

Dr. Christopher G. Kruse

Research Scientist

NorthWest Research Associates

ckruse@nwra.com

Boulder, CO

Areas of Interest

Atmospheric Dynamics (Mesoscale and Global), Mountain Meteorology (e.g. Orographic Gravity Waves, Drag (both GW and low-level processes), Parameterization, Precipitation), Numerical Weather Prediction, Observational Research

Education

- 2018 Ph.D. in Geology and Geophysics Yale University GPA: None
Thesis Title: Mountain wave propagation and attenuation and their influences on Earth's atmosphere
Adviser: Dr. Ronald B. Smith
- 2016 M.Phil. in Geology and Geophysics Yale University GPA: None
- 2013 M.S. in Atmospheric Science University of Wyoming GPA: 4.000/4
Thesis Title: Adjustment of the atmospheric boundary layer with capes and points off southern California
Adviser: Dr. Thomas R. Parish
- 2011 B.S. in Atmospheric Science University of North Dakota GPA: 3.899/4
Minors: Mathematics, Commercial Aviation

Professional Experience

Research Appointments

- 2021- Research Scientist NorthWest Research Associates
- 2020- Project Scientist 1 National Center for Atmospheric Research
- 2018-2020 Advanced Study Program Fellow National Center for Atmospheric Research
- 2018-2018 Postdoctoral Associate (3.5 month term) Yale University
- 2013-2018 Graduate Research Assistant Yale University
- 2011-2013 Graduate Research Assistant University of Wyoming
- 2008-2011 Undergraduate Research Assistant University of North Dakota

Peer-Review Service

Associate Editor – Journal of the Atmospheric Sciences

Reviewer - Journal of the Atmospheric Sciences, Journal of Applied Meteorology and Climatology, Quarterly Journal of the Royal Meteorological Society, Atmosphere, Journal of Geophysical Research: Atmospheres, PRACE

Professional Training

- UCAR Leadership Training Jan 2020
- UCAR Diversity, Equity, and Inclusion Training Jan 2020

Internships

2013	May-July	Summer Internships in Parallel Computational Science	NCAR
	Project:	<i>WRF performance and scaling assessment on the Yellowstone supercomputer</i>	Boulder, CO
2011	May-July	Summer Internships in Parallel Computational Science	NCAR
	Project:	<i>Increasing performance of the NCAR Command Language via parallel processing on GPUs</i>	Boulder, CO
2009	Jun-July	Student Airborne Research Program	NASA
	Project:	<i>Calculating crop water stress index using airborne remote sensing</i>	Irvine, CA

Teaching Assistant Appointments

2016		The Atmosphere, Ocean, and Environmental Change	Yale University
2016		Observing Earth From Space	Yale University
2015		Renewable Energy	Yale University
2013		The Atmosphere, Ocean, and Environmental Change	Yale University
2010		Introduction to Meteorology Lab Section	University of North Dakota

Other Professional/Service Experience

		<i>Committee for Professional Development Member</i>	NCAR
		Helped to come up with and organize seminars and workshops on professional development topics (e.g. statement writing, industry career panel) for postdocs in the Boulder region.	
		<i>Career Panel Series Organizer</i>	Yale University
		Helped organize a series of panel discussions on academic and non-academic topics for graduate students. Specifically, I organized panels on academia and jobs in industry.	
		<i>Atmosphere/Ocean/Climate Dynamics Colloquium Organizer</i>	Yale University
		Organized a process to select and invite colloquium speakers and handled their visit logistics and scheduling for the main series in the Geology and Geophysics Department.	

Field Campaign Involvement

2014		Deep Propagating Gravity Wave Experiment	New Zealand
2012		Precision Atmospheric Marine Boundary Layer Experiment	Southern Coastal CA
2009		Student Airborne Research Program	Central Valley CA
2008		Polarimetric Cloud Analysis and Seeding Test 2	North Dakota

Academic Awards

2011	Outstanding Graduating Senior	Dept. of Atmos. Sci.	U. of North Dakota
2017	Elias Loomis Prize	Dept. of Geology & Geophys.	Yale University

NCAR Supercomputing Awards

2019	Explicitly Resolving Observed Mountain Waves and Their Drag in the Middle Atmosphere	15,000,000 core hours
2015	DEEPWAVE modeling of gravity wave attenuation and dynamics over New Zealand, the Andes, and the Himalayas	1,000,000 core hours
2015	DEEPWAVE modeling over New Zealand	200,000 core hours

Professional Skills

- Extensive experience with the Weather Research and Forecasting (WRF) model in realistic and idealized experiments
- Experience using CESM for stratospheric dynamics research
- Experience in constructing simplified wave models (e.g. the linear Fourier Ray model)
- Very experienced in analyzing and interpreting data from research aircraft
- Very experienced in research computing on very large supercomputers (e.g. Yellowstone, Cheyenne)
- Very proficient in Matlab and NCL
- >1 year experience with Python, IDL, C, Perl, and BASH
- Commercial Pilot License holder with multi-engine and instrument ratings

Scientific Publications

Peer Reviewed

- 2020 Richter, J. H., M. J. Alexander, J. T. Bacmeister, C. Heale, **C. G. Kruse**, and J. Wei, 2019: Gravity wave drags in the atmosphere. Chapter 11 of AGU Book Titled “Fast physics in large-scale models: parameterization, evaluation, and observations.” Under review.
- 2020 **Kruse, C. G.**: Regional to global evolution of Impacts of Parameterized Mountain Wave Drag. *Journal of Climate*, In Press. <https://doi.org/10.1175/JCLI-D-19-0076.1>
- 2018 Fritts, D. C., S. B. Vosper, B. P. Williams, K. Bossert, M. J. Taylor, P.-D. Pautet, S. D. Eckermann, **C. G. Kruse**, R. B. Smith, A. Dörnbrack, M. Rapp, T. Mixa, I. M. Reid, and D. J. Murphy: Large-amplitude mountain waves in the mesosphere accompanying weak cross-mountain flow during DEEPWAVE research flight RF22. *J. of Geophys. Res. Atmos.*, **123**, 9992-10,022, doi: [10.1029/2017JD028250](https://doi.org/10.1029/2017JD028250)
- 2018 **Kruse, C. G.** and R. B. Smith: Non-Dissipative and Dissipative Momentum Deposition by Mountain Wave Events in Sheared Environments. *Journal of the Atmospheric Sciences*, **75**, 2721-2740, doi:10.1175/JAS-D-17-0350.1.
- 2018 Smith, R. B. and **C. G. Kruse**: A gravity wave drag matrix for complex terrain. *Journal of the Atmospheric Sciences*, **75**, 2599-2613, doi:[10.1175/JAS-D-17-0380.1](https://doi.org/10.1175/JAS-D-17-0380.1).
- 2017 Gisinger, S., A. Dörnbrack, V. Matthias, J. D. Doyle, S. D. Eckermann, B. Ehard, L. Hoffmann, B. Kaifler, **C. G. Kruse**, and M. Rapp: Atmospheric Conditions during the Deep Propagating Gravity Wave Experiment (DEEPWAVE). *Monthly Weather Review*, **145**, 4249-4275.
- 2017 Bossert K., **C. G. Kruse**, C. J. Heale, D. C. Fritts, B. P. Williams, J. B. Snively, P.-D. Pautet, and M. J. Taylor: Secondary gravity wave generation over New Zealand during the DEEPWAVE campaign, *J. Geophys. Res. Atmos.*, **122**, doi:[10.1002/2016JD026079](https://doi.org/10.1002/2016JD026079).
- 2017 Smith, R. B. and **C. G. Kruse**: Broad spectrum mountain waves. *Journal of the Atmospheric Sciences*, **74**, 1381-1402. doi:10.1175/JAS-D-16-0297.1.
- 2016 **Kruse, C. G.**, R. B. Smith, and S. D. Eckermann: The Mid-Latitude Lower-Stratospheric Mountain Wave “Valve Layer”. *Journal of the Atmospheric Sciences*, **73**, 5081-5100. doi:10.1175/JAS-D-16-0173.1.
- 2016 Smith, R. B., A. D. Nugent, **C. G. Kruse**, D. C. Fritts, J. D. Doyle, S. D. Eckermann, M. J. Taylor, A. Dörnbrack, M. Uddstrom, W. Cooper, P. Romashkin, J. Jensen, and S. Beaton: Stratospheric Gravity Wave Fluxes and Scales during DEEPWAVE. *Journal of the Atmospheric Sciences*, **73**, 2851-2869, doi:10.1175/JAS-D-15-0324.1.

- 2016 Fritts, D. C., R. B. Smith, M. J. Taylor, J. D. Doyle, S. D. Eckermann, A. Dörnbrack, M. Rapp, B. Williams, P. Pautet, K. Bossert, N. Criddle, C. Reynolds, A. Reinecke, M. Uddstrom, M. Revell, R. Turner, B. Kaifler, J. Wagner, T. Mixa, **C. G. Kruse**, A. Nugent, C. Watson, S. Gisinger, S. Smith, R. Lieberman, B. Laughman, J. Moore, W. Brown, J. Haggerty, A. Rockwell, G. Stossmeister, S. Williams, G. Hernandez, D. Murphy, A. Klekociuk, I. Reid, and J. Ma: The Deep Propagating Gravity Wave Experiment (DEEPWAVE): An Airborne and Ground-Based Exploration of Gravity Wave Propagation and Effects from their Sources throughout the Lower and Middle Atmosphere. *Bulletin of the American Meteorological Society*, **97**, 425-453, doi:10.1175/BAMS-D-14-00269.1.
- 2015 **Kruse, C. G.** and R. B. Smith: Gravity wave diagnostics and characteristics in mesoscale fields. *Journal of the Atmospheric Sciences*, **72**, 4372-4392, doi:10.1175/JAS-D-15-0079.1
- 2011 Delene, D., C. Grainger, P. Kucera, D. Langerud, M. Hamm, R. Mitchell, and **C. G. Kruse**: The second polarimetric cloud analysis and seeding test. *Journal of Weather Modification*, **43**, 14-28.

In Prep

- 2020 Kruse, C. G., M. Joan Alexander, Lars Hoffmann, Inna Polichtchouk, Annelize van Niekerk, Riwal Plougonven, Corwin Wright, Julio T. Bacmeister, Manfred Ern, Kaoru Sato, Ryosuke Shibuya, Laura Holt, Petr Šácha, Sonja Gisinger, Catrin Meyer, and Olaf Stein: Observed and modeled mountain waves from the surface to the mesosphere around the Drake Passage. *Journal of the Atmospheric Sciences*.

Not peer reviewed

- 2019 Alexander, M. J., J. T. Bacmeister, M. Ern, S. Gisinger, L. Hoffmann, L. Holt, **C. G. Kruse**, R. Plougonven, I. Polichtchouk, P. Sacha, K. Sato, R. Shibuya, A. van Niekerk, and C. Wright, 2019: Seeking New Quantitative Constraints on Orographic Gravity Wave Stress and Drag to Satisfy Emerging Needs in Seasonal to Sub-seasonal and Climate Prediction. SPARC Newsletter No. 53, July 2019, pp 31-36. Available at www.sparc-climate.org/publications/newsletter
- 2013 Lubin, M., S. McMillan, **C. G. Kruse**, D. Del Vento, R. Montouro: Full scale ahead: the Weather Research and Forecast (WRF) model and Intel Cluster Studio XE 2013. Intel, *The Parallel Universe Magazine*, Issue 15, 29-37.

Invited Presentations and Seminars

- 2020 Observed and Modeled Mountain Waves from the Surface to the Mesosphere around the Drake Passage. Workshop on new quantitative constraints on orographic gravity wave stress and drag, Bern, Switzerland, 20-24 Sep 2021. Invited to workshop.
- 2020 Observed and Resolved Mountain Waves from the Surface to the Mesosphere. MS-GWaves Workshop, Edertal, Germany, 24-25 Nov 2020. Invited to present and attend.
- 2020 Middle-Atmosphere Mountain Waves and Drag Near the Drake Passage: Observations, mini-MIP, and an OSSE. European Geophysical Union General Assembly, Vienna, Austria, 3-8 May 2020. Invited talk in the Internal Gravity Wave session.
- 2020 Middle-Atmosphere Mountain Waves and Drag Near the Drake Passage: Observations, mini-MIP, and an OSSE. Climate and Global Dynamics Laboratory, NCAR, 11 Feb 2020. Seminar.

- 2019 Kruse, C. G. and J. T. Bacmeister: Narrowing the uncertainty of mountain wave drag influences in Earth's general circulation. Dept. of Atmos. Sci., U. of Wyoming, 22 Oct 2019. Invited Seminar.
- 2019 Kruse, C. G. and J. T. Bacmeister: A blueprint for a spectral, quasi-transient mountain wave drag parameterization. Workshop on new quantitative constraints on orographic gravity wave stress and drag, Bern, Switzerland, 4 April 2019. Invited to workshop.
- 2019 Kruse, C. G. and R. B. Smith: Broad-spectrum, transient mountain waves: vertical dispersion and its influence. Workshop on new quantitative constraints on orographic gravity wave stress and drag, Bern, Switzerland, 3 April 2019. Invited to workshop.

Conference Presentations

- 2021 Christopher G. Kruse, Julio T. Bacmeister, Colin Zarzycki, Vince Larson, Katherine Thayer-Calder: A new effort to evaluate and improve the Community Atmosphere Model: latest version errors and attribution. AMS Annual Meeting, 14 Jan 2021.
- 2019 Christopher G. Kruse, M. Joan. Alexander, Lars Hoffmann, Annelize van Niekerk, Inna Polichtchouk, Julio T. Bacmeister, Laura Holt, Riwal Plougonven, Petr Sacha, Corwin Wright, Kaoru Sato, Ryosuke Shibuya, Sonja Gisinger, Manfred Ern, Catrin Meyer, and Olaf Stein, 2019: SA21A-03 - Stratospheric Orographic Gravity Waves from Patagonia and the Antarctic Peninsula: Observations, Model Validation and Inter-Comparison. San Francisco, CA, AGU Fall Meeting, 10 Dec 2019.
- 2019 Kruse, C. G. and J. T. Bacmeister: Description and Preliminary Results of a New Spectral Mountain Wave Drag Parameterization. International Conference on Alpine Meteorology, Riva del Garda, Italy, 2-6 September 2019. **Presentation.**
- 2019 Kruse, C. G.: Regional to global evolution of potential vorticity generated by parameterized mountain wave drag. American Meteorological Society Annual Meeting, Phoenix, Arizona, 6-10 January 2019. **Presentation.**
- 2018 Kruse, C. G.: Global influences of mountain waves in a general circulation model. 18th conference on mountain meteorology, Santa Fe, New Mexico, 25-29 June 2018. **Presentation.**
- 2018 Kruse, C. G. and R. B. Smith: Non-dissipative and dissipative momentum deposition by mountain wave events in sheared environments. EGU General Assembly, Vienna, Austria, 8-13 April 2018. **Presentation.**
- 2017 Kruse, C. G. and R. B. Smith: Reversible and irreversible mountain wave momentum deposition in sheared environments. AGU Fall Meeting, New Orleans, 11-15 December. **Presentation.**
- 2017 Kruse, C. G. and R. B. Smith: Mountain wave attenuation and momentum deposition in sheared environments. International Conference on Alpine Meteorology, Reykjavík, Iceland, 19-23 June. **Presentation.**
- 2017 Kruse, C. G. and R. B. Smith: Comparison of resolved and parameterized orographic gravity waves over New Zealand, the Andes, and the Himalayas. International Conference on Alpine Meteorology, Reykjavík, Iceland, 19-23 June. **Poster.**

- 2016 Kruse, C. G. and R. B. Smith: Stratospheric mountain wave attenuation in positive and negative ambient wind shear. AGU Fall Meeting, San Francisco, CA, 12-16 December. **Presentation.**
- 2016 Kruse, C. G. and R. B. Smith: Mountain wave attenuation and a quantitative evaluation of gravity wave drag parameterizations. Workshop on Drag processes and their links to large-scale circulation, ECMWF, Reading, United Kingdom, 12-15 September 2016. **Presentation and Poster.**
- 2016 Kruse, C. G. and R. B. Smith: A Comparison of Mountain Waves and Gravity Wave Drag Produced by New Zealand, the Southern Andes, and the Himalayas. 17th Conference on Mountain Meteorology, Burlington, VT, 27 June – 1 July. **Presentation.**
- 2016 Kruse, C. G. and R. B. Smith: Attenuation characteristics within a mountain wave “Valve Layer” and quantification of gravity wave drag. SPARC Gravity Wave Symposium, State College, PA, 16-20 May. **Presentation.**
- 2015 Kruse, C. G. and R. B. Smith: Statistics and Physics of Stratospheric Gravity Wave Attenuation over New Zealand. AGU Fall Meeting, San Francisco, CA, 14-18 December. **Presentation and Poster.**
- 2015 Kruse, C. G. and R. B. Smith: An investigation of a midlatitude lower stratospheric gravity wave “valve layer”. 33rd International Conference on Alpine Meteorology, Innsbruck, Austria, 31 Aug - 4 Sept 2015. **Presentation.**
- 2015 Kruse, C. G. and R. B. Smith: An investigation of a midlatitude lower stratospheric gravity wave “valve layer”. 16th Conference on Mesoscale Processes, Boston MA, 3-6 August 2015. **Presentation.**
- 2015 Kruse, C. G. and R. B. Smith: Stratospheric mountain wave propagation and dissipation over New Zealand. AMS Annual Meeting, Phoenix AZ, 4-8 January 2015. **Presentation.**
- 2014 Kruse, C. G. and R. B. Smith: Mountain wave energy and momentum fluxes from mesoscale model output. 16th Conference on Mountain Meteorology, San Diego CA, 18-22 August 2014. **Presentation.**
- 2014 Kruse, C. G. and D. Del Vento: Optimizing performance of the Weather Research and Forecasting model at large core counts: a comparison between pure MPI and hybrid parallelism and an investigation into domain decomposition. 94th AMS Annual Meeting, Atlanta, GA, 2-6 February 2014. **Poster.**
- 2013 Kruse, C. G., M. Lubin, S. McMillan, R. Montuoro, and D. Del Vento. Evaluation of WRF scaling to several thousand cores on the Yellowstone supercomputer. Front Range Consortium for Research Computing HPC Symposium, Laramie, WY, 13-15 August 2013. **Presentation.**
- 2009 Kruse, C. G., D. J. Delene, and C. A. Grainger: Evaluation of 3-dimensional winds measured by the Aircraft Integrated Meteorological Measurement System. AGU Fall Meeting, San Francisco, CA, 14-18 December. **Poster.**