

# McKenzie L. Larson

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## INTERESTS

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

## EDUCATION

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**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

**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

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**Graduate Research Assistant in Atmospheric and Oceanic Sciences** Boulder, CO  
University of Colorado Boulder (Full-time: 40-hrs/week) August 2022 - Present

**Project: An Updated Climatology of Extratropical Cyclones Across the Central U.S.**  
**Advisor: Dr. Andrew C. Winters**

- Creating an updated climatology of extratropical cyclones that impact Colorado and including information about cyclone seasonal frequency and pressure trends
- Training Self-Organizing Maps (SOMs) 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

**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**

- 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**

- 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
- Submitted thesis for a first-authored publication in 2023

## **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**

- 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

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- Larson, M. L.** and A. C. Winters 2024: An Updated Climatology of Lee Cyclones Across the Central United States, [**in prep**]
- 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 hurricane-force downslope winds changing? *Bull. Amer. Meteor. Soc.*, [**in revision**]
- 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

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- 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

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- 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 pursuing 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

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- 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**

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**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**

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**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**

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- **Programming Languages:** Python, C++, Fortran, R, MATLAB
- **Operating Systems:** Linux
- **Programs:** OpenMP, Message Passing Interface (MPI)
- **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-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:** 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

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### 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
- **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