

Ariel L. Morrison

Polar Climate Scientist

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Research Interests and Skills

Polar climate change
Cloud feedbacks

Climate intervention strategies
Machine learning in geoscience

STEM education
Python, QGIS, git

Education

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|-------------|------------------------------------------------------------------------------------------------------|
| 2016 – 2019 | PhD, Atmospheric and Oceanic Sciences
University of Colorado Boulder
Boulder, CO, USA |
| 2013 – 2015 | MSc, Atmospheric and Oceanic Sciences
University of Colorado Boulder
Boulder, CO, USA |
| 2006 – 2010 | BA, Earth Sciences (cum laude), Marine Sciences minor
Boston University
Boston, MA, USA |

Academic Positions

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| 2022 – present | Postdoctoral Research Fellow – Climate Intervention
Department of Atmospheric Science
Colorado State University
Fort Collins, CO, USA |
| 2020 – 2022 | Postdoctoral Research Fellow – Polar Climate Dynamics
School of Earth and Ocean Sciences
University of Victoria
Victoria, BC, Canada |
| 2013 – 2019 | PhD Candidate
Department of Atmospheric and Oceanic Sciences
University of Colorado Boulder
Boulder, CO, USA |

Publications

- 2024 | **Morrison, A.L.**, Barnes, E.A., and Hurrell, J.W. Natural variability can mask forced permafrost response to stratospheric aerosol injection in the ARISE-SAI-1.5 simulations. *Earth's Future*, 12(6), e2023EF004191.
- Hueholt, D.M., Barnes, E.A., Hurrell, J.W., and **Morrison, A.L.**. Speed of environmental change frames relative ecological risk in climate change and climate intervention scenarios. *Nature Communications*, 15(3332).
- Morrison, A.L.**, Barnes, E.A., and Hurrell, J.W. Stratospheric aerosol injection to stabilize Northern Hemisphere terrestrial permafrost extent under the ARISE-SAI-1.5 scenario. *Earth's Future*, 12(4): e2023EF004151.
- 2022 | **Morrison, A.L.**, Singh, H.A., and Rasch, P.J. Observations indicate that clouds amplify mechanisms of Southern Ocean heat uptake. *Journal of Geophysical Research: Atmospheres*, 127: e2021JD035487.
- Singh, H.A., Kay, J.E., Feldl, N., and **Morrison, A.L.** Ocean Heat Transport Changes with CO₂ Forcing Impact Global Climate Sensitivity through Lapse Rate and Cloud Feedbacks. *Journal of Climate*, 35(9): 2653–2674.
- 2020 | **Morrison, A.L.**, Rozak, S., Gold, A.U., and Kay, J.E. Quantifying student engagement in learning about climate change using galvanic hand sensors in a controlled educational setting. *Climatic Change*, 159(1): 17-36.
- 2019 | **Morrison, A.L.**, Kay, J.E., Frey, W.R., Chepfer, H., and Guzman, R. Cloud response to Arctic sea ice loss and implications for future feedback in the CESM1 climate model. *Journal of Geophysical Research: Atmospheres*, 124(2): 1003-1020.
- 2018 | Frey, W.R., **Morrison, A.L.**, Kay, J.E., Guzman, R., and Chepfer, H. The combined influences of observed Southern Ocean clouds and sea ice on top-of-atmosphere albedo. *Journal of Geophysical Research: Atmospheres*, 123(9): 4461-4475.
- Morrison, A.L.**, Kay, J.E., Chepfer, H., Guzman, R., and Yettella, V. Isolating the liquid cloud response to recent Arctic sea ice variability using spaceborne lidar observations. *Journal of Geophysical Research: Atmospheres*, 123(1): 427-490.
- 2016 | Kay, J.E., L'Ecuyer, T., Chepfer, H., Loeb, N., **Morrison, A.L.**, and Cesana, G. Recent Advances in Cloud and Climate Research. *Current Climate Change Reports*, 2(4): 159-169.

Kay, J.E., Bourdages, L., Miller, N., **Morrison, A.L.**, Yettella, Y., Chepfer, H., and Eaton, B. Evaluating and improving cloud phase in the Community Atmosphere Model version 5 using spaceborne lidar observations. *Journal of Geophysical Research: Atmospheres*, 121(8): 4162-4176.

- 2011 | Orlosk, J.L., Walker, J.M., **Morrison, A.L.**, and Atema, J. Conditioning the crab *Garcinus maenas* against instinctive light avoidance. *Marine and Freshwater Behaviour and Physiology*, 44(6): 375-381.

In Progress Publications

Morrison, A.L., Pathak, D., Barnes, E.A., and Hurrell, J.W. Projected changes to Arctic commercial shipping routes after stratospheric aerosol injection in the ARISE-SAI scenarios. In revision after review at *Frontiers in Climate Change*.

Awards and Certificates

- 2020 | **Certificate in College Teaching**
Graduate Teaching Program
University of Colorado Boulder
Boulder, CO, USA
- 2019 | **Innovative Research Proposal**
"Assessing the potential of biometric sensors to measure engagement and learning in the classroom"
Cooperative Institute for Research in Environmental Sciences (CIRES)
University of Colorado Boulder
Boulder, CO, USA
- 2018 | **Excellence in Teaching Award**
Atmospheric and Oceanic Sciences Laboratory/Recitation Instructor
University of Colorado Boulder
Boulder, CO, USA
- Outstanding Student Presentation Award (OSPA)**
Cryosphere Section, American Geophysical Union (AGU) Fall Meeting
Washington, D.C., USA
- 2015 | **First Place, 'Aerosols, Clouds, and Precipitation' category**
"Processes controlling seasonal variability of Arctic Ocean liquid cloud profiles"
Earth System & Space Science Poster Conference
University of Colorado Boulder
Boulder, CO, USA

Teaching Experience

2020 – 2021	Guest lecturer EOS365 (undergraduate), "Climate and Society" EOS433 (undergraduate/graduate), "The Climate System" School of Earth and Ocean Sciences, University of Victoria Victoria, BC, Canada
2018 – 2019	Graduate teacher – Recitation Instructor ATOC1060 (undergraduate), "Our Changing Environment" Department of Atmospheric and Oceanic Sciences, University of Colorado Boulder Boulder, CO, USA
2016	Summer Intensive Course instructor "Introduction to Climate Change" Boulder Preparatory High School Boulder, CO, USA
2013 – 2014	Graduate teaching assistant ATOC1060 (undergraduate), "Our Changing Environment" Department of Atmospheric and Oceanic Sciences, University of Colorado Boulder Boulder, CO, USA

Mentoring Experience

2023	Research Experience for Undergraduates (REU) research mentor Atmospheric Sciences Department, Colorado State University Fort Collins, CO, USA
2021 – 2023	Undergraduate Honours Thesis supervisor School of Earth and Ocean Sciences, University of Victoria Victoria, BC, Canada
2022	Undergraduate Student Research Awards co-supervisor Natural Sciences and Engineering Research Council of Canada School of Earth and Ocean Sciences, University of Victoria Victoria, BC, Canada
2021	Research Experience for Undergraduates (REU) writing mentor Department of Atmospheric and Oceanic Sciences, University of Colorado Boulder Boulder, CO, USA
2018	Research Experience for Community College Students (RECCS) research mentor Cooperative Institute for Research in Environmental Sciences (CIRES) University of Colorado Boulder Boulder, CO, USA

Invited Talks

- 2019 | “Arctic cloud and sea ice feedbacks from satellite observations and a global climate model.” Morrison, A.L., Kay, J.E., Frey, W., Chepfer, H., Guzman, R. American Physical Society March Meeting, Boston, MA, USA, March 2019
- 2018 | “Cloud response to Arctic sea ice loss and implications for future feedbacks in the CESM1 climate model.” Morrison, A.L., Kay, J.E., Frey, W., Chepfer, H., Guzman, R. American Geophysical Union Fall Meeting, Washington, D.C., USA, December 2018
- 2016 | “Observing the Cloud Response to Arctic Sea Ice Loss.” Morrison, A.L., Kay, J.E., Chepfer, H., Guzman, R. American Geophysical Union Fall Meeting, San Francisco, CA, USA, December 2016

Selected Conference Talks

- 2023 | "Natural variability masks the forced permafrost response to stratospheric aerosol injection in the ARISE-SAI-1.5 simulations." Morrison, A.L., Barnes, E.A., Hurrell, J.W. American Geophysical Union Fall Meeting, San Francisco, CA, USA, December 2023
- "Stratospheric aerosol injection to stabilize Northern Hemisphere terrestrial permafrost." Morrison, A.L., Barnes, E.A., Hurrell, J.W. Association for the Advancement of Artificial Intelligence (AAAI) Spring Symposium, AI Climate Tipping-Point Discovery, San Francisco, CA, USA, March 2023
- 2021 | "Teleconnections between El Niño events and Southern Ocean heat uptake in CMIP6." Morrison, A.L., Singh, H.A., Rasch, P.J. American Geophysical Union Fall Meeting, New Orleans, LA, USA, December 2021
- "Clouds amplify mechanisms of Southern Ocean heat uptake." Morrison, A.L., Singh, H.A., Rasch, P.J. American Meteorological Society's 16th Conference on Polar Meteorology and Oceanography, June 2021
- 2020 | "Impact of atmospheric processes on mechanisms of Southern Ocean heat uptake." Morrison, A.L., Singh, H.A., Rasch, P.J. American Geophysical Union Fall Meeting, December 2020
- 2019 | "Increasing student engagement by incorporating authentic climate science research in the classroom." Morrison, A.L., Gold, A.U., Kay, J.E. American Geophysical Union Fall Meeting, San Francisco, CA, USA, December 2019
- 2018 | "Evaluating the impact of educational activities on student engagement in climate science using galvanic hand sensors." Morrison, A.L., Gold, A.U., Kay, J.E., Rozak, S. American Geophysical Union Fall Meeting, Washington, D.C., USA, December 2018
- 2017 | "Observing the Cloud Response to Arctic Sea Ice Loss." Morrison, A.L., Kay, J.E., Chepfer, H., Guzman, R. European Geophysical Union General Assembly, Vienna, Austria, April 2017 (abstract noted by session conveners as being of public interest)

- 2015 | "How is Arctic sea ice loss affecting our clouds?" Morrison, A.L., Kay, J.E. Graduate Climate Conference, Woods Hole, MA, USA, November 2015

Selected Conference Posters

- 2023 | "Projected changes to Arctic commercial shipping routes after stratospheric aerosol injection." Morrison, A.L., Pathak, D., Barnes, E.A., Hurrell, J.W. American Geophysical Union Fall Meeting, San Francisco, CA, USA.
- 2021 | "Terrestrial Antarctic heat waves in CMIP6." Morrison, A.L., Oghenechovwen, O.C., Heyblom, K., Singh, H.A. American Geophysical Union Fall Meeting, New Orleans, LA, USA, December 2021
- 2017 | "Cloud response to Arctic sea ice loss and implications for feedbacks in the CESM1 climate model." Morrison, A.L., Kay, J.E., Chepfer, H., Guzman, R., Bonazzola, M. American Geophysical Union Fall Meeting, San Francisco, CA, USA, December 2017
- "Measuring engagement and learning outcomes during a teacher professional development workshop about creative climate communication." Morrison, A.L., Gold, A.U., Soltis, N., McNeal, K.S., Kay, J.E. American Geophysical Union Fall Meeting, San Francisco, CA, USA, December 2017
- 2016 | "Assessing the use of polar bear hooks in learning climate science." Morrison, A.L., Kay, J.E., Gold, A.U., MacFerrin, B., McNeal, K.S. Earth System & Space Science Poster Conference, University of Colorado Boulder, Boulder, CO, USA, December 2016
- 2015 | "Processes controlling seasonal variability of Arctic Ocean liquid cloud profiles." Morrison, A.L., Kay, J.E. Earth System & Space Science Poster Conference, University of Colorado Boulder, Boulder, CO, USA, November 2015

Seminars

- 2021 | "Clouds amplify mechanisms of Southern Ocean heat uptake." Morrison, A.L., Singh, H.A., Rasch, P.J. Regional and Global Model Analysis team meeting, February 2021
- 2020 | "Observed and predicted feedbacks between polar clouds, sea ice, and ocean heat uptake." Morrison, A.L., Kay, J.E., Chepfer, H., Guzman, R., Frey, W., Gold, A.U., Singh, H.A., Rasch, P.J. Earth and Ocean Sciences Fireside Chat seminar series, University of Victoria, Victoria, BC, Canada, October 2020
- 2019 | Invited - "Arctic cloud response to sea ice loss in satellite observations and a global climate model." Morrison, A.L., Kay, J.E., Frey, W., Chepfer, H., Guzman, R. Atmospheric Sciences departmental seminar, University of Utah, Salt Lake City, UT, USA, January 2019
- 2018 | "Arctic cloud - sea ice feedbacks from CALIPSO and CESM." Morrison, A.L., Kay, J.E., Frey, W., Chepfer, H., Guzman, R. Department of Atmospheric and Oceanic Sciences forum, University of Colorado Boulder, Boulder, CO, USA, September 2018

Professional Affiliations

2020 – 2023	Member - American Alliance of Museums
2019 – Present	Member - American Meteorological Society
2019 – 2020	Member - American Physical Society
2017 – 2018	Member - European Geophysical Union
2016 – Present	Member - American Geophysical Union
2016 – 2017	Board member - U.S. Association for Polar Early Career Scientists (USAPECS)

Outreach and Service

2019 – 2024	Prehistoric Journey exhibition volunteer Denver Museum of Nature and Science Denver, CO, USA
2020 - 2023	Outstanding Student Presentation Award (OSPA) judge Atmosphere, Biogeosciences, and Cryosphere Sections American Geophysical Union Fall Meeting
2018	Presenter TEDx Boulder Salon, "The Melting Arctic" theme Boulder, CO, USA

Reviewer - Journal of Climate, Journal of Geophysical Research: Atmospheres, Geophysical Research Letters, Scientific Reports, Journal of Atmospheric and Oceanic Technology, Earth's Future