Dr. Amy Hawes Butler

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Education

2009	**Ph.D. Atmospheric Science**, Colorado State University, Fort Collins, Colorado. *Dissertation*: "The Atmospheric Circulation Response to Climate Change-Like Thermal Forcings in a Simple General Circulation Model". Advisor: David W. J. Thompson
2006	**M.S. Atmospheric Science**, Colorado State University, Fort Collins, Colorado.
2003	**B.A. Physics** (*magna cum laude*) and **Astrophysics**, University of Colorado-Boulder, Boulder, Colorado. Minor: Atmospheric Science.

Professional Employment

2022-	**Research Physicist ZP-4**. NOAA Chemical Sciences Laboratory.
2020-2022	**Research Physicist ZP-3**. NOAA Chemical Sciences Laboratory.
2019-2020	**Research Scientist III**. Cooperative Institute for Research in Environmental Sciences (CIRES)/University of Colorado, NOAA/ESRL/Chemical Sciences Division, Boulder, Colorado
2013-2019	**Research Scientist II**. CIRES/University of Colorado, Colorado.
2009-2013	**Research Meteorologist GS-11** (Step 4). Climate Prediction Center, NOAA/National Weather Service, College Park, Maryland
2003-2009	**Graduate research assistant**, Colorado State University
2000-2003	**Undergraduate research assistant**, NOAA Aeronomy Lab. Advisor: Susan Solomon

Awards and Fellowships

2023	AGU Atmospheric Sciences Ascent Award (NOAA CSL article: https://csl.noaa.gov/news/2023/386_0918.html)
2021	Gold Star Award Winner for NOAA Boulder outreach
2021	Dr. Daniel L. Albritton Outstanding Science Communicator *"For outstanding communication of NOAA research regarding the impact of variations in the stratospheric polar vortex on weather at the Earth's surface"*. CSL News Item: https://csl.noaa.gov/news/2021/336_1202.html
2019	NASA Group Achievement Award, Atmospheric Tomography Mission
2018	CIRES award for outstanding service as flight meteorologist for NASA ATom
2018	Visiting Scientist, NCEP Climate Prediction Center, UCAR CPAESS Short-term Research Collaboration Opportunity
2014	Editor's Citation for Excellence in Refereeing, Geophysical Research Letters
2009	EPA Science to Achieve Results (STAR) Graduate Fellowship
2007	Herbert Riehl Memorial Award for Graduate Students, Colorado State

University

2004 American Meteorological Society Graduate Fellowship

Service and Professional Activities

Teaching and Advising

2022- **Advisor,** Ewa Bednarz, CIRES research scientist 2

- *Dr. Bednarz runs simulations and does analysis on stratospheric aerosol injection and chemistry-climate interactions*

2022 **Co-Advisor**, Divya Rea, NOAA Hollings Scholar undergraduate summer student

- *Divya examined relationships between austral fall sea ice and springtime polar vortex variability.*

2021- **Advisor**, Dillon Elsbury, CIRES research scientist 1

- *Dr. Elsbury works on issues related to the QBO, climate change, and chemical transport*

2021 **Co-Advisor**, Miranda Miranda, SOARS undergraduate summer student

- *Miranda looked at relationships of surface ozone (MDA8) to ENSO and the QBO on monthly timescales and for different seasons. Miranda received a 2021 SACNAS Student Presentation Award for her research.*

2019-2020 **Advisor**, Melissa Breeden, NOAA Climate and Global Change Post-doctoral Fellow

- *Dr. Breeden evaluated the role of the springtime transition of the Pacific jet stream on stratospheric intrusions of ozone over the western United States.*

2018-2019 **Advisor**, Reese Kelly, Monarch High School Senior Seminar Student

- *Reese correlated time series of stratospheric ozone in the tropics, extratropics, and polar regions with the Quasi-biennial Oscillation, in both model runs and observations. He won a special award for Excellence in Atmospheric Science from AMS at a regional science fair.*

2018 **Advisor**, Jordan Benjamin, NOAA Hollings Scholar undergraduate summer student

- *Jordan evaluated stratospheric ozone intrusions in pre-industrial and future climate simulations to see how they will change in the future. He presented his results at AGU 2018 and AMS 2019.*

2016 **Advisor**, NOAA high school summer student (Rohini Dasan).

- *Rohini looked at the relationship between El Nino-Southern Oscillation and stratospheric final warmings.*

2015-16 **Advisor**, post-doctoral researcher (Dr. Jeremiah Sjoberg)

- *Dr. Sjoberg helped develop the Sudden Stratospheric Warming Compendium (SSWC). He co-authored a paper on the database.*

2007 **Teaching Assistant**, Objective Analysis in the Atmospheric Sciences. Colorado State University, Dept of Atmospheric Science

2005 **Teaching Assistant**, Objective Analysis in the Atmospheric Sciences. Colorado State University, Dept of Atmospheric Science

Committees

2022- **Member** of the WCRP Explaining and Predicting Earth System Change (EPESC) Working Group 2

2022- **Member** of the Geoengineering Modeling Research Consortium (GMRC) steering group

2019-2027 **Member**, International Commission of the Middle Atmosphere (ICMA), International Association of Meteorology and Atmospheric Science (IAMAS)

2017- **Co-chair**, WCRP/SPARC project Stratospheric Network for the Assessment of Predictability (SNAP)

2018- **Co-chair**, S2S sub-project on the Stratosphere (joint with SNAP)

2020-2021 **Member** of the Regional Focal Point for the WCRP consultation of the North and Central America and the Caribbean region (SPARC representative)

2020-2021 **Liaison**, between the U.S. Weather Research Science Working Group (WRSWG)-S2S and the international S2S Prediction Project

2018-2021 **Member**, US CLIVAR Process Studies and Model Improvement (PSMI) panel

2018-2021 **Chair**, AMS Middle Atmosphere Committee

2016-2017 **Member**, AMS Middle Atmosphere Committee

2010- **Member**, SPARC DynVar Committee

Reviewing and Editing

2023 **Ph.D. Thesis external reviewer**, McGill University

2022 **Panel reviewer**, NASA ACMAP

2022 **Panel reviewer**, NOAA Climate Program Office/NWS OSTI

2021-2022 **Review Editor**, WMO Ozone Assessment, Chapter 5: Stratospheric Ozone Changes and Climate. **Reviewer** for Chapter 4.

2020 **Proposer**, AGU Special Collection "*The Exceptional Arctic Stratospheric Polar Vortex in 2019/2020: Causes and Consequences*", JGR-Atmospheres and GRL.

2019 **Guest Editor**, US CLIVAR "Variations", Vol. 17(1), *The role of stratospheric teleconnections on climate variability and predictability across timescales,* https://indd.adobe.com/view/b0e5a374-5321-4058-a31d-4b2130ac765e. Associated webinar: https://www.youtube.com/watch?v=gm1Pi3sXPQM

2017 **Reviewer**, WMO/UNEP Ozone Assessment Report Chapter

2017 **Panel reviewer**, NOAA Climate Program Office

2013 **Reviewer**, WMO/UNEP Ozone Assessment Report Chapter

2009- **Manuscript Reviewer**, *Geophysical Research Letters, Journal of Climate, Journal of Geophysical Research- Atmospheres, Environmental Research Letters, Climate Dynamics, Journal of the Meteorological Society of Japan, Atmospheric Chemistry and Physics, Proceedings of the National Academy of Sciences, Quarterly Journal of the Royal Meteorological Society, Nature Climate Change, Science Advances, Atmospheric Science Letters*

2009- **Proposal Reviewer**, National Science Foundation

Organizing Conferences

2023 **Planning committee,** Earth Radiation Budget science workshop, Boulder, CO
2023 **Co-organizer**, SPARC SNAP/DynVar workshop, Munich, Germany
2023 **Planning committee**, IUGG/IAMAS General Assembly
2023 **Convener**, Session: Stratosphere-troposphere coupling and links to climate across time scales, AMS annual meeting
2019 **Convener**, Advances and Challenges for Subseasonal to Seasonal Prediction, AGU fall meeting session
2019 **Planning Committee**, SPARC DynVarMIP-SNAP workshop, Madrid, Spain
2019 **Program chair**, AMS 20th Middle Atmosphere Conference, Phoenix, Arizona
2015 **Planning Committee**, SPARC regional workshop in Boulder, Colorado
2012 **Co-organizer**, NOAA's 37th Climate Diagnostics and Prediction Workshop

Professional Societies

2003- **Member**, American Meteorological Society
2003- **Member**, American Geophysical Union

Field Experience

2023 Flight Meteorologist for NOAA SABRE Mission
2018 Flight Meteorologist for NASA Atmospheric Tomography Mission 4
2017 Flight Meteorologist for NASA Atmospheric Tomography Mission 3

Outreach

2021 "Do you NOAA?" video on "Polar vortex and Jet Stream"
2018 NOAA Summer Intern Speed Mentoring
2018 Smoky Hill High School World Awareness Day, "Lessons from the Antarctic Ozone Hole", Parker, Colorado
2016 Denver Public Schools 8th Grade Career Fair
2015 Judge, Corden Pharma Colorado Regional Science Fair, University of Colorado-Boulder
2008 Smoky Hill High School, "Carbon Dioxide: Where it comes from, where it goes, and what we can do about it", Parker, Colorado

Media

Twitter, @DrAHButler, 7500 followers- 4125 tweets about stratospheric polar vortex events and large-scale circulation

2023 San Francisco Chronicle: *"Here's the science behind the endless storms drenching California this winter"*

NOAA's climate.gov, "*Disrupted polar vortex brings sudden stratospheric warming in February 2023*"

Newsweek: "*How sudden stratospheric warming could impact weather, according to experts*"

Axios: "*An event high above the Arctic may turn winter sharply colder in U.S., Europe*"

Washington Post: "*How a predicted polar vortex disruption could spur winter's revenge*"

2022 NPR, "*Winters are getting warmer across the Midwest. That's affecting Missouri farmers*"

2021 Accuweather, "*Warmer winter temperature trend worries experts*"

Philadelphia Inquirer, "*As the world warms, winters get stranger in Philly and the U.S. Here's one explanation.*"

Washington Post: "*South Pole posts most severe cold season on record, a surprising anomaly in a warming world*"

Climate.gov: "*Understanding the Arctic polar vortex*", and new NOAA polar vortex schematic

Popular Science: "*Explaining this week's deadly US cold snap*"

Gothamist: *"Why New York's snowstorms are growing—along with warming winter temperatures"*

The Conversation: *"What exactly is the polar vortex"*

New York Times: "*Forecast: Wild weather in a warming world*"

Climate.gov: *"On the sudden stratospheric warming and polar vortex of early 2021"*

Washington Post: *"What a 'wrecked' polar vortex means for winter-starved Americans"*

Popular Science: *"The polar vortex is about to split in two. But what does that actually mean?"*

Live Science: *"Wandering polar vortex may cause a wild, snowy winter"*

Mashable: *"The polar vortex has just been disrupted. What does this bode?"*

Washington Post: *"The polar vortex is splitting in two, which may lead to weeks of wild winter weather"*

2020 Washington Post: *"Signs point to a strong polar vortex to start winter. Here's what that may mean"*

Denver 9 news:*"How largest Ozone 'hole' ever over the north pole is tied to Polar Vortex that hit parts of US"*

Climate.gov: *"Spring 2020 brings rare ozone 'hole' to the Arctic"*

Washington Post: *"The demise of the polar vortex could spell weather surprises this spring"*

2019 ECMWF: "*Scientists review impact of the stratosphere on weather*"

EOS: *"Strong winds leave Arctic regions on thin ice"*

Popular Science: *"The polar vortex is running wild—and it may not be because of climate change"*

Live interview with NPR's On Point on the polar vortex, January 30, 2019

Popular Science: *"Record cold temperatures don't mean the planet isn't warming"*

New York Times: *"How the shutdown reordered American Life"*

Axios: *"The polar vortex has split, sending frigid air howling into the U.S., Europe"*

Earther: *"The polar vortex could bring record cold to this weekend's Chiefs-Patriots Championship game*"

Popular Science: *"The polar vortex split apart. Here's what to expect"*

Axios: *"The polar vortex is about to split into 3 pieces: Here's what it means"*

2018 The Weather Channel: *"The polar vortex might weaken soon, and that could unleash a much colder January"*

2016 BuzzFeed: *"There is a searing scientific debate about missing Arctic ice"*

Funded Grants

Near-term climate and extreme weather projections derived from stratosphere-troposphere coupling in Earth System Models. NOAA Climate Program Office/MAPP- Climate Futures. Lead PIs: **Amy H. Butler**, Dillon Elsbury. Budget: $520,648. FY2024-2026.

Process-oriented diagnostics of dynamical coupling between the troposphere and stratosphere in Earth System Models. Lead PI: **Amy H. Butler** (NOAA CSL). Co-PI: Zachary D. Lawrence (CIRES). Co-Is: Judith Perlwitz (NOAA PSL). NOAA Climate Program Office MAPP. Budget: $517,700. FY2022-2024. Time commitments: A. H. Butler (3 months/year).

Machine learning for S2S prediction related to stratospheric dynamics and ozone transport. Lead PI: **Amy H. Butler** (NOAA CSL). FY21 NOAA OAR Weather Portfolio, Advancements in S2S prediction. Budget: $228,672. FY21-22.

A diagnostic toolbox for the verification and validation of subseasonal stratosphere-troposphere coupling processes in NOAA's Unified Forecast System. NWS Office of Science and Technology Integration: Unified Forecast System, Weeks 3-4 Competition. Lead PI: **Amy H. Butler** (switched to Eric Ray after my federal employment; I became a collaborator). Co-I: Judith Perlwitz and Craig Long. Budget: $288,584. FY2021-2023. Time commitment for A.H. Butler: 4 months/yr.

The influence of climate variability and change on stratospheric intrusions of ozone over North America. National Science Foundation. Lead PIs: John R. Albers, **Amy H. Butler**. Budget: $312,334. Dec 2018-Dec 2021. Time commitment for A.H. Butler: 4 months/year.

Climate Forecast System Reanalysis model-level products for reanalysis validation and intercomparison. NOAA HPCC Information Technology Incubator Proposal. Lead PI: Karen Rosenlof. **Co-I: Amy H. Butler**, Sean Davis, Craig Long. Budget: $109,000. 2016-2017.

A comprehensive atlas of mid-winter sudden stratospheric warmings and associated surface climate extremes. NOAA/Climate Program Office/COM. Lead PI: Dian Seidel. **Co-PI: Amy H. Butler**. Total Budget: $338,903. 2013-2016.

Analysis of IPCC-AR5 and CFS model simulated stratosphere-troposphere coupling and its links to Eurasian snow cover variability. NOAA/Climate Program Office/CPPA. Grant#:NA10OAR4310163, Lead PI: Judah Cohen, Arun Kumar. **Co-I**: **Amy H. Butler**, J. Furtado, E. Riddle. Total Budget: $421,604. 2010-2013.

Pending Grants

Publications

Refereed Journal Articles (number = 74, h-index = 36)
& > 100 citations, ^ > 50 citations

74. Bednarz, E.M., D. Visioni, **A.H. Butler**, B. Kravitz, D. MacMartin, and S. Tilmes, Potential non-linearities in the high latitude circulation and ozone response to stratospheric aerosol injection, *Geophys. Res. Lett.*, 50, e2023GL104726, **2023**.

73. Bednarz, E.M., **A.H. Butler**, D. Visioni, Y. Zhang, B. Kravitz, and D.G. MacMartin, Injection strategy- a driver of atmospheric circulation and ozone response to stratospheric aerosol geoengineering, *Atmos. Chem. Phys.*, 23, 13665–13684, **2023**. CSL Highlight article: https://csl.noaa.gov/news/2023/390_1107.html

72. **Butler, A.H.,** A. Yu. Karpechko, and C.I. Garfinkel, Amplified decadal variability of extratropical surface temperatures by stratosphere-troposphere coupling, *Geophys. Res. Lett.*, 50, e2023GL104607, **2023**.

71. Lawrence, Z.D., D. Elsbury, **A.H. Butler**, J. Perlwitz, J. Albers, L. Ciasto, and E. Ray, Evaluation of processes related to stratosphere-troposphere coupling in GEFSv12 subseasonal hindcasts, *Mon. Wea. Rev.*, 151, 1735-1755, **2023**.

70. Elsbury, D., **A.H. Butler**, J. Albers, M. Breeden, and A.O. Langford, The response of the North Pacific jet and stratosphere-to-troposphere transport of ozone over western North America to RCP8.5 climate forcing, *Atmos. Chem. Phys.*, 23, 5101–5117, https://doi.org/10.5194/acp-23-5101-2023, **2023**.

69. Kolstad, E., S.H. Lee, **A.H. Butler**, D.I.V. Domeisen, C. Ole Wulff, Diverse surface signatures of stratospheric polar vortex anomalies, *J. Geophys. Res.*, 127, e2022JD037422, **2022**.

68. Albers, J.R., **A.H. Butler**, A.O. Langford, D. Elsbury, M.L. Breeden, Dynamics of ENSO-driven stratosphere-to-troposphere transport of ozone over North America, *Atmos. Chem. Phys.*, 22, 13035-13048, https://doi.org/10.5194/acp-22-13035-2022, **2022**.

67. Bednarz, E.M., D. Visioni, J.H. Richter, **A.H. Butler**, and D.G. MacMartin, Impact of the latitude of stratospheric aerosol injection on the Southern Annular Mode, *Geophys. Res. Lett.*, 49, e2022GL100353, **2022**.

66. Manney, G.L., **A.H. Butler**, K. Wargan, J.-U. Groos, Introduction to Special Collection "The Exceptional Arctic Stratospheric Polar Vortex in 2019/2020: Causes and Consequences", *J. Geophys. Res.*, 127(18), doi:10.1029/2022JD037381, **2022**.

65. Karpechko, A.-Yu., H. Afargan-Gertsman, **A. H. Butler**, D.I.V. Domeisen, M. Kretschmer, Z. Lawrence, E. Manzini, M. Sigmond, I.R. Simpson, and Z. Wu, Northern Hemisphere stratosphere-troposphere circulation change in CMIP6 models. Part 1: inter-model spread and scenario sensitivity, *J. Geophys. Res.*, 127(18), doi:10.1029/2022JD036992, **2022**. Associated EOS highlight: https://eos.org/editor-highlights/modeling-stratosphere-troposphere-coupling-in-a-changing-climate

64. Lawrence, Z.D., M. Abalos, B. Ayarzaguena, D. Barriopedro, **A.H. Butler**, et al., Quantifying stratospheric biases and identifying their potential sources in subseasonal forecast systems, *Weath. Clim. Dyn*., 3(3), 977-1001, doi:10.5194/wcd-3-977-2022, **2022.**

63. Breeden, M.L., J.R. Albers, **A.H. Butler**, and M. Newman, The spring minimum in subseasonal 2-meter temperature forecast skill over North America, *Monthly Weather Review*, 150, 2617-2628, **2022**.

62. **Butler, A.H.** and Lee, S., The 2021 Arctic Sudden Stratospheric Warming [in "State of the Climate in 2021"], *Bull. Amer. Met. Soc.*, 103(8), S296, **2022**.

61. Hitchcock, P., **A.H. Butler**, A. Charlton-Perez, C.I. Garfinkel, et al., Stratospheric Nudging and Predictable Surface Impacts (SNAPSI): A protocol for investigating the role of the stratospheric polar vortex in subseasonal to seasonal forecasts, *Geosci. Model Dev.*, 15, 5073-5092, **2022**.

60. Manney, G.L., **A.H. Butler**, Z.D. Lawrence, K. Wargan, M.L. Santee, What's in a name? On the use and significance of the term "polar vortex", *Geophys. Res. Lett.*, 49, e2021GL09761, **2022**.

59. S. Bahramvash Shams, V.P. Walden, J.W. Hannigan, W.J. Randel, I.V. Petropavlovskikh, **A.H. Butler**, and A. de la Camara, Analyzing ozone variations and uncertainties at high latitudes during sudden stratospheric warming events using MERRA-2, *Atmos. Chem. Phys.*, 22, 5435–5458, **2022**.

58. Thompson, C.R., **A.H. Butler**, et al., The NASA Atmospheric Tomography (ATom) Mission: Imaging the Chemistry of the Global Atmosphere, *Bull. Amer. Meteor. Soc.*, **103**, E761–E790, **2022**. Dataset: https://doi.org/10.3334/ORNLDAAC/1925

57. Scaife, A.A., M. Baldwin, **A.H. Butler**, A. Charlton-Perez, D. Domeisen, C. Garfinkel, S. Hardiman, P. Haynes, H. Hendon, A. Karpechko, E.P. Lim, S. Noguchi, J. Perlwitz, L. Polvani, J. Richter, J. Scinocca, M. Sigmond, T. Shepherd, S.W. Son, and D. Thompson, Long Range Prediction and the Stratosphere, *Atmos. Chem. Phys*., 22, 2601-2623, **2021**.

56. **Butler, A.H.** and D.I.V. Domeisen, The wave geometry of final stratospheric warming events, *Weather Clim. Dynam.*, 2, 453-474, **2021**.

55. Martin, Z., S.-W. Son, **A.H. Butler**, H. Hendon, H. Kim, A. Sobel, S. Yoden, and C. Zhang, The influence of the quasi-biennial oscillation on the Madden-Julian Oscillation, *Nature Review Earth and Environment*, 2, 477-489, **2021**.

54. Albers, J.R., **A.H. Butler**, M. Breeden, A.O. Langford, and G.N. Kiladis, Subseasonal prediction of springtime Pacific-North American transport using upper-level wind forecasts, *Weather Clim. Dynam.*, 2, 433-452, **2021**.

53. Banerjee, A., **A.H. Butler**, L.M. Polvani, A. Robock, I.R. Simpson, L. Sun, Robust winter warming over Eurasia under stratospheric sulfate geoengineering- the role of stratospheric dynamics, *Atmos. Chem. Phys.,* 21, 6985-6997, **2021**. Associated NOAA research highlight: https://research.noaa.gov/article/ArtMID/587/ArticleID/2756/Simulated-geoengineering-evaluation-cooler-planet-but-with-side-effects

52. Lim, E.-P., H. H. Hendon, **A.H. Butler**, D.W.J. Thompson, Z. 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, *BAMS*, 102(6), E1150-E1171, **2021**.

51. Breeden, M., **A.H. Butler**, J.R. Albers, M. Sprenger, and A.O. Langford, The spring transition of the North Pacific jet and its relation to deep stratosphere-to-troposphere mass transport over western North America, *Atmos. Chem. Phys*., 21, 2781-2794, **2021**.

50. **&** Baldwin, M.P., B. Ayarzaguena, T. Birner, N. Butchart, **A.H. Butler**, A.J. Charlton-Perez, D.I.V. Domeisen, C.I. Garfinkel, H. Garny, E.P. Gerber, M.I. Hegglin, U. Langematz, and N.M. Pedatella, Sudden stratospheric warmings, *Reviews of Geophysics*, 59, e2020RG000708, **2021**.

Related AGU EOS summary:
https://eos.org/editors-vox/global-effects-of-disruptions-to-the-stratospheric-circulation

49. ^ Domeisen, D.I.V. and **A.H. Butler**, Stratospheric drivers of extreme events at the Earth's surface, *Nature Communications Earth & Environment*, 1 (59), **2020**.

48. Martin, Z., A. Sobel, **A.H. Butler**, S. Wang, Variability in QBO temperature anomalies on annual and decadal timescales, *J. Climate*, 34 (2), 589-605, **2020**.

47. Newman, P., E.R. Nash, N. Kramarova, **A.H. Butler**: The 2019 southern stratospheric warming [in "State of the Climate in 2019"]. Bull. Amer. Meteor. Soc., **101** (8), S297–S298, https://doi.org/10.1175/BAMS-D-20-0090.1, **2020**.

46. & Lawrence, Z.D., J. Perlwitz, **A.H. Butler,** G.L. Manney, P.A. Newman, S.H. Lee, and E.R. Nash, The remarkably strong Arctic stratospheric polar vortex of winter 2020: Links to record-breaking Arctic Oscillation and ozone loss, *Jour. Geophys. Res*., 125, e2020JD033271, **2020**. Related AGU EOS summary:
https://eos.org/research-spotlights/an-extraordinary-winter-in-the-polar-north

45. Lee, S.H., Z.D. Lawrence, **A.H. Butler,** and A. Karpechko, Seasonal forecasts of the exceptional Northern Hemisphere winter of 2020, *Geophys. Res. Lett*., 47, e2020GL090328, **2020**.

44. Butler, A.H., Z.D. Lawrence, S.H. Lee, S.P. Lillo, and C.S. Long, Differences between the 2018 and 2019 stratospheric polar vortex split events, *Quar. Jour. Roy. Met. Soc*., 1-19, **2020**.

43. Sprintall, J., V.J. Coles, K.A. Reed, **A.H. Butler**, G.R. Foltz, S.G. Penny, and H. Seo, Best practice strategies for process studies designed to improve climate modeling, *BAMS*, 101, E1842–E1850, **2020**.

42. Ayarzaguëna, B., A. J. Charlton-Perez, **A. H. Butler**, P. Hitchcock, I. R. Simpson, L. M. Polvani, N. Butchart, E. P. Gerber, L. Gray, B. Hassler, P. Lin, F. Lott, E. Manzini, R. Mizuta, C. Orbe, S. Osprey, D. Saint-Martin, M. Sigmond, M. Taguchi, E. M. Volodin, S. Watanabe, Uncertainty in the response of sudden stratospheric warmings and stratosphere-troposphere coupling to quadrupled CO2 concentrations in CMIP6 models, *J. Geophys. Res*., 125, e2019JD032345, **2020**.

41. & Mariotti, A., C. Baggett, E. A. Barnes, E. Becker, **A.H. Butler**, D.C. Collins, P.A. Dirmeyer, L. Ferranti, N.C. Johnson, J. Jones, B. P. Kirtman, A.L. Lang, A. Molod, M. Newman, A.W. Robertson, S. Schubert, D.E. Waliser, and J. Albers, Windows of opportunity for skillful forecasts subseasonal to seasonal and beyond, *BAMS*, 101, E608-E625, **2020**.

40. ^ Merryfield, W.J., J. Baehr, L. Batte, E.J. Becker, **A.H. Butler**, et al., Current and emerging developments in subseasonal to decadal prediction, *BAMS*, 101, E869–E896, **2020**.

39. King, A. D., **A.H. Butler**, M. Jucker, N.O. Earl, and I. Rudeva, Observed relationships between sudden stratospheric warmings and European climate extremes, *J. Geophys. Res*., 124, 13943-13961, **2019**.

38. ^ Domeisen, D.I.V., **A.H. Butler,** A.J. Charlton-Perez, B. Ayarzaguena, M.P. Baldwin, E. Dunn-Sigouin, J.C. Furtado, C.I. Garfinkel, P. Hitchcock, A. Yu. Karpechko, H. Kim, J. Knight, A.L. Lang, E.-P. Lim, A. Marshall, G. Roff, C. Schwartz, I.R. Simpson, S.-W. Son, M. Taguchi, The role of stratosphere-troposphere coupling in sub-seasonal to seasonal prediction. Part I: Predictability in the Stratosphere, *J. Geophys. Res.*, 125, e2019JD030920, **2019**.

37. & Domeisen, D.I.V., **A.H. Butler,** A.J. Charlton-Perez, B. Ayarzaguena, M.P. Baldwin, E. Dunn-Sigouin, J.C. Furtado, C.I. Garfinkel, P. Hitchcock, A. Yu. Karpechko, H. Kim, J. Knight, A.L. Lang, E.-P. Lim, A. Marshall, G. Roff, C. Schwartz, I.R. Simpson, S.-W. Son, M. Taguchi, The role of stratosphere-troposphere coupling in sub-seasonal to seasonal prediction. Part II: Predictability arising from stratosphere-troposphere coupling, *J. Geophys. Res.*, 125, e2019JD030923, **2019**.

36. Lee, S.H. and **A.H. Butler**, The 2018-19 Arctic stratospheric polar vortex, *Weather*, doi:10.1002/wea.3643, **2019**.

35. Butler, A.H., A. Charlton-Perez, D.I.V. Domeisen, I.R. Simpson, and J. Sjoberg, The predictability of Northern Hemisphere final stratospheric warmings and their surface impacts, *Geophys. Res. Lett.*, 46, 10578-10588, **2019**.

34. Garfinkel, C.I., C. Schwartz, D.I.V. Domeisen, **A.H. Butler**, S.-W. Son, and I.P. White, Weakening of the teleconnection of El Niño-Southern Oscillation to the Arctic stratosphere over the past few decades: What can be learned from subseasonal forecast models?, *J. Geophys. Res*., 124, https://doi.org/10.1029/2018JD029961, **2019**.

33. & Domeisen, D.I.V., C.I. Garfinkel, and **A.H. Butler**, The teleconnection of El Niño-Southern Oscillation to the Stratosphere, *Reviews of Geophysics*, 57, https://doi.org/10.1029/2018RG000596, **2019**. Related AGU EOS summary: https://eos.org/editors-vox/global-impacts-of-ensos-reach-into-the-stratosphere

32. Garfinkel, C.I., C. Schwartz, D.I.V. Domeisen, S.-W. Son, **A.H. Butler**, and I.P. White, Extratropical atmospheric predictability from the Quasi-Biennial Oscillation in subseasonal forecast models, *Jour. Geophys. Res.*, 123 (15), 7855-7866, **2018**.

31. Martineau, P., S.-W. Son, M. Taguchi, and **A.H. Butler**, A comparison of the momentum budget in reanalysis datasets during sudden stratospheric warming events, *Atmos. Chem. Phys. Discuss.*, https://doi.org/10.5194/acp-2017-837, **2018**.

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Book and Report Chapters

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Manuscripts under Review

Elsbury, D., **A.H. Butler**, Y. Peings, and G. Magnusdottir, Sensitivity of easterly QBO's boreal winter teleconnections and surface impacts to SSWs, submitted to J. Climate, **2023**.

Rea, D., D. Elsbury, **A.H. Butler**, L. Sun, Y. Peings, and G. Magnusdottir, Interannual influence of Antarctic sea ice on Southern Hemisphere stratosphere-troposphere coupling, submitted to GRL, **2023**.

Manuscripts in Preparation

Karpechko, A. Yu., H. Afargan-Gerstman, **A.H. Butler**, D.I.V. Domeisen, H. Garny, M. Kretschmer, Z. Lawrence, E. Manzini, M. Sigmond, I. R. Simpson, Z. Wu, Northern Hemisphere stratosphere-troposphere circulation change in CMIP6 models. Part 2: mechanisms and sources of the spread, in prep for JGR Atmospheres, 2023.

Waugh, D.W., **A.H. Butler**, L.E. Revell, The stratosphere of the Southern Hemisphere, Chapter 2 of the Monograph of the Southern Hemisphere, in prep, 2023.

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Other Publications (not peer-reviewed)

Hitchcock, P., **A.H. Butler,** C. Garfinkel, An Update on the SNAPSI project, S2S newsletter no 22, 2023.

Highlight in 2021 NOAA Science Report, Frigid Arctic Air Outbreaks May be Predictable: https://sciencecouncil.noaa.gov/Portals/0/Science%20Report/The%20FINAL%202021%20NOAA%20Science%20Report%20_MW_3-21.pdf?ver=2022-03-22-081921-153

Ayarzaguena, B., M.P. Baldwin, T. Birner, N. Butchart, **A.H. Butler**, A.J. Charlton-Perez, D.I.V. Domeisen, C.I. Garfinkel, H. Garny, E.P. Gerber, M.I. Hegglin, U. Langematz, and N. Pedatella, Sudden stratospheric warmings: a phenomenon with global effects, SPARC newsletter, 57, p. 8-11, July 2021.

Hitchcock, P., **A.H. Butler**, C. Garfinkel, and A. Charlton-Perez, Stratospheric Nudging and Predictable Surface Impacts (SNAPSI), SPARC newsletter, 57, p. 21, July 2021.

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Domeisen, D.I.V., **A.H. Butler**, A.J. Charlton-Perez, The role of the stratosphere in sub-seasonal to seasonal prediction, SPARC newsletter, 54, p. 14-18, February 2020.

Lim, E.-P., H.H. Hendon, **A.H. Butler**, R. Garreaud, I. Polichtchouk, T.G. Shepherd, A. Scaife, R. Comer, L. Coy, P.A. Newman, D.W.J. Thompson, and H. Nakamura, The 2019 Antarctic sudden

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Butler, A.H., How winds miles above the Arctic may have brought wintry weather to mid-latitudes, https://www.climate.gov/news-features/blogs/enso/february-and-march-madness-how-winds-miles-above-arctic-may-have-brought, NOAA ENSO blog, April 27, 2018.

Butler, A.H., El Niño and the stratospheric polar vortex, NOAA ENSO blog, https://www.climate.gov/news-features/blogs/enso/el-nino-and-stratospheric-polar-vortex, April 28, 2016.

Butler, A.H., E.P. Gerber, D. Mitchell, and W. Seviour, New efforts in developing a standard definition for sudden stratospheric warmings, SPARC Newsletter, 43, p. 23-24, July 2014.

Seminars and Conference Proceedings

Invited Talks

2022	"Influence of stratosphere-troposphere coupling on surface climate across timescales", Yale University Colloquium (virtual)
2022	"Frigid Arctic air outbreaks may be predictable", 2021 NOAA Science Report Seminar Series (virtual)
2022	"The role of stratosphere-troposphere coupling on weather extremes", AMS Atmospheric Chemistry Conference, AMS Annual meeting (virtual)
2021	"Wintertime impacts of polar stratospheric variability", NWS Climate Services Webinar (virtual)
2021	"Stratospheric polar vortex extremes, impacts, and implications for future climate change", University of Albany, SUNY, Department Seminar (virtual)
2021	"Quantifying stratospheric biases and the role of stratosphere-troposphere coupling in S2S models", NCAR S2S workshop (virtual)
2021	"The Stratosphere: how winds miles above us can be used to predict the weather weeks in advance", NCAR ASP Summer Colloquium on S2S science (virtual)
2021	"Characteristics of final stratospheric warmings and implications for springtime predictability", NCAR Atmospheric Chemistry Observations and Modeling, Seminar series (virtual)
2020	"Stratospheric polar vortex extremes, their impacts, and implications for future climate change", Institute for Atmospheric and Climate Science, ETH-Zurich webinar (virtual)
2020	"Exceptional atmospheric dynamics in boreal winter-spring 2020", Interagency Arctic Research Policy Committee Atmosphere Collaboration Team webinar (virtual)
2020	"The Stratosphere: how winds miles above us can be used to predict the weather

weeks in advance", CIRES Education and Outreach webinar, https://cires.colorado.edu/outreach/scienceathome/butler

2020 "Stratospheric polar vortex influence on sub-seasonal predictive skill of surface temperature", NOAA Geophysical Fluid Dynamics Laboratory seminar, Princeton, New Jersey

2019 "The representation of stratosphere-troposphere coupling in S2S models", ECMWF Workshop on Stratospheric predictability and impact on the troposphere, Reading, UK.

2018 "Stratosphere-troposphere coupling processes on S2S and longer timescales", SPARC General Assembly, Kyoto, Japan.

2018 "The role of the stratosphere in sub-seasonal to seasonal predictability", Second International Conference on Subseasonal to Seasonal Prediction, Boulder, CO

2018 "Sub-seasonal to seasonal predictability and the stratospheric polar vortex", NOAA Climate Prediction Center working group meeting telecon

2018 "How important is the stratospheric pathway of ENSO for Northern Hemisphere wintertime climate variability?", AMS Annual Meeting, Austin, TX

2017 "Uncertainties in future stratospheric ozone and surface UV," Climate Engineering Conference, Berlin, Germany.

2016 "El Niño and the stratospheric polar vortex: improving seasonal prediction of mid-latitude winter climate," NOAA Chemical Sciences Division, Boulder, CO

2014 "Separating the stratospheric and tropospheric pathways of ENSO teleconnections", NCAR Climate Variability and Change Working Group meeting.

2014 "Do stratosphere-resolving models make improved seasonal climate predictions?", NCAR Atmospheric Modeling and Predictability seminar.

2013 "Toward a consistent definition for sudden stratospheric warmings", Colorado State University, Atmospheric Dynamics group seminar.

2013 "The Stratosphere-resolving Historical Forecast Project", SPARC DynVar Workshop, Reading, UK.

2011 "The atmospheric circulation response to climate change-like thermal forcings in an idealized GCM", Johns Hopkins University, Center for Applied and Environmental Fluid Mechanics (CEAFM), and Center for Ocean Land Atmosphere (COLA).

2010 "The atmospheric circulation response to climate change-like thermal forcings in an idealized GCM", Columbia University, SEAS colloquium.

Contributed Talks

2021 "Quantifying stratospheric biases and the role of stratosphere-troposphere coupling in S2S models", WGNE-36 meeting (virtual)

2021 "Stratospheric modulation of winter temperature trends in a warming climate", WCRP Workshop on attribution of multi-annual to decadal changes in the climate system (virtual)

2021 "The wave geometry of final stratospheric warming events", EGU vPiCO (virtual)

2019 "Predictability of Northern Hemisphere final stratospheric warmings and their surface impacts", SPARC DynVar/SNAP workshop, Madrid, Spain.

2019 "NOAA Chemical Sciences Division: Contributions to S2S efforts", NOAA OAR S2S Collaboration Workshop, Princeton, New Jersey (virtual)

2019 "The predictability of Northern Hemisphere stratospheric final warmings and their surface impacts", AMS Annual Meeting, Phoenix, Arizona.

2017 "Optimizing the definition for sudden stratospheric warmings", AMS Middle Atmosphere Meeting, Portland, OR.

2016 "Can the compact O_3-N_2O relationship be used to detect ozone recovery?", AGU Fall Meeting, San Francisco, CA.

2016 "Do stratosphere-resolving models make better seasonal climate predictions in boreal winter?", SPARC DynVar meeting, Helsinki, Finland.

2016 "The future stratospheric ozone layer conundrum", American Meteorological Society (AMS) Annual Meeting, New Orleans, LA

2015 "Do stratosphere-resolving models make better seasonal climate predictions in boreal winter?", Climate Diagnostics and Prediction Workshop, Denver, CO

2015 "Defining sudden stratospheric warmings", EGU General Assembly, Vienna, Austria. Led townhall discussion.

2015 "Defining sudden stratospheric warmings", AMS Annual Meeting, Phoenix, AZ. Led townhall discussion.

2014 "Reconsidering the standard definition for sudden stratospheric warmings", SPARC General Assembly, Queenstown, New Zealand.

2012 "Stratosphere-troposphere coupling in response to an idealized polar cooling", AGU Fall Meeting, San Francisco, CA

2012 "Equal Frequency of stratospheric sudden warmings in El Niño and La Niña", Climate Diagnostics and Prediction Workshop, Fort Collins, CO