Angeline G. Pendergrass

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EDUCATION

2013 Ph.D. University of Washington, Department of Atmospheric Sciences
Dissertation: *The atmospheric energy constraint on precipitation change*

2009 M.S. University of Washington, Department of Atmospheric Sciences
Thesis: *Time-averaged data assimilation for midlatitude climates: towards paleoclimate applications*

2006 B.S. University of Miami, Majors: Meteorology/Math and Physics (Minor: French)
Magna cum laude, Thesis: *Climate feedbacks in the surface radiation budget*

PROFESSIONAL APPOINTMENTS

2016- Project Scientist I, National Center for Atmospheric Research (NCAR), Climate and Global Dynamics (CGD)

2016 Postdoctoral Visiting Research Fellow, Cooperative Institute for Research in Environmental Sciences (CIRES)

2014-16 Advanced Studies Program (ASP) Postdoctoral Research Fellow, NCAR CGD

PUBLICATIONS

Articles in the review process

Gettelman, Hannay, Bacmeister, Neale, **Pendergrass**, Danabasoglu, Lamarque, Fasullo, Bailey, Lawrence: High Climate Sensitivity in the Community Earth System Model version 2 (CESM2). In revision for *Geophysical Research Letters*.

Reports

2019 **Pendergrass**, Zelikova, Arnott, Bain, Barnes, Baron, Dutt, Gay-Antaki, Haacker, Emily Jack-Scott, Lauer, Morris, Morrison, Nunez, Steltzer, Thompson: Inclusive scientific meetings: Where to start. https://500womenscientists.org/inclusive-scientific-meetings

Published Articles

2019 Sippel, Meinshausen, Merrifield, Lehner, **Pendergrass**, Fischer, Knutti: Uncovering the forced climate response from a single ensemble member using statistical learning. Accepted at *Journal of Climate*.

Kramer, Soden, **Pendergrass**: Evaluating climate model simulations of the radiative forcing and radiative response at the Earth's surface. *Journal of Climate*, doi: 10.1175/JCLI-D-18-0137.1.

Prein and **Pendergrass**: Can we Constrain Uncertainty in Hydrologic Cycle Projections?, *Geophys. Res. Lett.*, 2018GL081529, doi:10.1029/2018GL081529.

Eyring, Cox, Flato, Gleckler, Abramowitz, Caldwell, Collins, Gier, Hall, Hoffman, Hurtt, Jahn, Jones, Klein, Krasting, Kwiatkowski, Lorenz, Maloney, Meehl, **Pendergrass**, Pincus, Ruane, Russell, Sanderson, Santer, Sherwood, Simpson, Stouffer, and Williamson: Taking climate model evaluation to the next level. *Nature Climate Change*. doi:10.1038/s41558-018-0355-y

2018 **Pendergrass, A.G.**, What precipitation is extreme? *Science*. doi:10.1126/science.aat1871.

Pendergrass, A.G. and R. Knutti: The uneven nature of daily precipitation and its change. *Geophysical Research Letters*. doi:10.1029/2018GL080298.

Kim, Kang, Takahashi, Donohoe, **Pendergrass**: Characterizing the inter-model spread of tropical precipitation pattern in CMIP3/5 models. *Proceedings of the Korean Meteorological Society.*

Byrne, Michael P., **A.G. Pendergrass**, Anita Rapp, and Kyle Wodzicki: Response of the Intertropical Convergence Zone to Climate Change: Location, Width and Strength. *Current Climate Change Reports*. doi:10.1007/s40641-018-0110-5.

Zhang, R., W. Hailong, Q. Fu, **A.G. Pendergrass**, M. Wang, Y. Yang, P-L. Ma, and P.J. Rasch: An assessment of local radiative feedbacks in response to observed short-term climate variations over the Arctic. *Geophysical Research Letters.* doi:10.1029/2018GL077852.

Meehl, G., C. Tebaldi, S. Tilmes, J-F Lamarque, S. Bates, **A.G. Pendergrass**, and D. Lombardozzi: Future heat waves and surface ozone, *Environmental Research Letters*. doi:10.1088/1748-9326/aabcdc.

Kay, J.E., T. L'Ecuyer, **A.G. Pendergrass**, H. Chepfer, R. Guzman, and V. Yettella: Scale-aware and definition-aware evaluation of modeled near-surface precipitation frequency using CloudSat observations, *JGR-Atmospheres*. doi:10.1002/2017JD028213.

Yettella, V., J. B. Weiss, J.E. Kay, and **A.G. Pendergrass**: An ensemble covariance framework for quantifying forced climate variability and its time of emergence, *Journal of Climate*. doi:10.1175/JCLI-D-17-0719.1.

Pendergrass, A.G., A. Conley and F. Vitt, Surface and top-of-atmosphere radiative feedback kernels for CESM-CAM5. *Earth System Science Data*. doi:10.5194/essd-2017-108.

2017 **Pendergrass, A.G.**, R. Knutti, F. Lehner, C. Deser, and B. M. Sanderson, Precipitation variability increases in a warmer climate. *Scientific Reports*, doi:10.1038/s41598-017-17966-y.

Frey, William R., Elizabeth A. Maroon, **A.G. Pendergrass**, and Jennifer E. Kay, 2017: Do Southern Ocean cloud feedbacks matter for 21st century warming? *Geophysical Research Letters*, doi:10.1002/2017GL076339.

Lehner, F., S. Coats, T. F. Stocker, **A.G. Pendergrass**, B. M. Sanderson, C. C. Raible, and J. E. Smerdon, Projected drought risk in 1.5°C and 2°C warmer climates. *Geophys. Res. Lett.*, **44**, 7419–7428. doi:10.1002/2017GL074117.

Sanderson, B. M., Y. Xu, C. Tebaldi, M. Wehner, B. O'Neill, A. Jahn, **A.G. Pendergrass**, F. Lehner, W.G. Strand, L. Lin, R. Knutti, and J.F. Lamarque, Community climate simulations to assess avoided impacts in 1.5 and 2°C futures. *Earth Syst. Dyn.*, **8**, 827–847. doi: 10.5194/esd-8-827-2017.

Benedict, J.J., B. Medeiros, A.C. Clement, and **A.G. Pendergrass**, Sensitivities of the Hydrologic Cycle to Model Physics, Grid Resolution, and Ocean Type in the Aquaplanet Community Atmosphere Model. *Journal of Advances in Modeling Earth Systems*, **9**, 1307–1324. doi:10.1002/2016MS000891.

Pendergrass, A.G. and C. Deser, Climatological characteristics of typical daily precipitation. *Journal of Climate*, **30**, 5985–6003. doi:10.1175/JCLI-D-16-0684.1.

2016 **Pendergrass, A.G.**, K.A. Reed and B. Medeiros, The link between extreme precipitation and convective organization in a warming climate: Global radiative-convective equilibrium simulations. *Geophysical Research Letters*, **43**. doi:10.1002/2016GL071285.

Pendergrass, A.G., and E.P. Gerber, The rain is askew: Two idealized models relating the vertical velocity and precipitation distributions in a warming world. *Journal of Climate*, *29*, 6445-6462. doi:10.1175/JCLI-D-16-0097.1.

2015 **Pendergrass, A.G.**, F. Lehner, B. Sanderson, and Y. Xu. Does extreme precipitation scaling depend on the emissions scenario? *Geophysical Research Letters*, *42*(20), 8767-8774. doi:10.1002/2015GL065854.

2014 **Pendergrass, A.G.**, and D.L. Hartmann, Two modes of change of the distribution of rain. *Journal of Climate*. *27*, 8357-8371.

Pendergrass, A.G., and D.L. Hartmann, Changes in the distribution of rain frequency and intensity in response to warming. *Journal of Climate*. *27*, 8372-8383.

Donohoe, A., K.C. Armour, **A.G. Pendergrass**, and D.S. Battisti, Shortwave and longwave radiative contributions to global warming under increasing CO_2. *Proceedings of the National Academy of Sciences of the USA*. *111*, 16700-16705.

Pendergrass, A.G., and D.L. Hartmann, The atmospheric energy constraint on global-mean precipitation. *Journal of Climate*. *27*, 757-768.

2012 **Pendergrass, A.G.**, and D.L. Hartmann, Global-mean precipitation and black carbon in AR4 simulations, *Geophysical Research Letters*, *39*, L01,703.

Pendergrass, A.G., G. Hakim, D. Battisti, and G. Roe, Coupled air–mixed-layer temperature predictability for climate reconstruction, *Journal of Climate*, *25*(2), 459–472.

2009 **Pendergrass, A.G.**, and H. Willoughby, Diabatically induced secondary flows in tropical cyclones. Part I: Quasi-steady forcing, *Monthly Weather Review*, *137*(3), 805–821.

AWARDS

2018 *Science* Editor's Choice, Pendergrass and Knutti (2018)

CFMIP 2018 Early Career Presentation Award

2016 AGU Editor's Citation for Excellence in Refereeing

GRL Research Spotlight, Pendergrass, Reed, and Medeiros (2016)

2015 Outstanding AGU Reviewer

2015 CIRES Postdoctoral Visiting Research Fellowship

2014 GEWEX Early Career Scientist Presentation Certificate of Excellence

2013 NCAR Advanced Studies Program Postdoctoral Fellowship

2012 *Science* Editor's Choice, Pendergrass and Hartmann (2012)

2006 National Defense Science and Engineering Graduate Research Fellowship

Achievement Rewards for College Scientists (ARCS) Fellowship

University of Washington Program on Climate Change Fellow (Honorary)

FUNDING

2019 NASA, Quantifying the link between organized convection and extreme precipitation (co-PI/NCAR lead, PI: Kevin Reed, $240,072 requested)

2018 US DOE, Simulating extreme precipitation in the United States in the Energy Exascale Earth System Model: Investigating the importance of representing convective intensity versus dynamic structure (co-PI, PI: Gabriel Kooperman, $979,260)

2018 US DOE/NCAR Cooperative Agreement to analyze variability, change, and predictability in the earth system (CATALYST; Key personnel, PI: Gerald Meehl, $10.3 million)

2017 ETH-Zurich, Data Science-informed attribution of changes in the hydrologic cycle (PI Reto Knutti, Project Partner along with Nicolai Meinshausen, 425,000 CHF)

2016 GEWEX Earth's hydrologic sensitivity workshop travel award ($3,371)

2015 CIRES Postdoctoral Visiting Research Fellowship ($63,500)

2014 GEWEX 7th International Scientific Conference travel funding ($1,700)

2013 NCAR Advanced Studies Program Postdoctoral Fellowship ($123,500)

2009 NSF – Dynamical Climate Reconstruction using Paleoclimate Data and Ensemble State Estimation (unnamed contributor - $370,030)

2006 National Defense Science and Engineering Graduate Research Fellowship ($165,608)

Achievement Rewards for College Scientists (ARCS) Fellowship ($15,000)

2005 American Meteorological Society Undergraduate Scholarship ($5,000)

2004 American Meteorological Society Industry/Undergraduate Scholarship ($4,000)

2002 Bowman Foster Ashe Scholarship (approx. $80,000)

2002 Karl Cless Foundation Technology Scholarship ($3,000)

PRESENTATIONS

Invited seminars and conference talks

2019 University of New South Wales
University of Melbourne
Bureau of Meteorology (Australia)
Monash University
Multi-year drought in Australia – Monash University workshop

2018 Princeton University
Carnegie Institution for Science
Lawrence Livermore National Lab

2017 American Geophysical Union Fall Meeting
Aspen Global Change Institute - Earth System Model Evaluation to Improve Process Understanding

2016 GEWEX Earth's Hydrological Sensitivity to Climate Change workshop
ETH - Zurich
European Geophysical Union Annual Meeting
International Detection and Attribution Group Meeting

2015 University of Hawaii—Manoa
Scripps Institution of Oceanography
Colorado State University

2014 University of Miami
NOAA Earth System Research Laboratory
University of Colorado—Boulder, Institute for Arctic and Alpine Research
Caltech
State University of New York at Albany
Max Planck Institute for Meteorology
New York University

2013 NASA Jet Propulsion Laboratory
NCAR Climate Variability and Climate Change Working Group Meeting

2012 Oregon State University

Contributed conference talks (selected)

2019 AGU Fall Meeting

2018 CFMIP meeting on Clouds, Precipitation, Circulation & Climate Sensitivity
Aspen Global Change Institute, When the rain stops
ICTP workshop on Monsoons and the ITCZ

2017 CFMIP meeting on Clouds, Precipitation, Circulation & Climate Sensitivity

2014 7th International Scientific Conference on the Global Water and Energy Cycle (GEWEX)

2013 Gordon Research Seminar on Radiation and Climate

2012 AGU Fall Meeting

2009 Graduate Climate Conference

Campus and departmental seminars and talks (selected)

2019 DOE Extremes Telecon
Climate Variability and Climate Change Working Group Meeting
NCAR Water Systems Retreat
2018 CESM Workshop
2017 CESM Climate Variability and Climate Change Working Group Meeting
2016 NCAR IMAGe Brown Bag seminar
2015 CESM Breckenridge Workshop
NCAR Day of Networking and Discovery
CESM Climate Variability and Climate Change Working Group Meeting
2014 NCAR Climate and Global Dynamics Division
NCAR Climate Variability and Climate Change Working Group Meeting
2013 University of Washington Department of Atmospheric Sciences
2011 University of Washington Program on Climate Change Graduate Student Seminar

RESEARCH EXPERIENCE

2016- NCAR, Climate change and variability of the hydrologic cycle
2016 CIRES postdoctoral research, Extreme precipitation and its changes with warming
2014-16 NCAR postdoctoral research, Precipitation, energetics, and climate variability
2010-13 University of Washington PhD research, Precipitation: Energetic constraints and changes in distribution. Advised by Dennis Hartmann
2006-09 University of Washington MS research, Paleoclimate data assimilation, advised by Greg Hakim, Gerard Roe, and David Battisti
2006-07 University of Miami class project, Effects of secondary circulations structure on vortex intensification rate, with Hugh Willoughby
2005-06 University of Miami honors thesis, Climate feedbacks in the surface radiation budget, advised by Brian Soden
2005 Research Experience for Undergraduates (REU) Marine science in China at Ocean University of China, Analysis of a sea fog event on the Yellow Sea with Gang Fu
2004 National Weather Center REU at the National Severe Storms Lab, Ensemble forecast bias correction with Kim Elmore
2003 University of Miami independent research, Water vapor transport in the Inter-American Seas, advised by Chidong Zhang

TEACHING and MENTORING EXPERIENCE

Mentoring

Mentor. Qin Yang (NCAR visitor from Chongqing Climate Center, funded by China Scholorship Council)
PhD committee member. Ryan Kramer (University of Miami)
Collaborator. Hanjum Kim (Pusan National Univeristy, South Korea)
Collaborator. William Frey and Vineel Yettella (University of Colorado)
NCAR SOARS Academy mentor. Alexandria Downs (Valparaiso University)

Continuing Education

Lead learner (co-facilitator). UCAR|NCAR Equity and Inclusion training series, spring and fall 2018.

Graduate Teaching

Radiative feedback kernel tutorial. Provided a tutorial about radiative feedback kernels at Carnegie Institution for Science

NCAR ASP Summer Colloquium 2017: Orographic Precipitation. Organizing committee member and presenter.

Fundamentals of physics and chemistry of the atmosphere. Co-facilitator of seven flipped classroom meetings for Dennis Hartmann, Autumn 2013 at University of Washington

Objective analysis. Co-facilitator of two flipped classroom meetings for Dennis Hartmann, Winter 2013 at UW

Undergraduate Teaching

Our changing environment. Guest lecture for Jen Kay, Autumn 2015 at University of Colorado.

Atmospheric motions II. Guest lecture for Dargan Frierson, Winter 2012 at University of Washington (UW)

Climate variability and change. Three guest lectures for Steve Warren, Winter 2012 at UW

Global warming. TA with Dargan Frierson, Winter 2011 at UW

Weather. TA with Robert Houze, Autumn 2007 at UW

As a TA at UW, I designed and led 3-4 sessions per week for each class of order 200 students. Along with one other TA, I designed and graded homework, quizzes, and tests.

Meteorological instrumentation. Student assistant with Bruce Albrecht, Spring 2005 aboard Royal Caribbean Explorer of the Seas with the University of Miami (UM)

Math tutor. Tutor on walk-in basis for students taking any math class offered at the university, 2003-06 for UM Math Department

Linear algebra. Grader for one semester at UM

SEA EXPERIENCE

2013 Graduate student science crew member for University of Washington Applied Physics Lab's NEMO Deployment and Shelf Science Cruise with Chief Scientist Matthew Alford, 22—26 April off the Washington Coast aboard the *R/V Thompson*

2010 CTD Watch Stander for Scripps Institution of Oceanography on CLIVAR P6 Leg 2 with Chief Scientist Ruth Curry, 4 January—10 February from Papeete, Tahiti to Valparaiso, Chile aboard the *R/V Melville*

PROFESSIONAL and INSTITUTIONAL SERVICE

Committee service

2019 IPCC AR6 WGI Contributing Author, Water Cycle Changes chapter
2018- Co-lead, CGD Extremes cross-cutting theme
2018 Aspen Global Change Institute Science Committee

Reviewer

Academic journals: *Nature, PNAS, Nature Climate Change*, *Journal of Climate*, *Geophysical Research Letters, JAMES, Journal of the Atmospheric Sciences*, *Monthly Weather Review*, *Bulletin of the American Meteorological Society*, *Climate Dynamics*, *Quarterly Journal of the Royal Meteorological Society*, *Journal of Geophysical Research-Atmospheres*, *Atmospheric Science Letters*, *Climatic Change*, *Climate of the Past*, *Earth System Dynamics*, *Nature Communications, Environmental Research Letters, WIREs Climate Change, Asia-Pacific Journal of Atmospheric Sciences, Journal of Hydrometeorology, Science Advances,* and *npj Climate and Atmospheric Science.*

Funding agencies: NASA (panel member) and NSF (ad-hoc reviewer)

Textbook: *Modern Marine Weather*, 2nd edition, by David Burch

Conferences and Conference Sessions Organized

2019 Co-organizer, Using Observationally Based Metrics to Evaluate and Improve Earth System Model Precipitation (DOE)

2018 Co-organizer, AGU Fall Meeting Town Hall, Using Observationally Based Metrics to Evaluate and Improve Earth System Model Precipitation

Local organizing committee member, CFMIP

Organizer, Aspen Global Change Institute workshop on droughts

Primary organizer, Aspen Global Change Institute workshop on Diversity and Inclusion in Global Change Science

Co-convener, Air-Sea Exchange Processes in Western Boundary Current Systems and Marginal Seas: Their Local and Remote Climatic Implications, Ocean Sciences Meeting

2016 Session chair and co-convener, Atmospheric Circulation and Hydrological Cycle under a Changing Climate: Monsoons, Storm Tracks, and the ITCZ, AGU Fall Meeting

2015 Session chair and co-convener, Atmospheric Circulations and Their Role in the Hydrological Cycle: Monsoons, Storm Tracks, and the ITCZ session, AGU Fall Meeting

2014-15 NCAR ASP Thompson Lecture series committee member

2012 Session chair and abstract committee member, Graduate Climate Conference

2011 Seattle liaison, American Meteorological Society Student Conference

2009 Co-executive organizer, Graduate Climate Conference

2008 Undergraduate session chair and planning committee member, American Meteorological Society Student Conference

2007 Social committee chair, Graduate Climate Conference

Outreach presentations

2019 University of Colorado Anschutz Medical Campus Retired Faculty Association

2018 NCAR Journalism Summit

Web-based content

NCAR's *Climate Data Guide.* Expert user guidance contributor on TRMM 3b42, GPCP 1DD, and GPCP precipitation datasets, and the radiative kernel technique

Leadership

Undergraduate Leadership Workshop shadowee, NCAR, 2015
AMS Student Chapter, speaker, University of Miami, November 2014
Learning Community Facilitator, An Introduction to Evidence-Based Undergraduate STEM Teaching, Center for the Integration of Research, Teaching, and Learning, Boulder CO, 2014
Sea kayak czar, University of Washington Kayak Club, 2012-13
Founding president, University of Miami AMS Student Chapter, 2005
President, University of Miami Atmospheric Science Club, 2004-05

COMMUNITY INVOLVEMENT and OUTREACH

500 Women Scientists, a group of women in support science and diversity.
2016-7 Leadership team, local chapter coordinator

Open Adventure Rowing Northwest, adventure-based environmental education, outreach and research

2016 *Adventure: Mississippi River*, weather forecast team lead

2014 *Adventure: Mississippi River*, guest rower from Minneapolis, MN to La Crosse, WI (one week), including a visit to Summit Environmental Elementary

2013 *Canadian Wildlife Federation Africa to the Americas*, UW AMS Student Chapter weather forecast team leader, one classroom visit at King's Elementary School

2012 *Salish Sea Expedition*, UW AMS Student Chapter weather forecast team leader, one classroom visit at King's Elementary School

University of Washington Atmospheric Sciences Outreach

Developed a severe weather presentation, visited schools and fairs, presented to visiting student groups

Media Coverage

2019 "Steve King's Climate Change Rainfall Claims" *FactCheck.org*
"How to counter 'manels' and make scientific meetings more inclusive" *Nature News*

2018 “Why it never rains but it pours” *The Times* (UK)
“Half of the year's rain falls on Earth in just 12 days” *foxnews.com*
“Half the World's Annual Precipitation Falls In Just 12 Days, Study Says” *Weather.com*
“Wie der Klimawandel Überschwemmungen bringt” *Spektrum.de*
“Half of the World's Rain Falls In Just a Dozen Days a Year” *Gizmodo*
“Boulder scientist: Half the world's precipitation falls in just 12 days” *9 News Denver* (Denver local news segment)
“Study finds most rain falls in just a few days” *Boulder Daily Camera* (front page of local newspaper)
“Climate Change Means More Rainfall And Flooding, But Not Less Drought. Here's Why” *Colorado Public Radio* (live radio interview)
“In just 12 days, the world gets half of its annual rainfall” *Science News*
(See more coverage of Pendergrass and Knutti, 2018 from its AltMetrics page)
“Why extreme rains are gaining strength as the climate warms” *Nature News*
“The water impact in Roaring Fork Valley” *Aspen Times*
“Rainstorms are now up to 70% stronger and wetter than they were in the 1950s — and this is only the beginning” *Business Insider*

2017 “Women scientists: We’re not backing down, and we’re not going away,” *Grist*

2014 “Global warming is not just a ‘blanket’ trapping heat on Earth – it’s more like tanning oil, scientists claim,” *Daily Mail*

“Summit students learn from real-life explorers,” *La Crosse Tribune*