McKenzie L. Larson

Website: https://mckenzielarson.github.io/
Email: mckenzie.larson@colorado.edu
LinkedIn: mckenzie-larson
GitHub: github.com/mckenzielarson

Interests

Earth system modeling, model development, synoptic and mesoscale meteorology, high performance computing, forecast verification, data assimilation

Education

Ph.D. in Atmospheric and Oceanic Sciences — Boulder, CO
University of Colorado Boulder — August 2022 - Present | Expected May 2027

- Advisor: Dr. Andrew C. Winters
- Research topic: Understanding Extratropical Cyclone Predictability Along the Colorado Front Range

M.S. in Atmospheric and Oceanic Sciences — Boulder, CO
University of Colorado Boulder — 2024

- Advisor: Dr. Andrew C. Winters
- Thesis: *A Climatology of Lee Cyclones Across the Central United States, 1980–2021*

B.A. in Atmospheric and Oceanic Sciences; Physical Geography (Double Major) — Boulder, CO
University of Colorado Boulder — 2022

- Cumulative GPA: 3.982, *with distinction*
- Honors Thesis: *Downslope Wind Verification of the National Blend of Models Across the Northern Front Range of Colorado*, *summa cum laude*
- Dean's List: Fall 2018 - Spring 2022

Research Experience

Graduate Research Assistant in Atmospheric and Oceanic Sciences — Boulder, CO
University of Colorado Boulder (Full-time: 40-hrs/week) — August 2022 - Present
Advisor: Dr. Andrew C. Winters

Project #1: A Climatology of Lee Cyclones Across the Central United States, 1980–2021
Publication: Larson and Winters 2025

- Created an updated climatology of extratropical cyclones that impact Colorado and included information about cyclone seasonal frequency and pressure trends
- Trained a self-organizing maps (SOM) on mean sea-level pressure anomalies from ERA5 to examine the variability in large-scale weather regimes conducive to cyclogenesis along the Colorado Front Range

Project #2: Investigating how Colorado Front Range Downslope Windstorms may Change in a Future Climate

NOAA William M. Lapenta Internship — Boulder, CO
NOAA Global Systems Laboratory (Full-time: 40-hrs/week) — May - August 2024

Project: Evaluation of initial condition blending within MPAS to inform RRFSv2
Advisors: Dr. Jeffrey Beck, Michelle Harrold, & Will Mayfield

- Tested the sensitivity of MPAS-Atmosphere simulations to different initial condition blending weight distributions
- Informed RRFSv2 development by examining the impact of initial condition blending within MPAS

LANL Parallel Computing Summer Research Intern Los Alamos, NM

Los Alamos National Laboratory (LANL) (Full-time: 40-hrs/week) May - August 2024

Project: The Impact of Vertical Coordinates on Ice Shelf Cavity Simulations in MPAS-Ocean

Advisors: Dr. Carolyn B. Begeman & Dr. Mark R. Petersen

- Tested a new vertical coordinate for ice shelf cavities in MPAS-Ocean to reduce numerical mixing that affected cavity circulation and melt rates
- Implemented the new coordinate into MPAS-Ocean Fortran code for future use within a coupled sea ice and ocean E3SM simulation to examine the coordinate's impact on sea ice formation and lifetime

NCAR Student Visitor Boulder, CO

National Center for Atmospheric Research (NCAR) (Full-time: 40-hrs/week) May - August 2022

Project: Present and Future Climate Sensitivity Studies of Downslope Winds in Boulder, Colorado

Advisors: Christine Shields & Dr. Gerald Meehl, NCAR
Dr. Andrew Winters & Dr. Aneesh Subramanian, Univ. of Colorado Boulder

Publication: Meehl et al. 2025

- Expanded upon previous downslope windstorm research (see below) by running WRF simulations to understand what atmospheric conditions are necessary to reproduce the extreme January 1982 downslope windstorms in Boulder, Colorado
- Examined how downslope winds will change in a future climate by forcing WRF simulations with Community Earth System Model (CESM) anomalies

Honors Thesis in Atmospheric and Oceanic Sciences Boulder, CO

University of Colorado Boulder August 2021 - April 2022

Project: Downslope Wind Verification of the National Blend of Models (NBM) Across the Northern Front Range of Colorado

Advisor: Dr. Andrew Winters, University of Colorado Boulder

Publication: Larson et al. 2024

- Expanded upon NOAA Ernest F. Hollings summer internship (see below) by running WRF downslope wind simulations for a specific Chinook event in December 2020
- Prepared for graduate school research by improving scientific writing and presentation skills

NOAA Ernest F. Hollings Internship Boulder, CO

Boulder, Colorado National Weather Service Weather Forecast Office (Full-time: 40-hrs/week) June - August 2021

Project: Downslope Wind Verification of the National Blend of Models (NBM) Across the Northern Front Range of Colorado

Mentor: Paul Schlatter, Science and Operations Officer at Boulder NWS WFO

Publication: Larson et al. 2024

- Quantified and analyzed the multiplicative biases, mean absolute errors (MAE), and timing errors of the wind speeds and gusts for each downslope wind event to provide a better understanding of the NBM magnitude and timing errors
- Cultivated data management and statistical skills to apply to future research projects and coursework

Browne Research Group at the University of Colorado Boulder Boulder, CO

Independent Study (Part-time: 12-hrs/week) August 2019 - May 2022

Project: Quantification of Atmospheric Gases Emitted During Dew Evaporation

Advisor: Dr. Eleanor Browne, University of Colorado Boulder and CIRES

- Built a chamber for use with the Time-of-Flight Chemical Ionization Mass Spectrometer (CIMS) to better understand dew evaporation chemistry
- Gained experience working with analytical instruments (CIMS and Ion Chromatography System) and analyzing data from experiments

Summer Research Project (Part-time: 12-hrs/week) April - August 2020

Project: Investigating Wintertime Sources of Organic Aerosols in Cape Cod, MA
Advisor: Dr. Eleanor Browne, University of Colorado Boulder and CIRES

- Learned various data analysis techniques, such as Positive Matrix Factorization (PMF), source apportionment, and NOAA HYSPLIT back trajectories, to identify aerosol sources from Aerosol Mass Spectrometer (AMS) measurements
- Learned how to effectively and efficiently conduct independent research virtually

Publications

Larson, M. L., and A. C. Winters: A climatology of lee cyclones across the central United States, 1980–2021. *Mon. Wea. Rev.* [**PDF**]

Meehl, G. A., C. A. Shields, B. M. Myers, **M. L. Larson**, D. Durran, M. Pasha, A. Morales, A. Subramanian, A. C. Winters, P. Schlatter, and M. Weisman:Earth, wind and fire: Are Boulder's extreme downslope winds changing? [**PDF**]

Larson, M. L., A. C. Winters, and P. T. Schlatter 2024: Downslope Wind Verification of the National Blend of Models v4.0 Across the Northern Front Range of Colorado During the 2020/2021 Cool Season. *Journal of Operational Meteorology*, [**PDF**]

Conference Poster and Oral Presentations

Larson, M. L., J. Beck, M. Harrold, W. Mayfield, C. Schwartz, A. Johnson, and V. Vargas (2025), Evaluation of initial condition blending within MPAS to inform RRFSv2, Abstract [Student 3] presented at Unifying Innovations in Forecasting Capabilities Workshop, Boulder, CO, 8-12 Sept. **(Oral)**

Larson, M. L., J. Beck, M. Harrold, W. Mayfield, C. Schwartz, A. Johnson, and V. Vargas (2025), Evaluation of initial condition blending within MPAS to inform RRFSv2, Abstract [84] presented at 2025 Annual Program Review, DOE CSGF, Washington D.C., 13-17 Jul. **(Poster)**

Larson, M. L. and A. C. Winters (2025), Identifying Flavors of Lee Cyclogenesis over the Central U.S. Using Self-Organizing Maps, Abstract [454858] presented at 2025 Annual Meeting, AMS, New Orleans, LA, 12-16 Jan. **(Oral)**

Larson, M. L. and A. C. Winters (2024), An Updated Climatology of Lee Cyclones Across the Central United States, Abstract [14D] presented at 20th Cyclone Workshop, St. Sauveur, Quebec, Canada, 20-25 Oct. **(Oral)**

Larson, M. L., C. B. Begeman, and M. R. Petersen (2024), The Impact of Vertical Coordinates on Ice Shelf Cavity Simulations in MPAS-Ocean, Abstract [43] presented at 2024 Annual Program Review, DOE CSGF, Washington D.C., 14-18 Jul. **(Poster)**

Larson, M. L. and A. C. Winters (2024), An Updated Climatology of Extratropical Cyclones Across the Central United States, Abstract [435100] presented at 2024 Annual Meeting, AMS, Baltimore, MD, 28 Jan -1 Feb. **(Oral)**

Larson, M. L. and A. C. Winters (2023), An Updated Climatology of Extratropical Cyclones Across the Central United States, Abstract [20] presented at 2023 Annual Program Review, DOE CSGF, Washington D.C., 16-20 Jul. **(Poster)**

Larson, M., Shields, C. A., Meehl, G., Winters, A. C., Myers, B., Morales, A., Subramanian, A. (2023), Present and Future Climate Sensitivity Studies of Downslope Winds in Boulder, Colorado, Abstract [273444] presented at 2023 Annual Meeting, AMS, Denver, CO 8-12 Jan. **(Oral)**

Larson, M., Shields, C. A., Meehl, G., Winters, A. C., Myers, B., Morales, A., Subramanian, A. (2022), Present and Future Climate Sensitivity Studies of Downslope Winds in Boulder, Colorado, Abstract [A55P-1332] presented at 2022 Fall Meeting, AGU, Chicago, IL 12-16 Dec. **(Poster)**

Larson, M., Schlatter, P. T. (2021), Downslope Wind Verification of the National Blend of Models Across the Northern Front Range of Colorado, Abstract [390508] presented at 2022 Annual Meeting - Annual Student Conference, AMS, Houston, TX 22-23 Jan. **(Poster)**

Larson, M., Schlatter, P. T. (2021), Downslope Wind Verification of the National Blend of Models Across the Northern Front Range of Colorado, Abstract [A41E-07] presented at 2021 Fall Meeting, AGU, New Orleans, LA 13-17 Dec. **(Oral)**

Larson, M., Schlatter, P. T. (2021), Downslope Wind Verification of the National Blend of Models Across the Northern Front Range of Colorado, Abstract [B3] presented at 2021 Annual Earth System and Space Science Poster Conference, University of Colorado Boulder, Boulder, CO 3 Dec. **(Poster)**

Larson, M., Schlatter, P. T. (2021), Downslope Wind Verification of the National Blend of Models Across the Northern Front Range of Colorado, Abstract [TMAW-4] presented at 2021 Midwest Student Conference on Atmospheric Research (MSCAR), University of Illinois at Urbana-Champaign, 25 Sept. **(Oral)**

Larson, M., Browne, E. C. (2021), Investigating Wintertime Sources of Organic Aerosols in Cape Cod, Abstract [EC-10] presented at 2021 Rendezvous, CIRES, 21 May. **(Poster)**

Larson, M., Browne, E. C. (2020), Investigating Wintertime Sources of Organic Aerosols in Cape Cod, [A036-0009] presented at 2020 Fall Meeting, AGU, 1-17 Dec. **(Poster)**

Fellowships, Awards, and Research Grants

1st Place Student Oral Presentation Award 2025

Weather Analysis and Forecasting Conference, 2025 AMS Annual Meeting

- Student presentation award for oral presentation entitled "Identifying Flavors of Lee Cyclogenesis over the Central U.S. Using Self-Organizing Maps" after feedback and review from a panel of judges

Woman Who Makes a Difference Award 2024

CU Boulder

- The Women Who Make a Difference program has honors those who are impacting our CU Boulder community
- Nominations are accepted from the campus community to honor those who identify as women and awards are presented at a celebration for the nominees and their nominators

Service Award 2024

Department of Atmospheric and Oceanic Sciences, CU Boulder

- "For creating new types of departmental events that appeal to a wider audience and creating a stronger ATOC community."

Department of Energy Computational Science Graduate Fellowship (DOE CSGF) 2022

- Four year fellowship including additional computer science, high-performance computing, math, and statistic courses and a practicum at a DOE facility during the fellowship period

National Science Foundation Graduate Research Fellowship (NSF GRF) (Declined) 2022

- Five year fellowship with three years of financial support that recognizes outstanding students in STEM fields
- Declined this fellowship to accept the DOE CSGF

American Meteorological Society (AMS) Graduate Fellowship 2022

- One year fellowship that recognizes outstanding students who are pursing graduate degrees in atmospheric science or related fields and provides support to attend the 2023 AMS Annual Meeting

CU Boulder Graduate Recruitment Diversity Fellowship 2022

- Nominated by the Department of Atmospheric and Oceanic Sciences as a diverse applicant to CU Boulder and to the department's doctoral program

College of Arts & Sciences Honors Scholar 2022

- Completed 3 Honors courses, attended at least 2 Honors events per semester, and completed 5 hours of community service per semester
- Selected as the Featured Honors Scholar to speak at the 2022 Honors Scholars Reception

NOAA Ernest F. Hollings Undergraduate Scholar 2020

- Summer 2021 Internship Project with the Boulder, Colorado National Weather Service Weather Forecast Office (NWS WFO)

Undergraduate Research Opportunities Program (UROP) Grants 2020 - 2022

Advisor: Dr. Eleanor Browne

- Project 1: Investigating Wintertime Sources of Organic Aerosols in Cape Cod, Massachusetts
- Project 2: Quantification of Atmospheric Gases Emitted During Dew Evaporation

University of Colorado Boulder Presidential Scholarship 2018

- Awarded to the top 1-3% of the admitted nonresident class at CU Boulder

Leadership Experience

Social Committee Student Lead Boulder, CO

University of Colorado Dept. of Atmospheric and Oceanic Sciences (Part-time: 4-hrs/week) August 2023 - Present

- Member of the ATOC Social Committee since August 2022
- Host social events (i.e., community hours, coffee hours, tournaments, etc.) to encourage community building
- Delegate tasks to other committee members and manage the logistical aspects of social events

Co-Chair Boulder, CO

CU Arts and Sciences Honors Program Student Advisory Board (Part-time: 4-hrs/week) February 2020 - May 2022

- Technology Liaison from February 2020 to January 2021; Co-chair from January 2021 to present
- Ran weekly board meetings to discuss potential Honors Program events, enrollment, logistics, the blog, social media, and outreach
- Managed the program email and spoke with the Co-Chair and Faculty Advisor frequently throughout the week

Piccolo Section Leader Boulder, CO

University of Colorado Golden Buffalo Marching Band (Part-time: 10-hrs/week) August 2018 - May 2022

- Piccolo Squad Leader from April 2019 to April 2020; Piccolo Section Leader from April 2020 to present
- Ensured the facilitation of efficient and focused marching band rehearsals three times a week
- Provided feedback on marching technique and music, recorded attendance, and reminded members of meetings and deadlines

Mentorship and Teaching Experience

Research Mentor Boulder, CO

Browne Research Group (Part-time: 6-hrs/week) September 2021 - May 2022

- Mentored a new undergraduate researcher to use Ion Chromatography to measure amine concentrations in the air to improve our knowledge of Boulder's air quality
- Provided me with the opportunity to teach proper analytical instrumentation techniques and explain how to formulate scientific questions and experiments

Laboratory Assistant Boulder, CO

Statistics and Geographic Data Course (Part-time: 3-hrs/week) January - May 2021

- Assisted students and answered questions about using R for statistical analysis during lab period
- Prepared for the weekly lab period by reviewing statistical concepts and running through R commands

Eighth Grade Capstone Project Mentor Denver, CO
Denver Language School (Part-time: 8-hrs every year) Spring 2020 - Present

- Mentored students who chose topics on atmospheric or environmental sciences (such as coral reef deterioration and ocean pollution)
- Attended Mentor Days in Denver or online to discuss project progress

Work Experience

Senior Science Adventure Camp Counselor Plantation, FL
American Heritage Summer Camp June - July 2018 and 2019

- Taught children (ages 5-13) the basic concepts of earth science, physics, and chemistry
- Managed daily activities and field trips to educational parks and the ocean

Skills

- **Programming Languages:** Python, C++, Fortran, R, MATLAB
- **Operating Systems:** Linux, Unix
- **Programs:** OpenMP, Message Passing Interface (MPI), METplus
- **Software:** ArcGIS, Anaconda, Jupyter Notebook, Ubuntu, Spyder, R Studio, Igor Pro, Microsoft Office Suite, Google Suite, Panoply, Overleaf
- **Models:**
  - **WRF:** Weather Research and Forecasting Model
  - **WRF-DART:** WRF-Data Assimilation Testbed
  - **MPAS-Atmosphere:** Model for Prediction Across Scales-Atmosphere
  - **MPAS-Ocean:** Model for Prediction Across Scales-Ocean
  - **COMPASS:** Configuration Of Model for Prediction Across Scales Setups
  - **E3SM:** Energy Exascale Earth System Model
  - **CESM:** Community Earth System Model
  - **HYSPLIT:** NOAA Hybrid Single-Particle Lagrangian Integrated Trajectory Model
- **Supercomputers:** NOAA's Hera and Ursa, LANL's Perlmutter, NCAR's Derecho and Cheyenne, CU Boulder's Alpine and Summit
- **Forecasting Experience:** Participant in WxChallenge Collegiate Forecasting Competition (January 2021 - Present), 2022 NOAA Hazardous Weather Testbed Spring Forecasting Experiment (HWT SFE), 2023 AMS Annual Meeting Student Weather Briefing

Relevant Coursework

Graduate:

- **Atmospheric Science:** Atmospheric Thermodynamics and Dynamics, Synoptic Meteorology, Dynamics of the Atmosphere and Oceans, Radiative Transfer and Remote Sensing, Physics and Chemistry of Clouds and Aerosols
- **Oceanography:** Introduction to Physical Oceanography
- **Computer Science:** High Performance Scientific Computing, Neural Networks and Deep Learning, Data Mining
- **Applied Mathematics:** Data Assimilation in Higher Dimensions
- **Statistics:** Statistical Methods and Application I

Undergraduate:

- **Mathematics:** Calculus 1-3, Introduction to Differential Equations with Linear Algebra
- **Physics:** Physics 1-2 with laboratory
- **Statistics:** Statistics and Geographic Data
- **Oceanography:** Introduction to Oceanography, Physical Oceanography and Climate
- **Atmospheric Science:** Atmospheric Dynamics, Atmospheric Physics, Principles of Weather, Principles of Climate, Weather Modeling Laboratory, Climate Modeling Laboratory, Scientific Programming and Data Laboratory, Physical Oceanography and Climate, Weather Analysis and Forecasting

Interviews

CU Boulder Today 2025
Boulder, CO

- *CUriosity: What makes Colorado so windy—and will it stay that way?*, D. Strain [LINK]

CU Boulder Today 2022
Boulder, CO

- *It's been unusually windy this spring. Here's why you should care*, K. Simpkins [LINK]