

Zachary D. Lawrence

CIRES/NOAA PSL RESEARCH SCIENTIST

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Education

PhD in Physics, with Atmospheric Physics specialty

NEW MEXICO TECH

Aug. 2019

Socorro, New Mexico

B.S. in Physics with Computer Science emphasis (summa cum laude)

NEW MEXICO TECH

• Minor in Mathematics

May 2014

Socorro, New Mexico

Professional Experience

Research Scientist I

UNIVERSITY OF COLORADO, COOPERATIVE INSTITUTE FOR RESEARCH IN ENVIRONMENTAL SCIENCES (CIRES) & NOAA PHYSICAL SCIENCES LABORATORY (PSL)

• Stratospheric dynamics and stratosphere-troposphere coupling in subseasonal to seasonal forecasts

Oct. 2020 - Present

Boulder, CO

Post-Doctoral Research Associate

UNIVERSITY OF COLORADO, CIRES & NOAA PSL

Sep. 2019 - Sep. 2020

Boulder, CO

Graduate Research Assistant

NEW MEXICO TECH PHYSICS DEPARTMENT

• Led research related to polar vortex preconditioning and downward coupling of sudden stratospheric warmings
• Advised by Drs. Gloria Manney and Ken Minschwaner

Aug. 2014 - Aug. 2019

Socorro, NM

Undergraduate Researcher

NEW MEXICO TECH PHYSICS DEPARTMENT

• Conducted research related to stratospheric ozone depletion, polar chemical processing, and polar vortex dynamics

May 2012 - May 2014

Socorro, NM

Undergraduate Research Intern

MICROWAVE LIMB SOUNDER SCIENCE TEAM, JET PROPULSION LABORATORY

• Performed intercomparisons of stratospheric polar processing diagnostics among reanalysis datasets

May 2013 - Aug. 2013

Pasadena, CA

Research Technician

LANGMUIR LABORATORY FOR ATMOSPHERIC RESEARCH

• Performed analyses and developed software for visualizing volcanic lightning from the 2010 Eyjafjallajökull eruption

Jan. 2011 - May 2012

Socorro, NM

Academic, Professional, and Outreach Activities

Community Lead

SPARC SNAP ASSESSMENT OF STRATOSPHERIC BIASES IN S2S FORECAST MODELS

• Lead organizer of “Stratospheric Network for the Assessment of Predictability” (SNAP) community effort to quantify stratospheric biases in S2S models, and assess how these are associated with forecast skill in stratosphere and troposphere.

Jan. 2020 - Present

Developer & Curator

STRATOBSERVE

• Maintainer for StratObserve, a website for figures of near real-time forecasts of polar stratospheric conditions (see <https://www.stratobserve.com>)

Nov. 2018 - Present

Reviewer

May 2018 - Present

JOURNAL OF GEOPHYSICAL RESEARCH: ATMOSPHERES, GEOPHYSICAL RESEARCH LETTERS, JOURNAL OF ATMOSPHERIC SCIENCE, JOURNAL OF CLIMATE

Mentor to Undergraduate Researchers

Jun. 2016 - Sep. 2019

NEW MEXICO TECH

Socorro, NM

- Oversaw and advised NMT physics undergraduates on atmospheric research projects
- Taught scientific programming in python and IDL within Linux environments
- Former students: Nick Sheerin, Sean Palmer, Noah d'Antonio

Research Assistant

Aug. 2014 - Sep. 2019

NORTHWEST RESEARCH ASSOCIATES / JET PROPULSION LABORATORY

- Prepared bi-weekly stratospheric meteorology and trace gas updates for the Microwave Limb Sounder team at JPL.
- Managed and provided support for Dr. Gloria Manney's lab computer systems

Contributor

2013 - Present

SPARC REANALYSIS INTERCOMPARISON PROJECT (S-RIP)

- Author and contributor for the Extratropical Upper Troposphere/Lower Stratosphere Chapter (chapter 7), and Stratospheric Polar Processes Chapter (chapter 10)

Subject Organizer and Administrator

Feb. 2016 & 2017

NEW MEXICO SCIENCE OLYMPIAD

Socorro, NM

- Oversaw the development, organization, and administration of the meteorology element exams

Contributor

2013

WMO TWENTY QUESTIONS AND ANSWERS ABOUT THE OZONE LAYER: 2014 UPDATE

- Prepared a figure and contributed text for Question 10

Organizer & IT Czar

June 2012

2012 SPARC DATA ASSIMILATION WORKSHOP

Socorro, NM

- Organized meeting and controlled presentation equipment

Honors & Awards

Albert Petschek Award

May 2019

NEW MEXICO TECH PHYSICS DEPARTMENT

Socorro, NM

- Awarded for excellence in theoretical physics

Langmuir Award

May 2018

NEW MEXICO TECH

Socorro, NM

- Awarded for outstanding published research paper

Outstanding graduate student presentation award

June 2017

AMERICAN METEOROLOGICAL SOCIETY (AMS), 19TH CONFERENCE ON MIDDLE ATMOSPHERE

Portland, OR

- Awarded for presentation: "Characterizing stratospheric polar vortex variability with computer vision techniques"

NASA Earth and Space Science Fellowship

Aug. 2016 - Present

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

- Project title: "Polar vortex portents: Identifying polar vortex preconditioning signals prior to stratospheric warmings and precursors to their tropospheric influence"

NMSGC Graduate Scholarship

Jan. 2016

NEW MEXICO SPACE GRANT CONSORTIUM (NMSGC)

- Awarded for research project investigating relationships between Upper Tropospheric/Lower Stratospheric ozone and Upper Tropospheric jets

Abraham and Ester Brook Award

May 2013

NEW MEXICO TECH PHYSICS DEPARTMENT

Socorro, NM

- For excellence in undergraduate physics

Professional Memberships

Since 2013 **American Geophysical Union**, Member

Since 2013 **American Meteorological Society**, Member

Since 2011 **American Physical Society**, Member

Since 2013 **Sigma Pi Sigma (Physics Honor Society)**, Member

Skills

COMPUTING

Programming Extensive experience with C, IDL, MATLAB, and Python; good knowledge of Fortran and Java.

Scientific Python Extensive experience doing analysis & visualizations using numpy, scipy, matplotlib, etc.

Tools Experienced with various tools, including git, bash, \LaTeX , jupyter notebooks, etc.

Data Formats Extensive experience with handling, reading, and writing NetCDF, HDF, and GRIB files.

Linux Experienced with conventional sysadmin tasks with Linux machines (configuration, networking, backups, monitoring, etc.)

Web Dev Basic knowledge of HTML, CSS, and javascript.

MISCELLANEOUS

Electronics Experienced with basic design and development of analog/digital circuits, soldering, electronic testing instrumentation (e.g., multimeters, oscilloscopes, function generators), etc.

Computer Systems Extensive experience with building, maintenance, and repair of computer systems (laptops, desktops, and servers).

Graphics Processing Proficient with Photoshop, GIMP, and ImageMagick tools.

Publications

- Lim, E.-P., H. H. Hendon, A. H. Butler, D.W.J. Thompson, **Z. D. Lawrence**, A. A. Scaife, T. G. Shepherd, I. Polichtchouk, H. Nakamura, C. Kobayashi, R. Comer, L. Coy, A. Dowdy, R. D. Garreaud, P. A. Newman, and G. Wang, *The 2019 Southern Hemisphere polar stratospheric warming and its impacts*, submitted to Bulletin of the American Meteorological Society, 2020.
- **Lawrence, Z. D.**, J. Perlwitz, A. H. Butler, G. L. Manney, P. A. Newman, S. H. Lee, & E. R. Nash, *The Remarkably Strong Arctic Stratospheric Polar Vortex of Winter 2020: Links to Record-Breaking Arctic Oscillation and Ozone Loss*, J. Geophys. Res., 125, e2020JD033271. <https://doi.org/10.1029/2020JD033271>, 2020.
- Lee, S. H., **Z. D. Lawrence**, A. H. Butler, & A. Y. Karpechko, *Seasonal Forecasts of the Exceptional Northern Hemisphere Winter of 2020*, Geophys. Res. Lett., 47, e2020GL090328. <https://doi.org/10.1029/2020GL090328>, 2020.
- Manney, G. L., N. J. Livesey, M. L. Santee, L. Froidevaux, A. Lambert, **Z. D. Lawrence**, L. F. Millán, J. L. Neu, W. G. Read, M. J. Schwartz, & R. A. Fuller, *Record-Low Arctic stratospheric ozone in 2020: MLS observations of chemical processes and comparisons with previous extreme winters*, Geophys. Res. Lett., 47, e2020GL089063. <https://doi.org/10.1029/2020GL089063>, 2020.

- Butler, A. H., **Z. D. Lawrence**, S. H. Lee, S. P. Lillo, & C. S. Long, *Differences between the 2018 and 2019 stratospheric polar vortex split events*. Q. J. R. Meteorol. Soc., 1– 19. <https://doi.org/10.1002/qj.3858>, 2020.
- **Lawrence, Z. D.** & G. L. Manney, *Does the Arctic stratospheric polar vortex exhibit signs of preconditioning prior to SSWs?*, J. Atmos. Sci., 77, 611–632, <https://doi.org/10.1175/JAS-D-19-0168.1>, 2020.
- **Lawrence, Z. D.**, G. L. Manney, & K. Wargan, *Reanalysis intercomparisons of stratospheric polar processing diagnostics*, Atmos. Chem. Phys., 18, 13547–13579, <https://doi.org/10.5194/acp-18-13547-2018>, 2018.
- **Lawrence, Z. D.**, & G. L. Manney, *Characterizing stratospheric polar vortex variability with computer vision techniques*, J. Geophys. Res., 123, 1510–1535. <https://doi.org/10.1002/2017JD027556>, 2018.
- Albers, J. R., J. Perlwitz, G. N. Kiladis, **Z. D. Lawrence**, A. H. Butler, T. Birner, G. L. Manney, A. O. Langford, & J. Dias, *Mechanisms governing interannual variability of stratosphere to troposphere ozone transport*, J. Geophys. Res., 123, <https://doi.org/10.1002/2017JD026890>, 2018.
- Manney, G. L., M. I. Hegglin, **Z. D. Lawrence**, K. Wargan, L. F. Millan, M. J. Schwartz, M. L. Santee, A. Lambert, S. Pawson, B. W. Knosp, R. A. Fuller, & W. H. Daffer, *Reanalysis comparisons of upper tropospheric–lower stratospheric jets and multiple tropopauses*, Atmos. Chem. Phys., 17, 11541–11566, <https://doi.org/10.5194/acp-17-11541-2017>, 2017.
- Manney, G. L., & **Z. D. Lawrence**, *The major stratospheric final warming in 2016: dispersal of vortex air and termination of Arctic chemical ozone loss*, Atmos. Chem. Phys., 16, 15371–15396, <https://doi.org/10.5194/acp-16-15371-2016>, 2016.
- **Lawrence, Z. D.**, G. L. Manney, K. Minschwaner, M. L. Santee, & A. Lambert, *Comparisons of polar processing diagnostics from 34 years of the ERA-Interim and MERRA reanalyses*, Atmos. Chem. Phys., 15, 3873–3892, <https://doi.org/10.5194/acp-15-3873-2015>, 2015.
- Manney, G. L., **Z. D. Lawrence**, M. L. Santee, W. G. Read, N. J. Livesey, A. Lambert, L. Froidevaux, H. C. Pumphrey, & M. J. Schwartz, *A minor sudden stratospheric warming with a major impact: Transport and polar processing in the 2014/2015 Arctic winter*, Geophys. Res. Lett., 42, 7808–7816, <https://doi.org/10.1002/2015GL065864>, 2015.
- Manney, G. L., **Z. D. Lawrence**, M. L. Santee, N. J. Livesey, A. Lambert, & M. C. Pitts, *Polar processing in a split vortex: Arctic ozone loss in early winter 2012/2013*, Atmos. Chem. Phys., 15, 5381–5403, <https://doi.org/10.5194/acp-15-5381-2015>, 2015.
- Minschwaner, K., G. L. Manney, I. Petropavlovskikh, L. A. Torres, **Z. D. Lawrence**, B. Sutherland, A. M. Thompson, B. J. Johnson, Z. Butterfield, M. K. Dubey, L. Froidevaux, A. Lambert, W. G. Read, & M. J. Schwartz, *Signature of a tropical Pacific cyclone in the composition of the upper troposphere over Socorro, NM*, Geophys. Res. Lett., 42, 9530–9537, <https://doi.org/10.1002/2015GL065824>, 2015.

News & Media

“Why we removed an article on the ‘drunk’ polar vortex”

March 20, 2019

THE CONVERSATION (CA)

- Communicated with author and editors of The Conversation to remove a misleading article regarding the source of polar vortex disturbances.

“A Closer Look at the Polar Vortex’s Dangerously Cold Winds”

January 30, 2019

THE NEW YORK TIMES

- Provided expertise on stratospheric polar vortex disturbances, and aided with visualization.

2019 Stratospheric polar vortex split animation

January 2019

MULTIPLE SOURCES

- Animation featured in various news articles. Examples:
- “Brace for the Polar Vortex; It May Be Visiting More Often” – The New York Times
- “The polar vortex has fractured, and the eastern U.S. faces a punishing stretch of winter weather” – The Washington Post