

Curriculum Vitae
DANIEL MARSH

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Educational Information

1999 Ph.D. Atmospheric and Space Sciences, University of Michigan
1996 M.Sc. Atmospheric and Space Sciences, University of Michigan
1988 B.Sc. Mathematics and Physics, University of California Berkeley

Thesis Title: “Satellite observations of mesospheric ozone,” University of Michigan, 1999

Work History

2020-Present Senior Scientist, Climate and Global Dynamics Laboratory, National Center for Atmospheric Research, Boulder, CO

2018-Present Professor, Chair in Comparative Planetary Atmospheres, Priestley International Centre for Climate, University of Leeds, UK

2015-2020 Atmospheric Chemistry Observations and Modeling, National Center for Atmospheric Research, Boulder, CO

2008-2015 Scientist III, Atmospheric Chemistry Division, National Center for Atmospheric Research, Boulder, CO

2004-2008 Scientist II, Atmospheric Chemistry Division, National Center for Atmospheric Research, Boulder, CO

2001-2004 Scientist I, Atmospheric Chemistry Division, National Center for Atmospheric Research, Boulder, CO

1999-2001 Post-doctoral fellow, Advanced Study Program, National Center for Atmospheric Research, Boulder, CO

1994-1999 Graduate Research Associate, Space Physics Research Laboratory, University of Michigan, Ann Arbor, MI

1991-1994 Staff Research Associate, Space Sciences Laboratory, University of California, Berkeley, CA

1989-1991 Development Engineer, Electron Optics Division, Philips Components, Mitcham, UK

Scientific/Technical Accomplishments

Daniel Marsh is a global leader in the fields of whole atmosphere modeling, middle atmosphere composition and solar-terrestrial coupling and has had a long-term interest in the interaction of chemistry and dynamics in the mesosphere and lower thermosphere. He oversaw integration and validation of Whole Atmosphere Community Climate Model (WACCM) within NCAR's Community Earth System Model and the completion of coupled simulations for the IPCC phase 5 of the Coupled Model Intercomparison Project. This work led to studies on the influence of the middle atmosphere on the troposphere, in particular how development of the ozone hole has influenced Antarctic climate. He has worked extensively in the area of solar and energetic particle forcing of the mesosphere and stratosphere. His work on upper atmospheric chemistry led to the discovery of a local maximum in mesospheric ozone, development of an empirical model of thermospheric nitric oxide, and the first global model of meteoric sodium. He has led the Multi-Scale Chemistry Modeling Group in the Atmospheric Chemistry Observations and Modeling Laboratory and co-led the WACCM-X Group at the High Altitude Observatory at NCAR. He joined the Atmospheric Modeling and Predictability section in NCAR's Climate and Global Dynamics Laboratory in 2020.

Community Service

- Member of the National Academy of Sciences Decadal Survey for Solar and Space Physics (Heliophysics) 2024-2033: Panel on the Physics of Ionospheres, Thermospheres, and Mesospheres. January 2003 to July 2024.
- Advisory board member, UK EISCAT Advisory Group (2020-present).
- Advisory board member, Space Weather Atmosphere Models and Indices (SWAMI) project, a H2020 European Union research activity (2018-2020).
- Vice-president, Scientific Committee on Solar Terrestrial Physics (SCOSTEP), 2019-present.
- International Association of Meteorology and Atmospheric Sciences representative to SCOSTEP, 2015-2019.
- International Commission on the Middle Atmosphere, past-president (2015-2019), president (2011-2015), vice-president (2007-2010), member since 2003.
- Team Leader, International Space Science Institute International Team on "Quantifying Hemispheric Differences in Particle Forcing Effects on Stratospheric Ozone" (2012-2013).

- Co-leader, SCOSTEP VarSITI/ROSMIC Working Group on “Trends in the MLT” (2014-present).
- Co-leader, SCOSTEP CAWSES-II Task Group “How will Geospace Respond to a Changing Climate?” (2009-2013).
- Co-chair, CCSM Whole Atmosphere Working Group (2008-2011).
- Member, Scientific Committee on Solar-Terrestrial Physics (SCOSTEP) Climate and Weather of the Sun-Earth System (CAWSES) working group on Atmospheric Coupling (2004-2009).
- Chair, NCAR/UCAR Early Career Scientist Assembly (2002 - 2003).

Editorships

- Guest Editor, special issue SCOSTEP 15th Quadrennial Solar-Terrestrial Physics Symposium (STP-15), in *J. Atmos. Sol. Terr. Phys.*, 2022.
- Guest editor, special issue on Layered Phenomena in the Mesopause Region in *J. Atmos. Sol. Terr. Phys.*, 2016.
- Guest editor, special issue on Space Climate in *Journal of Atmospheric and Solar-Terrestrial Physics* Volume 73, Issue 2-3, 2011.
- Associate Editor, *Journal of Geophysical Research - Atmospheres* (2005-2008).
- Guest editor, special issue on "Vertical Coupling in the Atmosphere-Ionosphere System", *J. Atmos. Sol. Terr. Phys.*, Volume 69, Issues 17-18, 2007.

Education and Outreach

- Program Committee Member, Iberian Space Science Summer School, virtual, <https://www.i4s-iberian-space-science-summer-school.com>, July 26030, 2021.
- Ph.D. primary supervisor for Binghan Liu, School of Physics and Astronomy, University of Leeds, 2020-present.
- Ph.D. supervisor for Conor Clayton, School of Earth and Environment, University of Leeds, 2020-present.
- Ph.D. primary supervisor for Gregory Cooke, School of Physics and Astronomy, University of Leeds, 2019-present.
- Ph.D. supervisor for Christopher Kelly, School of Earth and Environment, University of Leeds, 2019-2020.
- Ph.D. supervisor for Natasha Aylett, School of Chemistry, University of Leeds, 2018-2019.

- Ph.D. supervisor for Nathaniel McAdam, School of Chemistry, University of Leeds, 2018-2019.
- Ph.D. advisory committee member for Joshua Pettit, University of Colorado, Boulder, 2015-2019.
- Graduate faculty, Department of Atmospheric and Oceanic Sciences, University of Colorado, Boulder, 2008-present.
- Adjunct Research Scientist in the Department of Applied Physics and Applied Mathematics at Columbia University, September 2013 - June 2014.
- Judge, Outstanding Student Paper Awards competition, Fall AGU meeting 2014.
- Comprehensive exam committee member for Joshua Matthew Pettit, , University of Colorado, Boulder.
- Ph.D. advisory committee member for Andrew Kren, University of Colorado, Boulder (Ph.D 2015).
- Ph.D. advisory committee member for Ethan Peck, University of Colorado, Boulder (Ph.D 2014).
- Ph.D. advisory committee member for Susanne Benze, University of Colorado, Boulder (Ph.D. 2012).
- Mentor, Significant Opportunities Atmospheric Research Sciences, National Center for Atmospheric Research, 2001-2003, 2006, 2008, 2009, 2012-2014.
- Co-convenor and presenter of the tutorial on CESM/WACCM-X at the 2012 CEDAR Workshop, 24-29 June 2012, Santa Fe, New Mexico.
- Workshop Scientific Organizing Committee and Lecturer at the Pan-American Advanced Studies Institute School and Workshop on the Dynamics and Chemistry of the Upper Atmosphere, October 4 - 9, 2010, San Juan, Argentina.
- Lecturer at the First Space Climate Symposium in Saariselkä, Finnish Lapland, 18-22 March, 2009.
- Ph.D. thesis defense opponent for Stefan Lossow, Stockholm University, 2008.
- Mentor and host, ASP Graduate Student Visitor program, Pinal Patel, Embry-Riddle Aeronautical University, summer 2007.
- Judge, CEDAR workshop student poster competition, 2007.

- Lecturer at the International Advanced School on Space Weather, ICTP, Trieste, Italy, May 2006.
- Invited tutorial on Numerical modeling of stratosphere-mesosphere-thermosphere, First Latin American Advanced School on Space Environment, INPE, São Paulo, Brazil, March 2004.
- Presenter, NCAR Undergraduate Leadership Workshop, Boulder, 2002.
- Presenter, First Student Conference, American Meteorological Society, Orlando, 2002.
- Lecturer, covering radiative transfer for a graduate level course on the Earth Climate System at the University of Colorado, 2001.
- Mentor, NSF Research Experiences for Undergraduates Program, University of Michigan, 1996.

Memberships

Fellow of the Royal Astronomical Society, December 2019 – present

Member of the American Geophysical Union, 1995 – present.

Honors and Awards

High Altitude Observatory's John W. Firor Publication Award, 2022.

NCAR Outstanding Publication Award, 2019.

NASA Group Achievement Award - TIMED team, May 2008.

NASA Group Achievement Award – UARS team, April 2006.

NCAR Advanced Study Program postdoctoral fellowship, 1999-2001.

NASA Group Achievement Award - Solar and Heliospheric Observatory International Solar Terrestrial Physics Project, May 1995.

Proposals and Grants

Co-PI, NSF, "Collaborative Research: CEDAR--Quantifying the Impact of Radiation Belt Electron Precipitation on Atmospheric Reactive Nitrogen Oxides (NO_x) and Ozone (O₃)," 2018-2020. University Co-PI: Katharine Duderstadt, University of New Hampshire.

Co-I, NASA Heliophysics Guest Investigator, “Study of IR emissions of CO₂ and OH in the mesosphere and lower thermosphere using SABER/TIMED observations,” 2017-2019.

Co-I, NASA LWS TR&T, “Response of the Atmosphere to Impulsive Solar Events (RAISE)” 2014-2018.

Co-PI, FESD Proposal Type I: The impact of the ozone hole on the climate of the Southern Hemisphere, 2013-2018. University Co-PIs: John Marshall and Susan Solomon, Massachusetts Institute of Technology; Lorenzo Polvani, Columbia University; Darryn Waugh, Johns Hopkins University.

PI, NASA-ROSES 2012, “Assessment and Interpretation of Decadal-Scale Variability of the Mesosphere and Lower Thermosphere: Observations and Simulations”, 2013-2016. University Co-PI: Jeng-Hwa Yee, Johns Hopkins University.

PI, NASA-ROSES 2010, “Atmospheric Effects of Solar Proton Events and Galactic Cosmic Rays”, 2012-2015. University Co-I: Cora Randall, University of Colorado.

PI, NRL BAA N00173-01, “On the relative roles of chemistry and dynamics in the upper mesosphere”, 2010-2013.

PI, NASA-ROSES 2007, “A comprehensive evaluation of the energy budget of the mesosphere and lower thermosphere using TIMED data”, 2008-2011.

PI, NASA Geospace Science Investigation titled “A Study of PMC Variability Using a 3-dimensional GCM”, 2006-2009.

PI, NASA Research Opportunities in Space Science supplemental E/PO project, “Bringing atmospheric chemistry to students, educators and the public through web outreach and activities development”, (2002 - 2006).

Workshops and Conferences

- Co-chair, Steering Committee, 3rd Eddy Cross Disciplinary Symposium: Sun, Earth, Planet, Space, Atmosphere and Ocean, <https://cpaess.ucar.edu/meetings/eddy-symposium-2022> , June 6-10, 2022, Vail, CO.
- Scientific Organizing Committee member and session co-convener, 15th Quadrennial Solar-Terrestrial Physics Symposium (STP-15), <https://stp15.in>, February 21-25, 2022.
- Steering Committee Member, 2nd Eddy Cross Disciplinary Symposium, <https://cpaess.ucar.edu/meetings/2nd-eddy-cross-disciplinary-symposium>, virtual, June 7-10, 2021.

- Science Organizing Committee member, Space Climate 7, Canton Orford, Quebec, Canada, on July 8-11, 2019.
- Science Organizing Committee member, The Fourteenth Edition of the Solar-Terrestrial Physics Symposium (STP14), York University, Toronto, Canada, July 9 -13, 2018.
- Science Organizing Committee member, 7th International HEPPA-SOLARIS Workshop, Roanoke, Virginia, June 11-14, 2018.
- Scientific Co-organizer, Whole Atmosphere Modelling Workshop: Developments in the context of space weather, Tres Cantos, Spain, June 13-15, 2018.
- Science Organizing Committee member, 10th Workshop on Long-term Changes and Trends in the Atmosphere, Hefei, China, May 14-18, 2018.
- Co-convener, WACCM-X Users Group session, 2017 Coupling, Energetics and Dynamics of Atmospheric Regions (CEDAR) workshop, Keystone, Colorado, 18-23 June, 2017.
- Co-convener, session SA53C: Progress in Observations, Modeling, and Understanding of the Chemistry and Dynamics of the Earth's Mesosphere, Fall AGU, San Francisco, 2016.
- Lead convener, ICMA session on “Middle Atmosphere Science” at the 26th IUGG General Assembly, Prague, Czech Republic, June 22- July 2, 2015.
- Co-organizer of the 12th International Workshop on Layered Phenomena in the Mesopause Region (LPMR), University of Colorado Boulder, August 10-13, 2015.
- Co-organizer of the ASP Summer Colloquium on Climate, Space Climate, and the Couplings Between (www.asp.ucar.edu/colloquium/summer_colloquia.php) , June 6-17, 2015.
- Science Organizing Committee member of the 8th International Workshop on Long term Changes and Trends in the Atmosphere (TRENDS-2014), Cambridge, United Kingdom, July 28-31, 2014.
- Science Organizing Committee member SCOSTEP International CAWSES-II Symposium, Nagoya, Japan, November 18-22, 2013.
- Co-convener, ICMA session on “Middle Atmosphere Science” at IAGA 12th Scientific Assembly, Merida, Yucatan, Mexico August 26-31, 2013.
- Science Organizing Committee member of the 7th International Workshop on Long term Changes and Trends in the Atmosphere (TRENDS-2012) Buenos Aires, Argentina, September 11-14, 2012.

- Local Organizing Committee member 4th International HEPPA Workshop in conjunction with SPARC/SOLARIS, National Center for Atmospheric Research, Boulder, Colorado, USA, 9-12 October, 2012.
- Science Organizing Committee member of the 5th Space Climate Symposium (SCS-5), June 2013, Oulu, Finland.
- Science Organizing Committee member of the 4th Space Climate Symposium (SCS-4), January 2011, Goa, India.
- Science Organizing Committee member of the SCOSTEP 12th Solar-Terrestrial Physics Symposium (STP-12), July 2010, Berlin, Germany.
- Co-convenor, session on “Middle Atmosphere Science” at MOCA-09 IAMAS/IAPSO/IACS Joint Assembly, July 2009, Montreal, Canada.
- Deputy Organizer/Co-convenor ICMA Symposium on middle atmosphere science, July, 2005, Toulouse, France.
- Co-organizer of the ASP Summer Colloquium on Space Weather, May 31-June 10, 2005.
- Organizer, UCAR/NCAR junior faculty forum on future scientific directions, Boulder, 2003.
- Co-convenor, session on “The Mesosphere/Lower Thermosphere Region: Structure, Dynamics, Composition, and Emission”, Fall AGU, San Francisco, 2000.

Publications

Ph.D. Dissertation

“Satellite observations of mesospheric ozone,” University of Michigan, 1999.

Refereed Journal Articles

1. Moldosanov, K.A., M.A. Samsonov, L.S. Kim, R. Henneck, O.H.W. Siegmund, J. Warren, S. Cully, and D. Marsh, 1998: Highly absorptive coating for the vacuum ultraviolet range, *Appl. Optics.*, 37, 93-97.
2. Fritts, D.C., J.R. Isler, R.S. Lieberman, M.D. Burrage, D.R. Marsh, T. Nakamura, T. Tsuda, R.A. Vincent, and I.M. Reid, 1999: Two-day wave structure and mean flow interactions observed by radar and high resolution doppler imager, *J. Geophys. Res.*, 104, 3953-3969.
3. Marsh, D.R., W.R. Skinner, and V.A. Yudin, 1999: Tidal influences on O₂ atmospheric band dayglow: HRDI observations vs. model simulations, *Geophys. Res. Lett.*, 26, 1369-1372.

4. Marsh, D.R., and J.M. Russell III, 2000: A tidal explanation for the sunrise/sunset anomaly in HALOE low-latitude nitric oxide observations, *Geophys. Res. Lett.*, 27, 3197-3200.
5. Marsh, D.R., A.K. Smith, G.P. Brasseur, M. Kaufmann, and K.U. Grossmann, 2001: The existence of a tertiary ozone maximum in the high-latitude middle mesosphere, *Geophys. Res. Lett.*, 28, 531-45534.
6. *Marsh, D.R., W.R. Skinner, A.R. Marshall, P.B. Hays, D.A. Ortland, and J.-H. Yee 2002: High Resolution Doppler Imager observations of ozone in the mesosphere and lower thermosphere, *J. Geophys. Res.*, 107(D19), 4390, doi: 10.1029/2001JD001505.
7. Marsh, D.R. and R.G. Roble, 2002: TIME-GCM simulations of lower thermospheric nitric oxide seen by the Halogen Occultation Experiment, *J. Atmos. Solar-Terr. Phys.*, 64, 889-895.
8. Marsh, D.R., A.K. Smith, and E. Noble, 2003: Mesospheric ozone response to changes in water vapor, *J. Geophys. Res.*, 108(D3), 4109, doi:10.1029/2002JD002705.
9. Smith, A.K., D.R. Marsh, and A.C. Szymczak, 2003: Interaction of chemical heating and the diurnal tide in the mesosphere, *J. Geophys. Res.*, 108(D5), 4164, doi:10.1029/2002JD002664.
10. Kaufmann, M., O.A. Gusev, K.U. Grossmann, F.J. Martin-Torres, D.R. Marsh, and A.A. Kutepov, 2003: Satellite observations of day- and nighttime ozone in the mesosphere and lower thermosphere, *J. Geophys. Res.*, 108(D9), doi:10.1029/2002JD002800.
11. Marsh, D.R., S.C. Solomon, and A.E. Reynolds, 2004: Empirical model of nitric oxide in the lower thermosphere, *J. Geophys. Res.*, 109, A07301, doi: 10.1029/2003JA010199.
12. Offermann, D., M. Jarisch, M. Donner, J. Oberheide, I. Wohltmann, R. Garcia, D. Marsh, B. Naujokat and P. Winkler, 2005: Middle atmosphere summer duration as an indicator of long-term circulation changes, *Adv. Space Res.*, 35(8), 1416-1422, doi:10.1016/j.asr.2005.02.065.
13. Smith, A.K., and D. R. Marsh, 2005: Processes that account for the ozone maximum at the mesopause, *J. Geophys. Res.*, 110, D23305, doi:10.1029/2005JD006298.
14. Schmidt, H., G. Brasseur, M. Charron, E. Manzini, M. A. Giorgetta, V. Fomichev, D. Kinnison, D. Marsh, and S. Walters, 2006: The HAMMONIA Chemistry Climate Model: Sensitivity of the mesopause region to the 11-year solar cycle and CO₂ doubling, *J. Climate*, 19, 3903-3931.
15. Marsh, D.R., A. K. Smith, M. G. Mlynczak, and J. M. Russell III, 2006: SABER observations of the OH Meinel airglow variability near the mesopause, *J. Geophys. Res.*, 111, A10S05, doi:10.1029/2005JA011451.

16. Eyring, V. et al., Assessment of temperature, trace species, and ozone in chemistry-climate model simulations of the recent past, 2006: *J. Geophys. Res.*, 111, D22308, doi:10.1029/2006JD007327.
17. Tilmes, S., D. E. Kinnison, R. R. Garcia, R. Müller, F. Sassi, D. R. Marsh, and B. A. Boville (2007), Evaluation of heterogeneous processes in the polar lower stratosphere in the Whole Atmosphere Community Climate Model, *J. Geophys. Res.*, 112, D24301, doi:10.1029/2006JD008334.
18. Garcia, R.R., D.R. Marsh, D.E. Kinnison, B.A. Boville, and F. Sassi, 2007: Simulation of secular trends in the middle atmosphere, 1950-2003, *J. Geophys. Res.*, 112, D09301, doi:10.1029/2006JD007485.
19. Smith, A.K., D. V. Pancheva, N. J. Mitchell, D.R. Marsh, J. M. Russell III, M. G. Mlynczak, 2007: A link between variability of the semidiurnal tide and planetary waves in the opposite hemisphere, *Geophys. Res. Lett.*, 34, L07809, doi:10.1029/2006GL028929.
20. Kinnison, D.E., G. P. Brasseur, S. Walters, R. R. Garcia, D.R. Marsh, F. Sassi, V. L. Harvey, C. E. Randall, L. Emmons, J. F. Lamarque, P. Hess, J. J. Orlando, X. X. Tie, W. Randel, L. L. Pan, A. Gettelman, C. Granier, T. Diehl, U. Niemeier and A. J. Simmons, 2007: Sensitivity of chemical tracers to meteorological parameters in the MOZART-3 chemical transport model, *J. Geophys. Res.*, 112, D20302, doi:10.1029/2006JD007879.
21. Marsh, D.R., R. R. Garcia, D. E. Kinnison, B. A. Boville, F. Sassi, S. C. Solomon, and K. Matthes, 2007: Modeling the whole atmosphere response to solar cycle changes in radiative and geomagnetic forcing, *J. Geophys. Res.*, 112, D23306, doi:10.1029/2006JD008306.
22. Marsh, D.R. and R.R. Garcia, 2007: Attribution of decadal variability in lower-stratospheric tropical ozone, *Geophys. Res. Lett.*, 34, L21807, doi:10.1029/2007GL030935.
23. Jackman, C.H., D.R. Marsh, F.M. Vitt, R.R. Garcia, E.L. Fleming, G.J. Labow, C.E. Randall, M. López-Puertas, and B. Funke, 2008: Short- and medium-term atmospheric effects of very large solar proton events, *Atmos. Chem. Phys.*, 8, 765-785.
24. Bardeen, C.G., O.B. Toon, E.J. Jensen, D.R. Marsh, and V.L. Harvey, 2008: Numerical simulations of the three-dimensional distribution of meteoric dust in the mesosphere and upper stratosphere, *J. Geophys. Res.*, 113, D17202, doi:10.1029/2007JD009515.
25. Austin, J., et al., 2008: Coupled chemistry climate model simulations of the solar cycle in ozone and temperature, *J. Geophys. Res.*, 113, D11306, doi:10.1029/2007JD009391.
26. Smith, A.K., D. R. Marsh, J. M. Russell, III, M. G. Mlynczak, F. J. Martin-Torres, and E. Kyrola, 2008: Satellite observations of high nighttime ozone at the equatorial mesopause, *J. Geophys. Res.*, 113, D17312, doi:10.1029/2008JD010066.

27. Fang, X., C. E. Randall, D. Lummerzheim, S. C. Solomon, M. J. Mills, D. R. Marsh, C. H. Jackman, W. Wang, and G. Lu, 2008: Electron impact ionization: A new parameterization for 100 eV to 1 MeV electrons, *J. Geophys. Res.*, 113, A09311, doi:10.1029/2008JA013384.
28. Siskind, D. E., D. R. Marsh, M. G. Mlynczak, F. J. Martin-Torres, and J. M. Russell III. 2008: Decreases in atomic hydrogen over the summer pole: Evidence for dehydration from polar mesospheric clouds? *Geophys. Res. Lett.*, 35, L13809, doi:10.1029/2008GL033742.
29. Liu, H.-L., D. R. Marsh, C.-Y. She, Q. Wu, and J. Xu, 2009: Momentum balance and gravity wave forcing in the mesosphere and lower thermosphere, *Geophys. Res. Lett.*, 36, L07805, doi:10.1029/2009GL037252.
30. Lossow, S., J. Urban, H. Schmidt, D. R. Marsh, J. Gumbel, P. Eriksson, and D. Murtagh, 2009: Wintertime water vapor in the polar upper mesosphere and lower thermosphere: First satellite observations by Odin submillimeter radiometer, *J. Geophys. Res.*, 114, D10304, doi:10.1029/2008JD011462.
31. Tourpali, K., Bais, A. F., Kazantzidis, A., Zerefos, C. S., Akiyoshi, H., Austin, J., Brhl, C., Butchart, N., Chipperfield, M. P., Dameris, M., Deushi, M., Eyring, V., Giorgetta, M. A., Kinnison, D. E., Mancini, E., Marsh, D. R., Nagashima, T., Pitari, G., Plummer, D. A., Rozanov, E., Shibata, K., and W. Tian, 2009: Clear sky UV simulations for the 21st century based on ozone and temperature projections from Chemistry-Climate Models, *Atmos. Chem. Phys.*, 9, 1165-1172.
32. Sofieva, V. F., E. Kyrölä, P.T. Verronen, A. Seppälä, J. Tamminen, D.R. Marsh, A.K. Smith, J.-L. Bertaux, A. Hauchecorne, F. Dalaudier, D. Fussen, F. Vanhellemont, O. Fanton d'Andon, G. Barrot, M. Guirlet, T. Fehr, L. and Saavedra, 2009: Spatio-temporal observations of the tertiary ozone maximum, *Atmos. Chem. Phys.*, 9, 4439-4445, doi:10.5194/acp-9-4439-2009.
33. Liu, H.-L., D.R. Marsh, C.-Y. She, Q. Wu, and J. Xu, 2009: Momentum balance and gravity wave forcing in the mesosphere and lower thermosphere, *Geophys. Res. Lett.*, 36, L07805, doi:10.1029/2009GL037252.
34. Randel, W. J., R. R. Garcia, N. Calvo, and D. Marsh, 2009: ENSO influence on zonal mean temperature and ozone in the tropical lower stratosphere, *Geophys. Res. Lett.*, 36, L15822, doi:10.1029/2009GL039343.
35. Merkel, A. W., D.R. Marsh, A. Gettelman, and E.J. Jensen, 2009: On the relationship of polar mesospheric cloud ice water content, particle radius and mesospheric temperature and its use in multi-dimensional models, *Atmos. Chem. Phys.*, 9, 8889-8901.
36. Jackman, C. H., D. R. Marsh, F. M. Vitt, R. R. Garcia, C. E. Randall, E. L. Fleming, and S. M. Frith, 2009: Long-term middle atmospheric influence of very large solar proton events, *J. Geophys. Res.*, 114, D11304, doi:10.1029/2008JD011415.

37. Bardeen, C. G., O. B. Toon, E. J. Jensen, M. E. Hervig, C. E. Randall, S. Benze, D. R. Marsh, and A. Merkel, 2010: Numerical simulations of the three-dimensional distribution of polar mesospheric clouds and comparisons with Cloud Imaging and Particle Size (CIPS) experiment and the Solar Occultation For Ice Experiment (SOFIE) observations, *J. Geophys. Res.*, 115, D10204, doi:10.1029/2009JD012451.
38. Rapp, M., I. Strelnikova, B. Strelnikov, P. Hoffmann, M. Friedrich, J. Gumbel, L. Megner, U.-P. Hoppe, S. Robertson, S. Knappmiller, M. Wolff, and D. R. Marsh, 2010: Rocket-borne in situ measurements of meteor smoke: Charging properties and implications for seasonal variation, *J. Geophys. Res.*, 115, D00116, doi:10.1029/2009JD012725.
39. Pierazzo, E., R.R. Garcia, D.E. Kinnison, D.R. Marsh, J. Lee-Taylor, and P.J. Crutzen, 2010: Ozone perturbation from medium-size asteroid impacts in the ocean, *Earth Planet. Sci. Lett.*, 299, 263-272, doi:10.1016/j.epsl.2010.08.036.
40. Calvo, N., R.R. Garcia, W.J. Randel, and D.R. Marsh, 2010: Dynamical mechanism for the increase in tropical upwelling in the lowermost stratosphere during warm ENSO events, *J. Atmos. Sci.*, 67 (7), 2331-2340, doi:10.1175/2010JAS3433.1.
41. Liu, H.-L., B. Foster, M.E. Hagan, J. McInerney, A. Maute, L. Qian, A. D. Richmond, R.G. Roble, S.C. Solomon, R.R. Garcia, D. Kinnison, D.R. Marsh, A.K. Smith, J. Richter, F. Sassi, and J. Oberheide, 2010: Thermosphere extension of the Whole Atmosphere Community Climate Model, *J. Geophys. Res.*, 115, A12302, doi:10.1029/2010JA015586.
42. Matthes, K., D. R. Marsh, R. R. Garcia, D. E. Kinnison, F. Sassi, and S. Walters, 2010: The Role of the QBO in Modulating the Influence of the 11-Year Solar Cycle on the Atmosphere Using Constant Forcings, *J. Geophys. Res.*, 115 (D18), D18110, doi:10.1029/2009JD013020, 2010.
43. Smith, A. K., R. R. Garcia, D. R. Marsh, D. E. Kinnison, and J. H. Richter, 2010: Simulations of the response of mesospheric circulation and temperature to the Antarctic ozone hole, *Geophys. Res. Lett.*, 37, L22803, doi:10.1029/2010GL045255.
44. Sassi, F., R.R. Garcia, D.R. Marsh and K.W. Hoppel, 2010: The role of the middle atmosphere in simulations of the troposphere during Northern Hemisphere Winter: Differences between high-and low-top models. *J. Atmos. Sci.*, 67 (9), 3048-3064, doi:10.1175/2010JAS3255.1.
45. Gardner, C. S., X. Chu, P. J. Espy, J. M. C. Plane, D. R. Marsh, and D. Janches, 2011: Seasonal variations of the mesospheric Fe layer at Rothera, Antarctica (67.5S, 68.0W), *J. Geophys. Res.*, 116, D02304, doi:10.1029/2010JD014655.
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Submitted articles

1. Nicholas Alexander Davis, Daniele Visoni, Rolando R. Garcia, et al. Climate, variability, and climate sensitivity of “Middle Atmosphere” chemistry configurations of the Community Earth System Model Version 2, Whole Atmosphere Community Climate Model Version 6 (CESM2(WACCM6)). ESS Open Archive . December 16, 2022. DOI: 10.22541/essoar.167117634.40175082/v1

Book chapters

1. Brasseur, G.P., **D.R. Marsh**, H. Schmidt, 2010:, Solar variability, climate, and atmospheric photo-chemistry, *Heliophysics: Evolving Solar Activity and the Climates of Space and Earth*, eds. C.J. Schrijver and G.L. Siscoe, 510 pp., ISBN: 9780521112949, Cambridge University Press.
2. Forster, P.M., and D.W.J. Thompson (Coordinating Lead Authors), M.P. Baldwin, M.P. Chipperfield, M. Dameris, J.D. Haigh, D.J. Karoly, P.J. Kushner, W.J. Randel, K.H. Rosenlof, D.J. Seidel, S. Solomon, G. Beig, P. Braesicke, N. Butchart, N.P. Gillett, K.M. Grise, **D.R. Marsh**, C. McLandress, T.N. Rao, S.-W. Son, G.L. Stenchikov, and S. Yoden, Stratospheric changes and climate, Chapter 4, *Scientific Assessment of Ozone*

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Non-refereed Publications

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Conference Proceedings

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Selected Conference Presentations

1. Kafkalidis, J.F., **D.R. Marsh**, and D.A. Ortland, "The Global Pattern of Mesospheric Temperature Inversions Observed by HRDI," Chapman Conference on Atmospheric Science Across the Stratopause, Annapolis, 1999.
2. **Marsh, D.R.**, W.R. Skinner, P.B. Hays, and M. Allen, "UARS observations and modeling of the diurnal cycle in mesospheric ozone," Spring AGU Meeting, Boston, 1999.
3. Kafkalidis, J.F., **D.R. Marsh**, A.R. Marshall, and D.A. Ortland, "Status of the HRDI mesospheric temperature retrieval: the impact of new correlative data and corrections for long-term instrument drift, UARS Science Team Meeting," Virginia Beach, 1999.
4. Kaufmann, M., R.R. Garcia, K.U. Grossmann, O. Gusev, A.A. Kutepov, and **D. Marsh**, "The Global Distribution of O₃ in the Mesosphere Measured by CRISTA, COSPAR," Warsaw, Poland, 2000.
5. **Marsh, D.R.**, W.R. Skinner, and J.-H. Yee, "High Resolution Doppler Imager mesospheric ozone climatology, COSPAR," Warsaw, Poland, 2000.
6. **Marsh, D.R.**, A.K. Smith, S. Walters, and G.P. Brasseur, "First chemical results from the ROSE model extended to the lower thermosphere, Fall AGU Meeting, San Francisco," 2000.

7. Solomon, S.C., **D.R. Marsh**, R.G. Roble, and J.M. Russell, "Nitric Oxide in the Mesosphere and Thermosphere: Dynamical Coupling and Vertical Transport," Spring AGU Meeting, Boston, 2001.
8. **Marsh, D.R.** and A.K. Smith, "Investigation of the 'HOx dilemma' with a 3-dimensional chemical transport model," CEDAR Workshop and SCOSTEP Symposium, Boulder, June 2001.
9. **Marsh, D.R.**, "An overview of the MLTI, CEDAR Student Workshop," Boulder, June 2001. (Invited tutorial)
10. **Marsh, D.R.**, "Trends in mesospheric ozone and interactions with water vapor trends," 2nd Workshop on Long-term Changes and Trends in the Atmosphere, Prague, July 2001. (Invited)
11. Kaufmann, M., O. Gusev, **D. Marsh**, K.U. Grossmann, and A.A. Kutepov, "Day- and nighttime ozone in the mesosphere as observed by CRISTA," EGS XXVII General Assembly, Nice, France, April 2002.
12. **Marsh, D.R.**, A. Smith, and E. Noble, "Mesospheric ozone response to long-term changes in water vapor, Heraeus Seminar on Trends in the Upper Atmosphere," Kuhlungsborn, Germany, May 2002. (Invited)
13. **Marsh, D.R.**, F. Sassi, D. Kinnison, R.R. Garcia, and B.A. Boville, "Simulations of the influence of increasing greenhouse gases on the structure and composition of the stratosphere and mesosphere, 34th COSPAR Scientific Assembly," Houston, October, 2002. (Invited)
14. **Marsh, D.R.**, "Tidal influences on composition and airglow, ICMA/IAMAS Workshop on Global Modelling of Atmospheric Tides," Honolulu, Hawaii, March, 2003. (Invited)
15. **Marsh, D.R.**, F. Sassi, D. Kinnison, S. Walters, R.R. Garcia, and B.A. Boville, "Ozone loss in the stratosphere and mesosphere due to trends in greenhouse gases," Annual meeting of the Atmospheric Chemistry Group of the Royal Meteorological Society, Oxford, March, 2003. (Invited)
16. **Marsh, D.R.** and S.C. Solomon, "An empirical model of nitric oxide in the lower thermosphere," EGS-AGU-EUG Joint Assembly, Nice, 2003.
17. **Marsh, D.R.**, and A.K. Smith, "Testing middle-atmospheric ozone photochemistry with TIMED satellite observations, International Union of Geodesy and Geophysics," Sapporo, July, 2003. (Invited)
18. **Marsh, D.R.**, D.E. Kinnison, R.R. Garcia, B.A. Boville, S. Walters, and S.C. Solomon, "A model study of the whole atmosphere response to solar cycle changes in radiative and

geomagnetic forcing, ICMA Symposium on middle atmosphere science,” Toulouse, France, July, 2005. (Invited)

19. **Marsh, D.R.**, D.E. Kinnison, and R.R. Garcia, “Simulation of past and future secular trends in the middle-atmosphere, 1950-2050,” 4th Workshop on long-term changes and trends in the atmosphere, Sodankylä, Finland, September, 2006. (Invited)
20. **Marsh, D.R.**, F.M. Vitt , R.R. Garcia, and C.H. Jackman, “A modeled response of the whole atmosphere to solar proton events, 3rd IAGA/ICMA Workshop on Vertical Coupling in the Atmosphere/Ionosphere System,” Varna, Bulgaria, September, 2006. (Invited)
21. **Marsh, D.R.**, D.E. Kinnison, F.M. Vitt, R.R. Garcia, and C.H. Jackman, “Chemical and dynamical response of the middle atmosphere to solar proton events,” IUGG, Perugia, Italy, July 2007. (Invited)
22. **Marsh, D.R.**, A.W. Merkel, A. Gettelman, and C.G. Bardeen, “Simulation of polar mesospheric clouds within a 3-dimensional chemistry climate model,” The Eighth International Workshop on Layered Phenomena in the Mesopause Region, Fairbanks, Alaska, August, 2007. (Invited)
23. **Marsh, D.R.**, and R.R. Garcia, “Attribution of decadal variability in lower-stratospheric tropical ozone,” SCOSTEP International CAWSES Symposium, Kyoto, Japan, Oct 23-27, 2007. (Invited)
24. **Marsh, D.R.** “Whole Atmosphere Community Climate Model (WACCM) Studies of the Upper Atmosphere,” 2009 CEDAR Workshop, Santa Fe (Invited tutorial)
25. **Marsh, D.R.**, A.W. Merkel, “30-year PMC variability modeled by WACCM,” Eos Trans. AGU, 90(52), Fall Meet. Suppl., Abstract SA33B-08, (Invited)
26. **Marsh, D.R.**, “Response of the whole atmosphere to solar cycle changes in radiative and geomagnetic forcing,” SCOSTEP Symposium, Berlin, 12-16 July, 2010 (Invited keynote)
27. **Marsh, D.R.**, D.E. Kinnison, C.H. Jackman, “Direct Versus Indirect EPP NO_x in the Stratosphere,” IUGG, Melbourne, 28 June to 7 July, 2011 (Invited)
28. **Marsh, D.R.**, “Climate change from 1850 to 2100 in CESM-WACCM,” 7th International Workshop on Long-term Changes and Trends in the Atmosphere (TRENDS-2012) Buenos Aires, Argentina, September 11-14, 2012.
29. **Marsh, D.R.**, “Chemistry-Climate Models: What we have and what we need, 4th International HEPPA Workshop in conjunction with SPARC/SOLARIS,” National Center for Atmospheric Research, Boulder, Colorado, USA, 9-12 October, 2012. (Invited tutorial)

30. **Marsh, D.R.**, “Adding aeronomy to a high-top climate model: lessons learned from the development of WACCM,” Workshop: From the stratosphere to the ionosphere, Universit Pierre et Marie Curie, Paris, France, 26-28 November, 2012. (Invited)
31. **Marsh, D.R.**, “The response of mesospheric metal layers to stratospheric sudden warmings,” 11th Layered Phenomena in the Mesopause Region workshop, University of Leeds, UK, 29 July - 1 August, 2013. (Invited)
32. **Marsh, D.R.**, “Projections of the response of the mesosphere and lower thermosphere to anthropogenic climate change,” 12th Scientific Assembly of the IAGA, Merida Yucatan, Mexico, August 25-31, 2013. (Invited)
33. **Marsh, D.R.**, “Progress in the detection of solar cycle signals in the lower atmosphere,” 5th International HEPPA Workshop in conjunction with SPARC/SOLARIS-HEPPA, Baden-Baden, Germany, 5-9 May, 2014. (Invited tutorial)
34. **Marsh, D.R.** (2014), “Recent Progress in Correctly Representing the Sun-Earth Connection in Earth System Models,” Eos Trans. AGU, Fall Meet. Suppl. (Invited)
35. **Marsh, D.R.**, M.A. Clilverd, D.E. Kinnison, C.J. Rodger and P.T. Verronen (2014), “The Relative Roles of Dynamics and Energetic Particle Precipitation in Driving Variability of High-Latitude Mesospheric NO_x,” Eos Trans. AGU, Fall Meet. Suppl. (Invited)
36. **Marsh, D.R.**, “Whole atmosphere modeling of solar-terrestrial coupling”, 1st PSTEP International Symposium, “Toward the Solar-Terrestrial Environment Prediction as Science and Social Infrastructure”, Nagoya Universtiy, Japan, 13-14 January, 2016. (Invited)
37. **Marsh, D.R.**, “Are stratospheric ozone chemistry feedbacks critical for the determination of climate sensitivity?”, International Symposium on the Whole Atmosphere (ISWA), The University of Tokyo, Japan, 14-16 September, 2016. (Invited)
38. **Marsh, D.R.** and G. Chiodo (2016), “Aeronomic Impacts of a Revision to the Solar Irradiance Forcing for CMIP6,” Eos Trans. AGU, Fall Meet. Suppl.
39. **Marsh, D.R.**, “The whole atmosphere response to impulsive solar events,” 2nd PSTEP International Symposium: Toward the Solar-Terrestrial Environment Prediction as Science and Social Infrastructure, Kyoto University, 23-24 March, 2017. (Invited)
40. **Marsh, D.R.**, “The Community Earth System Model: A platform for atmospheric prediction from the surface to geospace,” Whole Atmosphere Modelling Workshop, Tres Cantos, Spain, June 13-15, 2018.
41. **Marsh, D.R.**, D.E. Kinnison, L. Emmons and J.-F. Lamarque, “A novel approach to quantifying EPP Influences on the Budgets of stratospheric NO_y and ozone,” The

Fourteenth Edition of the Solar-Terrestrial Physics Symposium (STP14), York University, Toronto, Canada, July 9 -13, 2018.

42. **Marsh, D.R.**, “Current Status and Future Directions of Climate Modeling,” Comparative Climatology of Terrestrial Planets III, Lunar and Planetary Institute, Houston, Texas, August 27-30, 2018. (Invited)
43. **Marsh, D.R.** and D.E. Kinnison, "Tracking NO_x produced by energetic particle precipitation and its effects throughout the whole atmosphere", 27th IUGG General Assembly, Montreal, Canada, July 8-18, 2019.
44. **Marsh, D.R.**, The Response to Variable Solar Forcing in WACCM Simulations for CMIP6, 4th PSTEP International Symposium (PSTEP-4) and the 2nd ISEE Symposium “Toward the Solar-Terrestrial Environmental Prediction as Science and Social Infrastructure”, Nagoya University, Japan, January 28 to 30, 2020 (Invited).
45. **Marsh, D.R.**, A Whole Atmosphere View of Solar-Terrestrial Coupling, 4th Swiss SCOSTEP workshop, virtual, October 29, 2020. (Invited)