 565: Middle Atmosphere, Meteo 532, Chemistry of the Atmosphere; Meteo 436: Atmospheric Physics I; Meteo 440W, Meteorol. Measurements; Meteo 597, Remote Sensing
7. NCAR - Advanced Study Program, Philip D. Thompson Lecturer, 2005
8. Penn State Committees: Meteorology MS: 2005: A. Metcalf; K Bailey; 2006: C. Beatty; 2007: M Root, A K. Huff, D. M. Shelow. PhD - J. Mao (Meteorology, 2007), J.H. Park (Elec. Engineering, 2008)

REFEREED PUBLICATIONS:

1. **A. M. Thompson**, The photochemical *cis-trans* isomerization of azomethane: A kinetic investigation, Ph.D. Thesis, Bryn Mawr College, 1978.
2. **A. M. Thompson**, P. C. Goswami, and G. L. Zimmerman, A kinetic analysis of the photochemistry of alkyldiazenes in hydrocarbon solution, *J. Phys. Chem.,* **83**, 314-320, 1979.
3. **A. M. Thompson**, Wet and dry removal of tropospheric formaldehyde at a coastal site, *Tellus,* **32**, 376-383, 1980.
4. **A. M. Thompson** and R. J. Cicerone, Clouds and wet removal as causes of variability in the trace gas composition of the marine troposphere, *J. Geophys. Res.,* **87**, 8811-8826, 1982.
5. **A. M. Thompson** and O. C. Zafiriou, Air-sea fluxes of transient atmospheric species, *J. Geophys. Res.,* **88**, 6696-6708, 1983.
6. B. G. Heikes and **A. M. Thompson**, Effects of heterogeneous processes on NO_3, HONO, and HNO_3 in the troposphere, *J. Geophys. Res.,* **88**, 10,883-10,895, 1983.
7. **A. M. Thompson**, The effect of clouds on photolysis rates and ozone formation in the unpolluted troposphere, *J. Geophys. Res.,* **89**, 1341-1349, 1984.
8. **A. M. Thompson** and D. H. Lenschow, Mean profiles of trace reactive species in the unpolluted marine surface layer, *J. Geophys. Res.,* **89**, 4788-4796, 1984.
9. **A. M. Thompson** and R. J. Cicerone, Possible perturbations to atmospheric CO, CH_4, and OH, *J. Geophys. Res.,* **91**, 10,853-10,864, 1986.
10. **A. M. Thompson** and R. J. Cicerone, Atmospheric CH_4, CO, and OH from 1860-1985, *Nature*, **321**, 148-150, 1986.
11. **A. M. Thompson**, R. W. Stewart, M. A. Owens, and J. A. Herwehe, Sensitivity of tropospheric oxidants to global chemical and climate change, *Atmos. Environ.,* **23**, 519-532, 1989.
12. R. W. Stewart, **A. M. Thompson**, M. A. Owens, and J. A. Herwehe, Comparison of parameterized nitric acid rainout rates using a coupled stochastic-photochemical tropospheric model, *J. Geophys. Res.,* **94**, 5219-5226, 1989.
13. **A. M. Thompson**, M. A. Owens, and R. W. Stewart, Sensitivity of atmospheric hydrogen peroxide to global chemical and climate change, *Geophys. Res. Lett.,* **16**, 53-56, 1989.
14. C. J. Nappo, J. A. Herwehe, and **A. M. Thompson**, Observations of ozone profiles in the developing convective boundary layer, *Ozone in the Atmosphere*, edited by R. D. Bojkov and P. Fabian, pp. 477-480, A. Deepak Publishing, 1989.
15. **A. M. Thompson**, Atmospheric chemical and climate change: Possible effects on tropospheric ozone, *Ozone in the Atmosphere*, edited by R. D. Bojkov and P. Fabian, pp. 580-583, A. Deepak Publishing, 1989.
16. **A. M. Thompson**, Effects of atmospheric chemical and climate change on tropospheric ozone, *Ozone Sci. and Engin.,* **7**, 177-194, 1990.
17. R. W. Stewart, **A. M. Thompson**, and M. A. Owens, Atmospheric residence times for soluble species: Differences in numerical and theoretical model results, *Atmos. Environ.,* **24A**, 519-524, 1990.
18. K. E. Pickering, **A. M. Thompson**, R. R. Dickerson, W. T. Luke, D. P. McNamara, P. R. Zimmerman, and J. P. Greenberg, Model calculations of tropospheric ozone production potential following observed convective events, *J. Geophys. Res.,* **95**, 14049-14062, 1990.
19. **A. M. Thompson**, M. A. Huntley, and R. W. Stewart, Perturbations to tropospheric oxidants, 1985-2035: 1. Model calculations of ozone and OH in chemically coherent regions, *J. Geophys. Res.,* **95**, 9829-9844, 1990.
20. J. R. Scala, M. Garstang, W-K. Tao, K. E. Pickering, **A. M. Thompson**, J. Simpson, V. W. J. H. Kirchhoff, E. V. Browell, G. W. Sachse, A. L. Torres, G. L. Gregory, R. A. Rasmussen and M. A. K. Khalil, Cloud draft structure and trace gas transport, *J. Geophys. Res.,* **95**, 17017-17030, 1990.
21. **A. M. Thompson**, W. E. Esaias, and R. L. Iverson, Two approaches to determining the sea-to-air flux of DMS: Satellite ocean color and a photochemical model with atmospheric measurements, *J. Geophys. Res.,* **95**, 20551-20558, 1990.
22. **A. M. Thompson**, M. A. Huntley, and R. W. Stewart, Perturbations to tropospheric oxidants, 1985-2035: 2. Model calculations of hydrogen peroxide in chemically coherent regions, *Atmos. Environ.* **25A**, 1837-1850, 1991.
23. **A. M. Thompson**, Interaction of atmospheric chemical and climate change: implications for tropospheric

ozone, in *Atmospheric Chemistry: Models and Predictions for Climate and Air Quality*, ed. C. S. Sloane and T. W. Tesche, Lewis Pub., Boca Raton, FL, 1991, pp. 47-61.

24. **A. M. Thompson** and R. W. Stewart, How chemical kinetics uncertainties affect concentrations computed in an atmospheric photochemical model, *Chemometrics and Intelligent Laboratory Systems*, **10,** 69-79, 1991.
25. K. E. Pickering, **A. M. Thompson**, J. R. Scala, W-K. Tao, J. Simpson, and M. Garstang, Photochemical ozone production in tropical squall line convection in ABLE 2A, *J. Geophys. Res.,* **96,** 3099-3114, 1991.
26. **A. M. Thompson** and R. W. Stewart, The effect of chemical kinetics uncertainties on calculated constituents in a tropospheric photochemical model, *J. Geophys. Res.*, **96**, 13089-13108, 1991.
27. **A. M. Thompson**, New ozone hole phenomenon, News and Views in *Nature*, **352**, 282-283, 1991.
28. Commentary by K. B. Hogan, **A. M. Thompson**, and J. S. Hoffman, Methane on the greenhouse agenda, *Nature*, **354**, 181-182, 1991.
29. K. S. Law and J. Pyle, **A. M. Thompson**, Discussion on modelling the response of tropospheric trace species to changing source gas concentrations, *Atmos. Environ.* **26A**, 195-197, 1992.
30. K. E. Pickering, **A. M. Thompson**, J. R. Scala, W.-K. Tao, and J. Simpson, Ozone production potential following convective redistribution of biomass burning emissions, *J. Atmos. Chem.*, **14**, 297-313, 1992.
31. K. E. Pickering, J. R. Scala, **A. M. Thompson**, W.-K. Tao, and J. Simpson, A regional estimate of convective transport of CO from biomass burning, *Geophys. Res. Lett.*, **19**, 289-292, 1992.
32. **A. M. Thompson**, K. B. Hogan, and J. S. Hoffman, Methane reductions: Implications for global warming and atmospheric chemical change, *Atmos. Environ.*, **26A**, 2665-2688, 1992.
33. **A. M. Thompson**, The oxidizing capacity of the Earth's atmosphere: Probable past and future changes, *Science*, **256**, 1157-1165, 1992.
34. K. E. Pickering, **A. M. Thompson**, J. R. Scala, W.-K. Tao, R. R. Dickerson, and J. Simpson, Free tropospheric ozone production following entrainment of urban plumes into deep convection, *J. Geophys. Res.*, **97**, 17985-18000, 1992.
35. A. L. Torres and **A. M. Thompson**, Nitric oxide in the equatorial pacific boundary layer: SAGA-3 measurements, *J. Geophys. Res.*, **98**, 16949-16954, 1993.
36. J. A. Chappellaz, I. Y. Fung, and **A. M. Thompson**, Atmospheric methane increase since the last glacial maximum. 1. Source estimates, *Tellus*, **45B**, 228-241, 1993.
37. **A. M. Thompson**, J. A. Chappellaz, I. Y. Fung, and T. L. Kucsera, Atmospheric methane increase since the last glacial maximum. 2. Effect on oxidants, *Tellus*, **45B**, 242-257, 1993.
38. **A. M. Thompson**, J. E. Johnson, A. L. Torres, and 10 others, SAGA-3 ozone observations and a photochemical model analysis of the marine boundary layer during SAGA-3, *J. Geophys. Res.*, **98**, 16955-16968, 1993.
39. E. Atlas, W. Pollock, J. Greenberg, L. Heidt, and A. Thompson, Alkyl nitrates, nonmethane hydrocarbons, and halocarbon gases over the equatorial Pacific Ocean during SAGA-3, *J. Geophys. Res.*, **98**, 16933-16948, 1993.
40. K. E. Pickering, **A. M. Thompson**, W.-K. Tao, and T. L. Kucsera, Upper tropospheric production following mesoscale convection during STEP/EMEX, *J. Geophys. Res.*, **98**, 8737-8749, 1993.
41. **A. M. Thompson**, D. P. McNamara, K. E. Pickering, and R. D. McPeters, Effect of marine stratocumulus clouds on TOMS ozone, *J. Geophys. Res.*, **98**, 23051-23057, 1993.
42. J. E. Johnson, V. M. Koropalov, K. E. Pickering, **A. M. Thompson**, N. Bond, and J. W. Elkins, Third Soviet-American Gases and Aerosols (SAGA 3) Experiment: Overview and meteorological and oceanographic conditions, *J. Geophys. Res.*, **98**, 16893-16908, 1993.
43. J. P. Pinto, C. H. Brühl, and **A. M. Thompson**, The current and future environmental role of atmospheric methane: Model studies and uncertainties: Working Group Report, in *Atmospheric Methane*: Sources, Sinks and Role in global Change, ed. by M. A. K. Khalil, Springer-Verlag, 1993, Chapter 21.
44. **A. M. Thompson**, K. E. Pickering, R. R. Dickerson, W. G. Ellis, Jr., D. J. Jacob, J. R. Scala, W.-K. Tao, D. P. McNamara, and J. Simpson, Convective transport over the central United States and its role in the regional CO and ozone budgets, *J. Geophys. Res.*, **99**, 18703-18711, 1994.
45. K. E. Pickering, **A. M. Thompson**, D. P. McNamara, M. R. Schoeberl, L. R. Lait, P. A. Newman, C. O. Justice, and J. D. Kendall, A trajectory modeling investigation of the biomass burning - tropical ozone relationship, *Ozone in the Troposphere and Stratosphere*, ed. R. D. Hudson, NASA CP-3266, 101-104,

1994.
46. K. E. Pickering, **A. M. Thompson**, J. R. Scala, W.-K. Tao, and J. Simpson, Enhancement of free tropospheric ozone production by deep convection, *Ozone in the Troposphere and Stratosphere*, ed. R. D. Hudson, NASA CP-3266, 105-108, 1994.
47. **A. M. Thompson**, Aspects of modeling the tropospheric hydroxyl radical concentration, *Israel J. Chem*, **34**, 277-288, 1994.
48. K. E. Pickering, **A. M. Thompson**, D. P. McNamara, and M. R. Schoeberl, An intercomparison of isentropic trajectories over the South Atlantic, *Mon. Wea. Rev.*, **122**, 864-879, 1994.
49. **A. M. Thompson**, Photochemical modeling of chemical cycles: Issues related to the interpretation of ice core data, in *Biogeochemical Cycles and Ice Cores*, NATO ASI Series I-30, ed. R. J. Delmas, Springer-Verlag, Vol. I30, 265-297, 1995.
50. C. W. Brown, W. E. Esaias, and **A. M. Thompson**, Using the ratio of euphotic depth to mixed-layer depth to predict phytoplankton composition: An evaluation, *Remote Sensing of Env.*, **53**, 172-176, 1995.
51. R. D. Hudson, J. Kim, and **A. M. Thompson**, On the derivation of tropospheric column ozone from radiances measured by the total ozone mapping spectrometer, *J. Geophys. Res.* **100**, 11137-11145, 1995.
52. **A. M. Thompson**, Measuring and modeling the tropospheric hydroxyl radical (OH), *J. Atmos. Sci.*, **52**, 3315-3327, 1995.
53. K. E. Pickering, **A. M. Thompson**, D. P. McNamara, W.-K. Tao, A. M. Molod, and R. B. Rood, Vertical transport by convective clouds: Comparisons between cloud-scale and global-scale models, *Geophys. Res. Lett.*, **22**, 1089-1092, 1995.
54. M. A. Carroll and **A. M. Thompson**, NO_x in the non-urban troposphere, 198-255 in *Problems and Progress in Atmospheric Chemistry*, ed. J. Barker, World Pub. Company, 1995.
55. B. Heikes, M. Lee, D. Jacob, R. Talbot, J. Bradshaw, H. Singh, D. Blake, B. Anderson, H. Fuelberg, and **A. Thompson**, Ozone, hydroperoxides, oxides of nitrogen, and hydrocarbon budgets in the marine boundary layer over the South Atlantic, *J. Geophys. Res.*, **101**, 24221-24234, 1996.
56. J.-H. Kim, R. D. Hudson, and **A. M. Thompson**, A new method of deriving time-averaged tropospheric column ozone over the tropics using TOMS radiances: Intercomparison and analysis, *J. Geophys. Res.*, **101**, 24317-24330, 1996.
57. J. R. Ziemke, S. Chandra, **A. M. Thompson**, and D. P. McNamara, Zonal asymmetries in southern hemisphere column ozone: Implications of biomass burning, *J. Geophys. Res.,* **101**, 14421-14427, 1996.
58. S. A. Yvon, E. S. Saltzman, D. J. Cooper, T. S. Bates, and **A. M. Thompson**, The flux of dimethylsulfide from the tropical South Pacific during a time-series station at 12 S, 135 W, *J. Geophys. Res.*, **101**, 6899-6909, 1996.
59. **A. M. Thompson**, R. D. Diab, G. E. Bodeker, M. Zunckel, G. Coetzee, C. B. Archer, D. P. McNamara, K. E. Pickering, J. B. Combrink, J. Fishman, and D. Nganga, Ozone over southern Africa during SAFARI-92/TRACE-A, *J. Geophys. Res.*, **101**, 23793-23807, 1996.
60. R. D. Diab, **A. M. Thompson**, M. Zunckel, G. J. R. Coetzee, J. B. Combrink, G. E. Bodeker, J. Fishman, F. Sokolic, D. P. McNamara, C. B. Archer, and D. Nganga, Vertical ozone distribution over southern Africa and adjacent oceans during SAFARI-92, *J. Geophys. Res.*, **101**, 23,809-23,821, 1996.
61. K. E. Pickering, **A. M. Thompson**, D. P. McNamara, M. R. Schoeberl, H. E. Fuelberg, R. O. Loring, Jr., M. V. Watson, K. Fakhruzzaman, and A. S. Bachmeier, TRACE-A trajectory intercomparison: 1. Effects of different input analyses, *J. Geophys. Res.*, **101**, 23,909-23,925, 1996.
62. H. E. Fuelberg, R. O. Loring, Jr., M. V. Watson, M. C. Sinha, K. E. Pickering, **A. M. Thompson**, D. R. Blake, G. W. Sachse, and M. R. Schoeberl, TRACE-A trajectory model intercomparison: 2. Isentropic and kinematic methods, *J. Geophys. Res.*, **101**, 23,927-23,939, 1996.
63. W. G. Ellis, Jr., **A. M. Thompson**, S. Kondragunta, K. E. Pickering, G. Stenchikov, R. R. Dickerson, and W-K. Tao, Potential ozone production following convective transport based on future emission scenarios, *Atmos. Environ.*, **30**, 667-672, 1996.
64. K. E. Pickering, **A. M. Thompson**, Y. Wang, W.-K. Tao, D. P. McNamara, V. W. J. H. Kirchhoff, B. G. Heikes, G. W. Sachse, J. D. Bradshaw, G. L. Gregory, and D. R. Blake, Convective transport of biomass burning emissions over Brazil during TRACE-A, *J. Geophys. Res.*, **101**, 23,993-24,012, 1996.
65. Y. Wang, W.-K. Tao, K. E. Pickering, **A. M. Thompson**, R. Adler, J. Simpson, P. Keehn, and J. Lai, Mesoscale (MM5) simulations of TRACE-A and PRE-STORM convective events, *J. Geophys. Res.*,

101, 24,013-24,027, 1996.

66. N. C. Hsu, J. R. Herman, P. K. Bhartia, C. J. Seftor, **A. M. Thompson**, J. Gleason, T. Eck, and B. N. Holben, Detection of biomass burning smoke from TOMS measurements, *Geophys. Res. Lett.*, **23**, 745-748, 1996.
67. R. W. Stewart and **A. M. Thompson**, Kinetic data imprecisions in photochemical rate calculations: Means, medians and temperature dependence, *J. Geophys. Res.*, **101**, 20,953-20,964, 1996.
68. T. Zenker, **A. M. Thompson**, D. P. McNamara, T. L. Kucsera, G. W. Harris, F. G. Wienhold, P. Le Canut, M. O. Andreae and R. Koppman, Regional trace gas distribution and airmass characteristics in the haze layer over southern Africa during the biomass burning season (Sep./Oct. 92): Observations and modeling from the STARE/SAFARI '92/DC-3, *Biomass Burning and Global Change,* ed. J. S. Levine, MIT Press, 296-308, 1996.
69. P. D. Tyson, M. Garstang, R. J. Swap, E. V. Browell, R. D. Diab and **A. M. Thompson**, Transport and vertical structure of ozone and aerosol distributions over southern Africa, *Biomass Burning and Global Change,* ed. J. S. Levine, MIT Press, 403-421 1996.
70. D. J. Allen, R. B. Rood, **A. M. Thompson**, and R. D. Hudson, Three-dimensional Rn-222 calculations using assimilated meteorological data and a convective mixing algorithm, *J. Geophys. Res.*, **101**, 6,871-6, 881, 1996.
71. **A. M. Thompson**, Modeling framework for atmospheric trace gas measurements at the air-snow interface, in *Processes of Chemical Exchange Between the Atmosphere and Polar Snow*, ed. by E. W. Wolff and R. C. Bales, NATO ASI Springer-Verlag, **143**, 225-248, 1996.
72. **A. M. Thompson**, Evaluation of biomass burning effects on ozone during SAFARI/TRACE-A: Examples from process models, in *Biomass Burning and Global Change*, ed. J. S. Levine, MIT Press, Chapter 32, 1996.
73. **A. M. Thompson**, K. E. Pickering, D. P. McNamara, M. R. Schoeberl, R. D. Hudson, J. H. Kim, E. V. Browell, V. W. J. H. Kirchhoff, and D. Nganga*,* Where did tropospheric ozone over southern Africa and the tropical Atlantic come from in October 1992? Insights from TOMS, GTE/TRACE-A and SAFARI-92, *J. Geophys. Res.*, **101**, 24,251-24,278, 1996.
74. **A. M. Thompson**, Biomass burning and the environment: Accomplishments and research opportunities, *Atmos. Environ.*, **30** (19), I-ii, 1996.
75. D. J. Allen, P. Kasibhatla, **A. M. Thompson**, R. B. Rood, B. Doddridge, K. E. Pickering, R. D. Hudson, and S.-J. Lin, Transport-induced interannual variability of carbon monoxide determined using a chemistry and transport model, *J. Geophys. Res.*, **102**, 28,655-28,669, 1996.
76. N. C. Hsu, R. D. McPeters, C. J. Seftor, and **A. M. Thompson**, The effect of an improved cloud climatology on the TOMS total ozone record, *J. Geophys. Res.*, **102**, 4,247-4,255, 1997.
77. **A. Thompson**, T. Zenker, G. Bodeker, and D. McNamara, Ozone over southern Africa: Patterns and influences, *Fire in Southern African Savanna: Ecological and Atmospheric Perspectives,* ed. B. Van Wilgen, M. O. Andreae, J. G. Goldammer and J. A. Lindesay, Univ. of Witwatersrand Press, Chapter 9, 1997.
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Technical Qualification Questions - Anne Mee Thompson

1. Recognized in the international science community for research and publications in development and application of space technology for Earth science research with demonstrated capabilities in the management and leadership of Earth science research activities.

SUMMARY STATEMENTS

My resume lists more than 20 years of achievements in (1) Earth science and Earth science from space; (2) technology development; (3) related leadership and management. Pertinent details are enumerated below. Although my activities are remarkably diverse, three **themes** underlie the scientific and career paths I have chosen: (1) constant innovation and exploration of new areas, while keeping focus on core NASA-defined missions; (2) an evolution from lab work (PhD) to modeling (80s) to data analysis (90s) to data collection and archiving for NASA's Earth science enterprise (00s); (3) working broadly across Earth science disciplines (land, air, water) while maintaining core, in-depth specialization in atmospheric chemistry. I am at once a big-picture scientific thinker and a details-minded technological expert. These talents were developed during 20 years at NASA, where I took advantage of exceptional scientific and leadership opportunities. The big-little combination works equally well at Penn State (PSU) where strategic innovations in research are rewarded but education still rests on mastery of physical science fundamentals.

Recognition can be summarized as follows:

- More than 170 peer-reviewed publications with more than 5100 citations.
- Honors and Awards in the professional community (AGU, AMS, AAAS, COSPAR, Women in Aerospace)
- Numerous performance awards from NASA along with Peer Awards for leadership, a NASA Group Honor Award and an Exceptional Achievement Medal, the latter for program development. In addition to those listed are half a dozen citations for mentoring in Goddard educational programs and serving as a Public Affairs speaker
- Two Penn State research and leadership awards

1. EARTH SCIENCE. EARTH SCIENCE FROM SPACE

A. Fundamental Scientific Studies

A1. Chemistry and Cycling in Marine Atmospheres

I made a transition from bench chemist to Earth scientist with a Woods Hole Oceanographic Institution (WHOI) Post-doctoral Fellowship. Laboratory skills in spectroscopy, photochemistry were augmented with working at sea and along the Cape Cod coast. Air-sea gas exchange studies on non-CO2 species were nearly non-existent so I undertook a study of the cycling of formaldehyde (HCHO), a simple gas both human and natural in origin, through photochemical calculation and HCHO measurements in precipitation and seawater (*Tellus,* 1980). With O. Zafiriou, I applied standard air-sea gas exchange computations to reactive gases and free radicals (*JGR,* 1983). These pioneering papers are still cited, as are measurements of biogenic alkyl nitrates I made as a NASA employee on a 1990 NOAA-Soviet Pacific cruise (*JGR,* 1993a).

A second post-doc (with R. Cicerone) straddled his residency at UCSD/Scripps

Institution of Oceanography (SIO) and Directorship of Atmospheric Chemistry at NCAR (National Center for Atmospheric Research) in Boulder. Here computer modeling and programming were added to my skill set, but the importance of the SIO-NCAR appointments was building one of the first tropospheric photochemistry models (*JGR*, 1982; 1984a,b). I used the model to study natural variability in the marine atmosphere but as I moved from NCAR to Goddard (on-site contractor, 1984-1986, then Civil Servant) I explored global chemical changes in the troposphere.

A2. Tropospheric Chemical & Climate Change

In the stratosphere, human impacts threaten to destroy ozone (O3); in the troposphere, we make too much O3 through pollution that can travel thousands of km. I used the NCAR-GSFC tropospheric model to demonstrate that cycling among methane (CH4)-carbon monoxide (CO)-O3-hydroxyl radical (OH) with a non-linear dependence on nitrogen oxides (Nox) created a critical link among global pollution, stratospheric O3 loss and temperature and moisture increases in a warming climate (*Nature,* 1986, 1991; *JGR*, 1986; *OSE*, 1990).

Uncertainties in O3 calculations due to kinetics imprecision and variations among models are vital to these assessments. I initiated the first study of tropospheric model uncertainties (*JGR*, 1991) and participated in the tropospheric model comparisons for the first and second IPCC Assessments (1991, 1994).

B. Atmospheric Chemical Variability: Natural vs Human Processes

Entering the EOS era (1988-), my attention turned to satellites. Remote sensing inspired all the projects below and in turn I charted new directions for space measurements. Examples: determining DMS (dimethyl sulfide, a natural source of marine aerosols) from ocean color (*JGR*, 1990); cloud corrections for the TOMS algorithm (*JGR*, 1993c); fire and lightning counts to interpret tropical ozone (*BAMS*, 1997); high-resolution TOMS tropospheric maps that correlate El-Nino with tropical ozone (*Science*, 2001). The most important findings on natural variability-human impacts follow.

B1. Convection & Chemical Transport

This research, with K. Pickering (UMCP, now GSFC) and J. Simpson & W. Tao (GSFC/now 613.2), was inspired by R. Dickerson's 1985 measurements showing that cloud-injected pollution travels 1000 km downwind. We performed the first studies putting my model chemistry into the GSFC Cloud-Resolving Model (*JGR,* 1992, 1993b) and later the 613.2 Mesoscale model (*JGR,* 1996a). This work is still being translated to assimilation models (*JGR,* 1996b; 1998; 2000) where getting convection "right" remains a challenge.

B2. Fires

Southern hemisphere African and Brazilian fires and their atmospheric impacts were the target of NASA's TRACE-A, the first aircraft campaign in which I flew. Prepared with trajectories (*MWR,* 1994) and new satellite products, we designed a flight with mixed convection, fires and lightning (*JGR,* 1996c). Fire impacts depend on meteorology as much as people, as we demonstrated on SAFARI-2000 with sonde launches in Zambia (*GRL,* 2002) and our oft-cited "Atlantic paradox ozone" cruise (*GRL,* 2000). Our summer 2008 ARCTAS mission analysis showed that 20% of North American O3 was from fires.

B3. Commercial Aviation

I established the SASS (Subsonics Assessment) program within NASA HQ (below) and served as SONEX Co-Mission Scientist in 1997. Planning and executing 16 DC-8 flights in 29 days was my Goddard high point. We proved that a convection-pollution-lightning mix over the North Atlantic often swamped aviation Nox signals (*GRL,* 1999a), though aerosols are more problematic (*GRL,* 1999b).

B4. Stratosphere-Troposphere Exchange & Tropical Waves

The SHADOZ (Southern Hemisphere Additional Ozonesondes) network I initiated (below) for satellite validation uncovered the source of the O3 "zonal wave-one" over the Atlantic - dynamics interacting with pollution (*JGR*, 2003a,b) and large-scale waves (*JGR*, 2009a). Beyond that, my TC4 sondes (*JGR*, 2009b) found stratospheric influences as well as lightning on equatorial tropospheric O3. A similar surprise from our 2008 North American IONS campaign - robust stratospheric penetration in summer (*JGR,* 2007a, 2008).

2. TECHNOLOGY DEVELOPMENT

My scientific research is always coupled with space-based technological development. Examples follow.

A. SONEX Mission Design & Meteorological Support

Prior to SONEX (SASS Ozone and Nitrogen Oxides Experiment, 1997), DC-8 tropospheric missions (in the Global Tropospheric Experiment HQ project) used classic approaches to mission design - weather and cloud maps. The assessment-driven requirements of SONEX required a new approach. I applied all the tools developed at GSFC and Ames for stratospheric experiments (eg the Antarctic and Arctic campaigns of 1987-1996) to SONEX: meteorological forecasts, trajectories from GEOS (GSFC Earth Observing System), enhanced cloud images. I added satellite data (lighting maps, total ozone) and trajectory mapping with gridded aircraft emissions, lightning flashes, TOMS aerosols in a series of "exposure" products. A printed Handbook (!) was given to the Science Team, our partners (NOAA and the German DLR) and all products were web-based for real-time access from the US and European operational bases. Since the emergence of the A-Train, these products and hundreds more are standard but they transformed tropospheric experiments in the 90s.

B. Ozone Validation - Strategic Ozonesonde Networks

The most significant contribution I have made to technology has been to re-cast the simple ozonesonde from tried-and-true device to high-tech through a concept of integrated observations, novel deployment strategies and enhanced quality control (review article, *Atmos Environ,* 2010). Ozonesondes have been around for 50 years but only with SHADOZ (a 12-station tropical network, 1998-) and three IONS (INTEX Ozonesonde Network Study over North America; 2004, 2006, 2008), have people had easy access to the data, and applied the profiles in hundreds of studies around the globe. High-resolution data near the tropopause has spawned a sub-field of the "tropical tropopause layer" (*JGR*, 2009b).

Two spinoffs are noteworthy. (1) Air Quality models are far from reliable and often over-predict "Code Red" violations of ozone standards. Nighttime sondes launched near Washington, DC, and Houston pinpoint the failings of the models (*Atmos Environ,* 2009a,b) and we assist modelers in finding solutions; (2) Quality assurance. When SHADOZ began, all stations adopted the same instrument but we discovered that different solution types, manufacturers and data processing algorithms were employed. The results: precision of 10-15%, unacceptable for 21st century satellite validation. A WMO (World Meteorological Organization) chamber test was designed around SHADOZ needs (JOSIE-2000; *JGR*, 2007b,c), followed by a field test in 2004 (*JGR*, 2008). The precision is now 5%. As a result, satellite and model validation are more sonde-dependent than ever. Requested sonde launches accommodate specialized maneuvers of Aura overpasses. In summary, I have re-written the book on ozonesondes.

3. LEADERSHIP AND MANAGEMENT.

Scientific leadership and management has been a by-product of my path-breaking science since the first years at GSFC. Our eye-opening results on the pollution-climate link led to EPA and NOAA inter-Agency funding, participation in international Workshops to define research priorities, assign greenhouse warming potentials to short-lived gases and to re-frame UNEP/WMO Assessments (1991, 1994, 1998 lead author) in terms of interacting troposphere and stratospheric processes. I was an author on the first two IPCC Assessments and a reviewer for the 4th IPCC Report (recognized with the Nobel Peace Prize in 2007). In addition to the SASS (Subsonics Assessment), SONEX and SHADOZ roles, I was a PI on 6 other NASA aircraft missions, and I played a leading role on three NOAA cruises while at GSFC. I assembled and presently deploy PSU's NATIVE (Nittany Atmospheric Trailer and Integrated Validation Experiment) as a core facility in NASA's validation projects.

I have served NASA, NOAA, NSF and DOE on co-funded projects, at program formulation Workshops and Panels. I have served on three Committees for NAS (National Academy of Sciences), including their standing Climate Research Committee when we released a special report on the importance maintaining climate observations (forward looking for 1999). I was on the Environmental Advisory Panel of the industry group, the American Chemistry Council (1998-2002). Presently, I am on WMO's Ozone Experts group, the SPARC (Stratospheric Processes and their Role in Climate) Steering Committee, and serve as IAMAS (Intl Association for Meteorology and Atmospheric Sciences). I served as CACGP President (2002-2006) and for 8 years on the International Ozone Commission. I have been elected to Council, Section President/Chair in AAAS (American Association for the Advancement of Science), AMS (American Meteorological Society) and AGU (American Geophysical Union).

At Penn State, I competed through a proposal process to become Director of Center for Environmental Chemistry and Geochemistry in 2008. I work with a Steering Committee to select new research initiatives and I run several activities each year to network senior and junior faculty for these efforts.

2. Demonstrated ability to provide high-quality definition and support for proposal preparation and submission, proposal advocacy on behalf of a field center organization before that Agency's Headquarters organization and/or other Agencies, and formulation and implementation of successful proposals, for new scientific missions, through a team approach working with executives, engineers, technologists, scientists, and administrative personnel.

Staying competitive through successful proposal writing was always a plus of working at GSFC, where I wrote several PI-class proposals each year. At Penn State, the rate has accelerated with a target of more Agencies and special solicitations. Although I have not been PI for a Goddard satellite proposal, I was part of the ESSP process, putting forth an aerosol pollution sensor (APACS) in 1996 with engineers, industry partners, outreach specialists. We targeted a critical problem in the earth system, matched it with new technology, and optimized likelihood of success in the face of spaceflight risk. I understand the breadth, depth and scope of the proposal process, and the commitment required and the serious responsibility of the GSFC Earth Science Director to advocate tirelessly.

My advocacy at HQ took several forms while I was at GSFC. For example, I presented the scientific results of TRACE-A in 1993 to HQ Earth Science Managers. I was on the Tropospheric Chemistry Program Ad-Hoc Steering Committee (R.J. McNeal, Program Manager) in the 1990's. We designed a field mission aimed at background Pacific tropical chemistry; I proposed a mission on chemistry-convection interactions. TRACE-P (2001) combined both objectives after surveying the tropical Pacific (PEM-Tropics, 1999).

As the first Project Scientist for the joint Aeronautics-Earth Science (then Code R-Code Y) SASS Project in 1993-1994, I developed a Program vision with budget plan and presented to HQ numerous times. I got buy-in for our new program from an Advisory Panel consisting of Government officials, academics, scientists from 4 Centers, representatives of the commercial aircraft industry. In the Global Modeling Initiative (GMI), I formulated a novel approach to assessment modeling, incorporating modules from various research groups into a single core model platform, in analogy with a spacecraft or aircraft mission. GMI is active at 15 years, with components changing as requirements demand.

As Mission Scientist on SONEX, I designed, advocated and fine-tuned the experiment with HQ, formally coordinated our mission with NOAA and with DLR (German Air and Space Agency).

3. Demonstrated knowledge of data analysis activities, science operations, data management, publication and outreach activities sufficient to ensure successful science programs.

NASA has revolutionized scientific data-taking, data management and data analysis as profoundly as it has transformed Earth science with space observations. This view is strongly endorsed by the scientific community, as I saw in 2005-2007 when I served on an NASA/NRC Panel reviewing 50 years of Earth-from-Space achievements (*NAS/NRC*, 2007). It was easy to write about NASA successes because the data are globally distributed. Quality assured data, open access, education and training of a new generation of "earth scientists" make up a legacy of NASA Earth Science Programs over several decades. I credit visionary HQ leadership for these successes and the funds along with first-rate Center commitment and implementation. GSFC is exemplary in this regard, archiving data for all user levels: the hobbyist, K-12 education, the college student, the research professional, NGOs and policymakers at local to international scale. It is critical to maintain data, access, to develop models to assimilate data and to distribute derived products as well.

I participate enthusiastically in all phases of NASA data analysis, collection, archiving, publication and outreach. I am proud to have been part of the cultural change of "getting data out there" at a time when other organizations and nations lagged NASA's insistence that Government-sponsored data belongs to everyone. I dispensed model results for the first two IPCC Assessments and directed my graduate students at UMCP to make tropospheric ozone products available before their theses were written. When I was Mission Scientist for SONEX, I committed our DLR partners to open data sharing, a first for them. At PSU, our NATIVE data are public and customized analyses from soundings taken during NASA missions are posted in near-real time. At PSU I initiated a course for undergraduates and graduate students on "Remote Sensing of the Earth System" that introduces the whole-earth view. Students are initiated into the complexities of space operations, data collection, algorithms, analysis and interpretation.

SHADOZ epitomizes my commitment to data management, archiving, analysis, publication and outreach. The data collection goal was as important as the motivating science and validation. SHADOZ began with operational stations that started and stopped with campaigns and shared data rarely or not at all. Goddard archives the data at a user-friendly, attractive, non-password website. The "additional sondes" are supplied to selected stations that have to release all their data. The open access and easy format caught on immediately and more stations joined in order to distribute and publicize their data. Outreach comes through a newsletter, frequent communications with stations, participation in WMO intercomparisons, distribution of CDs with images and data. I attend 2-3 meetings or conferences each year to get out the word about SHADOZ and its NASA support. In addition to the project archival papers, I have published individually with the US CoIs Oltmans and Schmidlin, the Japanese sponsors of three Asian sites, South American Co-Is, faculty and students in South Africa and Reunion Island. We continue to seek partners to fill geographical gaps. I have affiliated SHADOZ with GCOS (Global Cimate Observing System) and NDACC (Network for Detection of Atmospheric Composition Change) to further distribute the data. Each year, SHADOZ data are transmitted to the World Ozone and UV Data Centre.

4. Demonstrated ability to prepare and implement annual institutional budgets, implementation of approaches to improve operational efficiency and effective and timely performance, revisit and accommodate budgets, resources, science program, congressional and other external changes affecting an organization's research programs, remaining flexible sufficient to ensure successful completion of revised programs.

Budget limitations are a fact of life and no one has accomplished more scientifically and programmatically with constantly changing resources than I have. Contributions to data collection, analysis and satellite missions while I was at GSFC were made with only 1-3 Contractors and, in the last 2-3 years, with shrinking budgets. During this time, output (data sets, publications) and contributions to NASA and partner programs actually increased. Penn State has presented a similar picture, although I have been successful in supplementing individual NASA grants with NSF funding and through NASA's MURED at Howard University. My PSU output is even greater than it was at GSFC. This is due to on-going partnerships with US and international partners as well as a quantum leap in data collection by NATIVE, built with internal PSU funds. These fund amounts are small-scale compared to a Center or Directorate budget but the required abilities are the same. Flexibility is the key word, but the mission and vision are the drivers. I leverage funding masterfully and make tough decisions when necessary.

Institutional experience:

- SASS (Subsonic Assessment). This program had six sub-elements, covering Near-field interactions, Modeling, Combustion, Field Missions, with a Center partner from Ames, LaRC, Glenn, JPL assigned to each. With the Aeronautics Program Manager, I had to prepare budgets, work with the Centers on reports with stringent deadlines and costing requirements. SASS was an augmentation program, meant to fill gaps in the Earth

Sciences (Code Y) Research and Analysis (R&A) budget. As such, I coordinated with the relevant Code Y and Code R (Aeronautics) Program Managers, a task made difficult by different funding rules operating in each unit at the time, as well as a different culture and approach to carrying out scientific missions. Implementation included working with the Aircraft Operations group and their changing charging algorithms and heavy scheduling demands. I handled all challenges competently and with speed and flexibility as needed. At the end of this HQ assignment, I received a NASA Exceptional Achievement Medal.

- Penn State's CECG (Center for Environmental Chemistry and Geochemistry). As Director of CECG, the scope of budgets is modest but the aims are outsize. I foster connections among dozens of environmental researchers (Faculty and Research Associates) across 4 of Penn State's 7 Colleges, with a concrete goal of bringing in grants of 5-25M. Customarily, each proposal target, from NSF or DoD, allows only 1-2 proposals from each university. Thus, a highly competitive down-select process is required and I have to justify concepts, uniqueness and defend budget plans. In addition, a signature activity of CECG is co-sponsorship of a student-run annual Environmental Student Symposium, unique in the eastern US. I work with students on budget development and oversee adjustments and strategies for co-funding, all very challenging in today's very negative university economy.

5. Demonstrated ability to serve as an effective advocate of an organization's science objectives and projects in the context of reviewing, studying, presenting and justifying various aspects of exploration requirements in a manner to provide for effective long-range planning and implementation without significant change in allocated resources (e.g. civil service staffing, support service contractor support).

Here too, my abilities have been demonstrated on the scale of opportunities to date. In the 1996 APACS (Atmospheric Pollution, Aerosol and Chemistry Satellite) I reviewed and re-formulated the exploration requirements for a mission that was put together with existing resources for design, analysis and management by the scientific team in our Branch. Despite energetic and incisive advocacy, the mission was not selected for ESSP.

The best example of maintaining a long-term project without significant changes in resources is SHADOZ. This is one of the most visible earth-space scientific projects on the planet and many are unaware that it rests on PI funding competed every 3-4 years. My effort and Goddard's (PSU PI with archiving and web work by a GSFC Contractor) have been approximately constant over the 12 years of the project. Likewise, the funded partners (CoIs Schmidlin at WFF, Oltmans at NOAA/ESRL) have added capabilities and sites despite rising costs for expendables, institutional assessments and complicated management environments. The success of SHADOZ rests on my clear commitment to NASA's Earth-from-space vision and to meeting an increasing demand for high-quality data from environmentally distinct tropical stations, along with a willingness to distribute the data from multiple archives used by the scientific community. Still, my Co-Is and I justify and present on behalf of SHADOZ constantly, as I did last year, when data gaps began to appear at some stations. This included advocacy with NASA, NOAA and our international partners.