

Troy Zaremba | Curriculum Vitae

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Education

University of Illinois Urbana-Champaign

Urbana, IL

Ph.D. in Atmospheric Sciences

2023

- Committee: Dr. Robert M. Rauber (Primary Advisor), Dr. Stephen Nesbitt, Dr. Robert Trapp, and Dr. Greg McFarquhar
- Dissertation: Vertical motions in orographic clouds over the Payette River Basin and their impact on cloud liquid water content: results from SNOWIE
- Graduate Minor in College Teaching, Mentoring Certificate

University of Illinois Urbana-Champaign

Urbana, IL

M.S. in Atmospheric Sciences

2020

- Advisor: Dr. Robert M. Rauber
- Thesis: Cloud top phase characterization of cold sector Southern Ocean clouds and ice production at warm cloud top temperatures: results from the SOCRATES field campaign

University of Illinois Urbana-Champaign

Urbana, IL

B.S. in Atmospheric Sciences

2018

- Minor: Minor in Geography and GIS
- Graduated with high distinction

Research Experience

University of Washington

Seattle, WA

Postdoctoral Scholar

September 2024 - Present

Advisors: Dr. Lynn McMurdie, Dr. Peter Blossey

Current Research Projects:

- Ran a seasonal WRF simulation to provide a community dataset for the S²noCLIME project to characterize snowfall across the Park Range.
- Developing methods to detect and analyze shear layers using perturbations in radial velocity from ground-based radar observations.
- Investigating precipitation onset processes, demonstrating evidence for top-down precipitation development in inland orographic clouds.
- Examining large-scale synoptic patterns associated with precipitation events to connect storm-scale microphysics to broader atmospheric forcing.

- Used conically scanning radar observations from IMPACTS to show the 3D structure of cloud top generating cells precipitating to the surface.

National Center for Atmospheric Research

Boulder, CO

Postdoctoral Visitor

August 2024

Advisor: Dr. Sarah Tessendorf

- Contributed to NSF FROSTIE proposal on evaluating ground-based cloud seeding impacts.
- Wrote draft of SNOWIE review paper
- Investigated microphysical responses of cloud-top generating cells and terrain-induced vertical motions.

University at Albany

Albany, NY

Postdoctoral Scholar

July 2023-July 2024

Advisor: Dr. Justin Minder

- Analyzed perturbations within the melting layer and published on small-scale wind fluctuations driven by shear, convection, and gravity waves.
- Analyzed WRF-LES runs to study precipitation-type transitions and small-scale wind fluctuations during WINTRE-MIX.
- Examined Doppler spectra data to examine vertical microphysical variability.
- Used cloud radar observations from IMPACTS to study reflectivity and vertical velocity variability in extratropical cyclones.

University of Illinois Urbana-Champaign

Champaign, IL

Graduate Research Assistant

August 2018 – July 2023

Advisor/Supervisor: Dr. Robert M. Rauber

Master's Research (SOCRATES):

- Analyzed Southern Ocean cloud microphysics using radar, lidar, and satellite data.
- Developed a classification scheme for cold-sector cloud-top phase, showed the importance of ice-phase at temperatures above -5°C
- Contributed to an atmospheric river case study examining moisture and microphysics.

Ph.D. Research (SNOWIE & IMPACTS):

- Developed four-part series of papers on vertical motions to assess microphysical processes over complex terrain.
- Demonstrated limitations of cloud seeding detection using radar remote sensing.
- Examined microphysics and cloud structure in extratropical cyclone comma heads (IMPACTS), including differences between stratiform and convective regions.
- Built a classification scheme to quantify extratropical cyclone cloud-phase distributions over the Midwest and Northeast U.S.

Field Experience

North American Upstream Feature-Resolving and Tropopause Uncertainty Reconnaissance Experiment

Goose Bay, NL
Winter 2026

NURTURE

- Goal was to sample tropopause polar vortices that cause downstream high impact weather events
- Led design, execution, and organization of daily forecast briefings
- Helped forecast TPV locations for aircraft flight operations in the field, helped design project dry runs

Snow Sensitivity to Clouds in a Mountain Environment

Steamboat Springs, CO

S²noCLiME

Winter 2025

- Goal was to sample wintertime orographic cloud cover impacting the Park Range near Storm Peak Laboratory
- Led design, execution, and organization of daily forecast briefings
- Launched radiosondes in support of operations and operated cloud probes at SPL

National Eclipse Ballooning Project

Albuquerque, NM; Watertown, NY

NEBP

Fall 2023, Spring 2024

- Goal was to sample boundary layer evolution and potential stratospheric gravity waves generated by environmental variations as a result of annular and total eclipses
- Led a team of six undergraduates in launching rawinsondes before, during, and after eclipses
- Launched 70 rawinsondes and operated a weather station

Boundary-Layer Evolution and Structure of Tornadoes

Great Plains, USA

BEST

Spring 2023

- Goal was to sample supercellular tornadoes
- Drove and operated a Doppler on Wheels radar during intensive operation periods sampling three tornadoes

Propagation, Evolution, and Rotation in Linear Storms

Southeast, USA

PERiLS

Spring 2022, 2023

- Goal was to sample tornadic quasi-linear convective systems in Mississippi River Valley
- Drove and operated a Doppler on Wheels radar during intensive operation periods
- Launched rawinsondes and helped with deployment of wind profiler

Investigation of Microphysics and Precipitation for Atlantic Coast-Threatening Storms

Northeast, USA

Winter 2020, 2022, 2023

IMPACTS

- Goal was to sample mesoscale snow bands
- Coordinated over 100 rawinsonde launches throughout the Northeast United States that were used by mission scientists in real time for decision support

Doppler on Wheels Radar Deployments

Champaign, IL

Fall 2022

- Collected data in the field with undergraduate and graduate students as part of the course ATMS 410: Radar remote Sensing
- Successfully completed 10 intensive operation periods
- Mentored students on how to develop Python code to analyze radar data collected

Seeded and Natural Orographic Wintertime Clouds: the Idaho Experiment

Boise, ID

Winter 2017

SNOWIE

- Goal was to sample orographic cloud cover and prove the efficacy of wintertime orographic cloud seeding
- Coordinated rawinsonde launches during intensive operation periods

Teaching Experience

University of Illinois Urbana-Champaign

Champaign, IL

Department of Atmospheric Sciences

Fall 2016– Summer 2022

- **ATMS 324: Field Studies of Convection (Summer 2022)**
Assisted students in recognizing structural features of severe convective storms, mesoscale convective systems, and supercells through extensive field observations (over 5000 miles of travel). Led daily forecast briefings and group discussions.
- **ATMS 410: Radar Remote Sensing (Fall 2021)**
Designed in-class assignments and interactive lectures in a flipped classroom format, teaching students Python-based methods for airborne and ground-based radar analysis. Guided field data collection with Doppler on Wheels radar and supervised project work.
- **ATMS 313: Synoptic Weather Forecasting (Spring 2019)**
Supported student learning through weekly office hours and grading. Helped students interpret synoptic-scale weather maps and compose forecast discussions.
- **ATMS 100: Introduction to Meteorology (Fall 2018)**
Delivered lectures to weekly lab sections (~20 students each) for non-majors. Provided one-on-one assistance in office hours and evaluated assignments.
- **ATMS 120: Severe and Hazardous Weather (Fall 2016 – Spring 2018)**
Coordinated coursework and grading for a large lecture course (>500 students). Supervised a team of undergraduate TAs and facilitated both in-person and online components.

Grants and Proposals

Current Support

- *I am currently supported as a Postdoctoral Researcher on the NSF-funded S²noCLiME project with funding through August 2026.*

Pending Proposals

- **PREFIRE Science and Applications Team**

Status: Part 1 of 2 Submitted; pending review.

(NASA ROSES, in preparation for submission Fall 2025) – *Co-Investigator*
In collaboration with L. McMurdie (UW), I am co-leading a proposal to analyze tropopause polar vortices using PREFIRE satellite data. The goal is to show that TPVs are detectable in the far infrared and quantify far infrared characteristics throughout their evolution.

Declined Proposals

- **FROSTIE: Fundamental Research on cloud Seeding – The Idaho Experiment**

(NSF, submitted Spring 2025) – *Co-Investigator* – (led proposal preparation but was unable to serve as PI due to postdoc role; Project PI: K. Friedrich, CU Boulder, UW PI: Lynn McMurdie).

Amount Requested: \$800,001

Status: Declined

I co-developed the scientific framework and analysis plan for this multi-institution field campaign proposal, which aimed to evaluate the impacts of ground-based orographic cloud seeding using coordinated aircraft and radar observations. The project's goal was to provide a rigorous assessment of seeding efficacy and to determine how natural cloud properties vary with upstream aerosol conditions.

Publications

1. Zaremba, T. J., R. M. Rauber, L. A. McMurdie, G. M. McFarquhar, J. Yorks, C. N. Helms, and G. M. Heymsfield, 2025: 3D Structure of a shallow generating cell driven snowstorm over the Midwest and its microphysical characteristics determined using particle aspect ratio: results from IMPACTS, *J. Atmos. Sci.*, *in press*, <https://doi.org/10.1175/JAS-D-25-0029.1>
2. Afrifa, F., B. Geerts, L. Xue, S. Chen, C. Hohman, C. Grasmick, J. French, K. Friedrich, R. M. Rauber, S. A. Tessendorf, and T. J. Zaremba, 2025: A case study of cold-season emergent orographic convection and its impact on precipitation. Part 1: Mesoscale analysis, *Mon. Wea. Rev.*, *in press*, <https://doi.org/10.1175/MWR-D-24-0241.1>
3. Zaremba, T. J., and R. M. Rauber, 2025: The Use of Vertical Gradients of Radar Reflectivity Factor and Radial Velocity to Diagnose Dynamical and Microphysical Structures in Extratropical Cyclones: results from IMPACTS, *J. Atmos. Oceanic Technol.*, 42 (2), 187-206, <https://doi.org/10.1175/JTECH-D-24-0016.1>

4. Zhang, S., T. J. Zaremba, R. M. Rauber, M. M. Varcie, M. Kumjian, S. Graybush, G. M. McFarquhar, and L. A. McMurdie, 2025: Mesoscale and Microphysical Characteristics of Elevated Convection and Banded Precipitation over an Arctic Cold Front: results from IMPACTS, *J. Atmos. Sci.*, 82 (6), 1113-1135, <https://doi.org/10.1175/JAS-D-24-0177.1>
5. Zaremba, T. J., J. R. Minder, and K. Friedrich, 2025: Small scale wind fluctuations within the melting layer of winter storms: results from WINTRE-MIX, *J. Atmos. Sci.*, 82 (3), 457-482, <https://doi.org/10.1175/JAS-D-24-0087.1>
6. Janiszkeski, A., R. M. Rauber, B. F. Jewett, T. J. Zaremba, 2024: Re-organization of snowfall beneath cloud-top within the comma head of two extreme U.S. East Coast winter cyclones, *Wea. Forecasting*, 39 (8), 1181-1202, <https://doi.org/10.1175/WAF-D-23-0184.1>
7. Zaremba, T. J., R. M. Rauber, K. Heimes, J. E. Yorks, J. A. Finlon, S. D. Nicholls, P. Selmer, L. A. McMurdie, and G. M. McFarquhar, 2024: Cloud top phase characterization of extratropical cyclones over the Northeast and Midwest United States: results from IMPACTS, *J. Atmos. Sci.*, 81 (2), 341-361, <https://doi.org/10.1175/JAS-D-23-0123.1>
8. Zaremba, T. J., R. M. Rauber, L. Di Girolamo, J. R. Loveridge, and G. M. McFarquhar, 2024: On the radar detection of cloud seeding effects in wintertime orographic cloud systems, *J. Appl. Meteor. Climatol.*, 63 (1), 27-45, <https://doi.org/10.1175/JAMC-D-22-0154.1>
9. Janiszkeski, A., R. M. Rauber, B. F. Jewett, G. M. McFarquhar, T. J. Zaremba, J. E. Yorks, 2023: A Kinematic Modeling Study of the Re-Organization of Snowfall between Cloud-top Generating Cells and low-level Snow Bands in Midlatitude Winter Storms, *J. Appl. Meteor. Climatol.*, 80 (11), 2729-2745, <https://doi.org/10.1175/JAS-D-23-0024.1>
10. Zaremba, T. J., R. M. Rauber, B. Geerts, J. French, S. A. Tessendorf, L. Xue, K. Friedrich, C. Weeks, R. M. Rasmussen, M. L. Kunken, and D. R. Blestrud, 2023: Vertical Motions in Orographic Cloud Systems over the Payette River Basin. Part 4: Controls on Supercooled Liquid Water Content and Cloud Droplet Number Concentration, *J. Appl. Meteor. Climatol.*, 62 (10), 1389-1413, <https://doi.org/10.1175/JAMC-D-23-0080.1>
11. Rea, D., R. M. Rauber, H. Hu, S. A. Tessendorf, S. W. Nesbitt, B. Jewett, and T. J. Zaremba, 2023: The Contribution of Subtropical Moisture Within an Atmospheric River on Moisture Flux, Cloud Structure, and Precipitation over the Salmon River Mountains of Idaho using Moisture Tracers, *JGR: Atmospheres*, 128 (6), <https://doi.org/10.1029/2022JD037727>
12. Geerts, B., C. Grasmick, R. M. Rauber, T. J. Zaremba, L. Xue, and K. Friedrich, 2023: Vertical motions forced by mesoscale terrain and cloud microphysical response in extratropical precipitation systems, *J. Atmos. Sci.*, 80 (3), 649-669, <https://doi.org/10.1175/JAS-D-22-0161.1>
13. Varcie, M. M., T. J. Zaremba, R. M. Rauber, G. M. McFarquhar, J. A. Finlon, L. A. McMurdie, A. Ryzhkov, F. Waitz, M. Schnaiter, E. Järvinen, D. J. Delene, M. R. Poellet, M. McLinden, and A. Janiszkeski, 2023: Precipitation Growth Processes in the Comma Head Region of the 7 February 2020 Northeast Snowstorm: results from IMPACTS, *J. Atmos. Sci.*, 80 (1), 3-29, <https://doi.org/10.1175/JAS-D-22-0118.1>

14. Zaremba, T. J., R. M. Rauber, S. Haimov, B. Geerts, J. R. French, C. Grasmick, K. Heimes, S. A. Tessendorf, K. Friedrich, L. Xue, R. M. Rasmussen, M. L. Kunkel, and D. R. Blestrud, 2022: Vertical Motions in Orographic Cloud Systems over the Payette River Basin. Part 1: Recovery of Vertical Motions and their Uncertainty from Airborne Doppler Radial Velocity Measurements, *J. Appl. Meteor. Climatol.*, 61 (4), 1713-1731, <https://doi.org/10.1175/JAMC-D-21-0228.1>
15. Zaremba, T. J., K. Heimes, R. M. Rauber, B. Geerts, J. R. French, C. Grasmick, S. A. Tessendorf, L. Xue, K. Friedrich, R. M. Rasmussen, M. L. Kunkel, and D. R. Blestrud, 2022: Vertical Motions in Orographic Cloud Systems over the Payette River Basin. Part 2: Fixed and Transient Updrafts and their Relationship to Forcing, *J. Appl. Meteor. Climatol.*, 61 (4), 1733-1751, <https://doi.org/10.1175/JAMC-D-21-0229.1>
16. Heimes, K., T. J. Zaremba, R. M. Rauber, S. A. Tessendorf, L. Xue., K. Ikeda, B. Geerts, J. R. French, K. Friedrich, R. M. Rasmussen, M. L. Kunkel, and D. R. Blestrud, 2022: Vertical Motions in Orographic Cloud Systems over the Payette River Basin, Part 3: Evaluation of the Impact of Transient Vertical Motions on Targeting During Orographic Cloud Seeding Operations, *J. Appl. Meteor. Climatol.*, 61 (4), 1753-1777, <https://doi.org/10.1175/JAMC-D-21-0230.1>
17. Xue, L., C. Weeks, S. Chen, S. A. Tessendorf, R. M. Rasmussen, K. Ikeda, B. Kosovic, D. Behringer, J. R. French, K. Friedrich, T. J. Zaremba, R. M. Rauber, C. P. Lackner, B. Geerts, D. Blestrud, M. Kunkel, N. Dawson, and S. Parkinson, 2022: Comparison between observed and Simulated AgI seeding impacts in a well observed case from the SNOWIE field program, *J. Appl. Meteor. Climatol.*, 61 (4), 345-367, <https://doi.org/10.1175/JAMC-D-21-0103.1>
18. Zaremba, T. J., R. M. Rauber, G. M. McFarquhar, P. J. Demott, J. J. D'Alessandro, and W. Wu, 2021: Ice in Southern Ocean Clouds with Cloud Top Temperatures Exceeding -5°C , *JGR: Atmospheres*, 126 (14), <https://doi.org/10.1029/2021JD034574>
19. Zaremba, T. J., R. M. Rauber, G. M. McFarquhar, M. Hayman, J. A. Finlon, and D. M. Stechman, 2020: Phase Characterization of Cold Sector Southern Ocean Cloud Tops: Results from SOCRATES. *JGR: Atmospheres*, 125 (24), <https://doi.org/10.1029/2020JD033673>
20. Finlon, J. A., R. M. Rauber, W. Wu, T. J. Zaremba, G. M. McFarquhar, S. W. Nesbitt, M. Schnaiter, E. Järvinen, F. Waitz, T. C. J. Hill, and P. J. DeMott, 2020: Structure of an Atmospheric River Over Australia and the Southern Ocean: Part II. Microphysical Evolution, *JGR: Atmospheres*, 125 (18). <https://doi.org/10.1029/2020JD032514>
21. Rauber, R. M., H. Hu, F. Dominguez, S. W. Nesbitt, G. M. McFarquhar, T. J. Zaremba, and J. A. Finlon, 2020: Structure of an Atmospheric River Over Australia and the Southern Ocean. Part I: Tropical and Midlatitude Water Vapor Fluxes, *JGR: Atmospheres*, 125 (18), <https://doi.org/10.1029/2020JD032513>

Submitted Manuscripts

1. Valdivia-Padro, J., K. Friedrich, T. J. Zaremba, and S. A. Tessendorf, 2025: Temporal evolution of cloud top generating cells: a case study, *submitted to J. Atmos. Sci.*

2. Afrifa, F., B. Geerts, L. Xue, S. Chen, C. Hohman, C. Grasmick, K. Friedrich, J. French, S. Tessendorf, T. J. Zaremba, and R. M. Rauber, 2025: A case study of cold season emergent orographic convection and its impact on precipitation. Part 2: High-resolution LES Analysis of Convective Cell Evolution and Precipitation Processes, *submitted to Mon. Wea. Rev.*
3. Yorks, J. E., M. A. Miller, T. J. Lang, J. A. Finlon, I. S. Adams, B. A. Colle, S. J. Greybush, A. J. Heymsfield, G. M. Heymsfield, R. Kroodsma, S. LeBlanc, M. Walker McLinden, G. M. McFarquhar, R. M. Rauber, S. E. Yuter, T. J. Zaremba, and L. McMurdie, 2025: Sampling strategies to optimize coincident remote sensing and in situ cloud and precipitation observations from multiple aircraft, *submitted to BAMS*
4. Zaremba, T. J., L. A. McMurdie, P. N. Blossey, R. M. Rauber, L. Xue, B. Geerts, K. Friedrich, S. A. Tessendorf, J. French, S. Chen, and F. Afrifa, 2025: Dominant Modes of Terrain Tied Vertical Motion Variability: results from SNOWIE, *submitted to J. Appl. Meteor. Clim.*
5. Hall, A., R. M. Rauber, and T. J. Zaremba, 2025: Diurnal Variations of Wintertime Precipitation rates across the Northeastern United States, *submitted to GRL*

Other Scholarly Work

1. Rauber, R. M, and T. J. Zaremba, 2024: Intentional Weather Modification, *Encyclopedia of Atmospheric Sciences*, Academic Press, 3rd edition, <https://doi.org/10.1016/B978-0-323-96026-7.00100-4>
2. Rauber, R. M, and T. J. Zaremba, 2024: Cloud and Precipitation Bands, *Encyclopedia of Atmospheric Sciences*, Academic Press, 3rd edition, <https://doi.org/10.1016/B978-0-323-96026-7.00082-5>
3. Rauber, R. M., J. Walsh, D. Charlevoix, and T. J. Zaremba, 2025: Severe and Hazardous Weather, Kendall Hunt, 7th edition, *in prep for publication Spring 2026*

Invited Presentations

1. Zaremba, T. J., Aviation Hazards in Winter Storms: New insights into Supercooled Water and Turbulence from Field Campaigns and High-Resolution Modeling, University of Oklahoma, Norman, Oklahoma, 24 Apr 2025.
2. Zaremba, T. J., From Cloud Top to Ground: Insights into Snowfall Processes from IMPACTS, University of Washington, Seattle, Washington, 5 Dec 2024.
3. Zaremba, T. J., 3D Structure of shallow generating cells and their impact on cloud microphysical processes: results from IMPACTS, HAPpy Hour, NCAR, Boulder, Colorado, 23 Aug 2024.
4. Zaremba, T. J., Cloud Top Phase Characteristics and Precipitation Growth Processes in Extratropical Cyclones: results from IMPACTS, University of Wyoming, Laramie, Wyoming, 2 April 2024.
5. Zaremba, T. J., Vertical Motions in Orographic Cloud Systems over the Payette River Basin and their impact on Cloud Liquid Water Content: results from SNOWIE, Albany, New York, 10 July 2023.

- Zaremba, T. J.: Precipitation Growth Processes in Winter Storms: results from IMPACTS and Other Projects, Florida State University, Tallahassee, Florida, 8 March 2023.

Honors and Awards

- **Schlesinger Travel Grant** – Summer 2022
- **Ogura Outstanding Research Paper by a Graduate Student, Honorable Mention** – Spring 2021
Phase Characterization of Cold Sector Southern Ocean Cloud Tops: Results from SOCRATES
- **LAS IMPACT Award** – Spring 2021
- **Graduate College Conference Travel Award** – Fall 2019
- **UIUC List of Teachers Ranked Excellent**
 - ATMS 410 (Fall 2021)
 - ATMS 313 (Spring 2019)
 - ATMS 100 (Fall 2018)
- **Ogura Undergraduate Research Award** – Spring 2018
- **North American Weather Modification Council (NAWMC) Scholarship** – Fall 2017

Service

Conference and Departmental Organization

- **UW ATMS Postdoc Representative** (2025-present)
- **Department of Atmospheric Sciences Student Organization (DASSO)** (2019–2023)
Served as President, Secretary, and Treasurer
- **School of Earth, Society and Environment Research Review Planning Committee** (2021)
Led organizing team for school-wide research review with 50+ posters, 10 lightning talks, and ~100 attendees.
- **Midwest Student Conference on Atmospheric Research (MSCAR)** (2019–2022)
Chaired organizing committee; oversaw invited speakers, workshops, careers panel, and grad fair. Directed transition to virtual format during the pandemic.
- **Student Chapter of the American Meteorological Society (SCAMS), University of Illinois** (2017–2018)
Vice President and Social Committee Chair; organized student social events.

Reviewing and Editorial Service

- **Associate Editor, Journal of Applied Meteorology and Climatology** (2025-present)
- **Associate Editor, Monthly Weather Review** (2025-present)
- **Journal Reviewer** (2022–present)
Journal of the Atmospheric Sciences, Weather and Forecasting, Monthly Weather Review, Journal of Geophysical Research: Atmospheres, Atmospheric Chemistry and Physics, Atmospheric Research, Journal of Hydrometeorology

Professional Service

- **AMS Radar STAC Committee** (2023–present)

- **Undergraduate Research Apprenticeship Program (URAP) Mentor** (2022–2023)

Outreach

- **UAlbany Weather, Climate, and Chemistry Camp** (2023)
- **Doppler on Wheels Outreach Events** (2021–2022)
Represented the Department of Atmospheric Sciences by driving DOW radar at community events (Engineering Open House, Farmer’s Markets, emergency manager workshops).

Graduate Committees

- Jairo Valdivia-Prado (PhD Committee, CU Boulder, PI: K. Friedrich, 2025–present)

Professional Memberships

American Meteorological Society (2017–present)

American Geophysical Union (2017–present)