

 ID

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Dustin D. Roten, Ph.D.

Atmospheric Scientist || STEM Educator

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PROFESSIONAL EXPERIENCE

Postdoctoral Research Fellow [January 2023 - *current*]

Earth Science Division – Atmospheric Composition
Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA

Adjunct Instructor, Physics [Fall 2024 – *current*]

College of Natural Science & Mathematics
Lenoir-Rhyne University, Hickory, NC

Adjunct Instructor, Physics [Spring 2016, Fall 2023 – *current*]

Division of Arts and Sciences
Wilkes Community College, Wilkesboro, NC

Adjunct Instructor, Mathematics [Fall 2020 – Spring 2022]

Department of Mathematics
Forsyth Technical Community College, Winston Salem, NC

Graduate Research Assistant [Fall 2018 – Fall 2022]

Department of Atmospheric Sciences
The University of Utah, Salt Lake City, UT

Graduate Fellow [Fall 2018 – Spring 2019]

Global Change & Sustainability Center
The University of Utah, Salt Lake City, UT

Graduate Research Assistant [Fall 2016 – Spring 2018]

Department of Mathematical Sciences
Appalachian State University, Boone, NC

Instructor [Summers 2016 - 2018]

Upward Bound
Appalachian State University, Boone, NC

High School Teacher, Mathematics [Fall 2015 – Spring 2016]

Ashe County High School, West Jefferson, NC

EDUCATION

Ph.D. – Atmospheric Sciences [Fall 2018 – Spring 2023]

Emphases: atmospheric physics, carbon cycle science, space-based remote sensing of CO₂, ground-based CO₂ observing networks
University of Utah, Salt Lake City, UT

Dissertation Title: *Constraining Sector-specific CO₂ Emissions from the Los Angeles Megacity using NASA's Orbiting Carbon Observatory-3 Instrument*

M.S. – Engineering Physics [Fall 2016 – Summer 2018]

Concentration: systems and laboratory automation
Appalachian State University, Boone, NC

M.A. – Mathematics [Fall 2016 – Summer 2018]

Emphases: mathematical modeling, college teaching
Appalachian State University, Boone, NC

B.S. – Physics & Mathematics [Fall 2010 – Spring 2015]

Concentrations: mathematical physics, general mathematics
Appalachian State University, Boone, NC

TECHNICAL SKILLS

⇒ Instrumentation

Ultra-high vacuum systems, time of flight mass spectroscopy (TOFMS), data loggers, analog circuits, digital circuits, microcontrollers, environmental sensors, DAQ boards, Arduino, laboratory/instrumentation automation, EM27/SUNs, weather-based instrumentation.

⇒ Modeling/Programming/Scripting Skills

R/RStudio, MATLAB, Arduino, C, Assembly, LaTeX, X-STILT, HYSPLIT, data acquisition, data analytics, hardware/software interfacing, parallel processing, workflow development, version control

PROJECTS

Title	Amount	Role
[Funded] NASA ROSES – Carbon Monitoring System (NNH23ZDA001N-CMS) CMS-Urban: A Carbon Monitoring System (CMS) prototype framework to deliver urban sectoral emission estimates using space- and activity-based data (2024-2027)	\$855,735	Science P.I.
[Submitted] NASA ROSES – Carbon Cycle Science (NNH24ZDA001N-CARBON) STREAM: Small Tributaries Releasing Emissions in the Appalachian Mountains (2025-2028)	\$772,370	Science P.I.

PUBLICATIONS

h-index: 5

Total Citations: 202

⇒ Peer-Reviewed Publications ([†]Co-first authors)

D. Roten, A. Chatterjee, J. Lin. *A Novel Scheme for Incorporating Spatial Information Provided by Dense Atmospheric CO₂ Observations from Space-based Observing Platforms*. Journal of Advances in Modeling Earth Systems (JAMES). 202X. ([in prep.](#))

D. Roten[†], C. Brooks[†], S. Tuberty, M. Bowles, T. Pavelsky, W. Roten, A. Chatterjee. *A Spotlight on Greenhouse Gases in Appalachia: The Potential for Monitoring Emissions from the Waters Connecting this Regional Carbon Sink, its Communities, and the World with Space-based Technologies*. Bulletin of the American Meteorological Society (BAMS). 202X. ([in review](#))

D. Roten and A. Chatterjee. *Coverage-Limiting Factors Affecting the Monitoring of Urban Emissions with the Orbiting Carbon Observatory Missions*. AGU Advances. Special Issue: *Observing CO₂ from Space: A Decade of progress from NASA's Orbiting Carbon Observatories (OCO-2 and OCO-3)*. 2025. (DOI: [10.1029/2024AV001630](https://doi.org/10.1029/2024AV001630))

D. Roten, J. C. Lin, L. Kunik, D. Mallia, D. Wu, T. Oda, E. Kort. *The Information Content of Dense Carbon Dioxide Measurements from Space: An Urban-Focused Inversion Approach with Simulated Data from the OCO-3 Instrument*. ESS Open Archive. 2024. (Updated preprint DOI: [10.22541/essoar.172485642.21372186/v1](https://doi.org/10.22541/essoar.172485642.21372186/v1) . Original preprint DOI: [10.5194/acp-2022-315](https://doi.org/10.5194/acp-2022-315))

D. Roten, J. C. Lin, D. Wu, T. Oda, E. Kort. *Constraining Sector-specific CO₂ Fluxes using Space-based XCO₂ Observations over the Los Angeles Basin*. Geophysical Research Letters. Special Issue: *Observing CO₂ from Space: A Decade of progress from NASA's Orbiting Carbon Observatories (OCO-2 and OCO-3)*. 2023. (DOI: [10.1029/2023GL104376](https://doi.org/10.1029/2023GL104376))

D. Roten, D. Wu, B. Fasoli, T. Oda, J. C. Lin. *An Interpolation Method to Reduce the Computational Time in the Stochastic Lagrangian Particle Dispersion Modeling of Spatially Dense XCO₂ Retrievals*. Earth and Space Science. 2021. (DOI: [10.1029/2020EA001343](https://doi.org/10.1029/2020EA001343))

M. Kiel, A. Eldering, **D. Roten**, J. C. Lin, S. Feng, R. Lei, T. Lauvaux, T. Oda, C. M. Roehl, J. Blavier, L T. Iraci. *Urban-focused satellite CO₂ Observations from the Orbiting Carbon Observatory-3: A First Look at the Los Angeles Megacity*. Remote Sensing of Environment – Remote Sensing of Greenhouse Gas Emissions [Special Issue]. 2021. (DOI: [10.1016/j.rse.2021.112314](https://doi.org/10.1016/j.rse.2021.112314))

S. Hogue, **D. Roten**, E. Marland, G. Marland. *Gridded Estimates of CO₂ Emissions: Uncertainty as a Function of Grid Size*. Mitigation and Adaptation Strategies for Global Change. 2018. (DOI: [10.1007/s11027-017-9770-z](https://doi.org/10.1007/s11027-017-9770-z))

⇒ Book Chapters

D. Roten, R. Andrew, G. Marland, R. Bun, M. Crippa, D. Gilfillan, M. Jones, G. Janssens-Maenhout, E. Marland, R. Quadrelli. *CO₂ Emissions from Energy Systems and Industrial Processes: Inventories from Data- and Proxy-driven Approaches in Balancing Regional Greenhouse Gas Budgets: Accounting for Natural and Anthropogenic Flows of CO₂ and other Trace Gases*. Elsevier. 2022.
(ISBN: [978-0-12-814952-2](#))

⇒ Peer Review Activity

Advances in Space Research (Elsevier)
Atmospheric Chemistry and Physics (European Geophysical Union)
Geoscientific Model Development (European Geophysical Union)
Geophysical Research Letters (American Geophysical Union)
Remote Sensing of Environment (Elsevier)
Scientific Data (Springer)

PRESENTATIONS

⇒ Lead Author Presentations [*presenter]

Maximizing the Use of Spatial Information in Dense XCO₂ Observations for Bayesian Inversions

D. Roten, A. Chatterjee*, J. Lin

20) 21st International Workshop on Greenhouse Gas Measurements from Space (IWGGMS), Takamatsu, Japan (Poster; June 9, 2025)

The Potential and Limitations of the Orbiting Carbon Observatory Missions for Monitoring Urban Emissions

D. Roten and A. Chatterjee*

19) 21st International Workshop on Greenhouse Gas Measurements from Space (IWGGMS), Takamatsu, Japan (Poster; June 9, 2025)

An Overview of the Multi-Instrument Dataset Collected during the 2023 AEROMMA Campaign

D. Roten, J. Laughner, S. Das, G. Osterman, H. Parker, A. Meyer, J. Franklin, F. Hopkins, S. Winslow, C. Miller, T. Taylor, V. Payne*

18) 21st International Workshop on Greenhouse Gas Measurements from Space (IWGGMS), Takamatsu, Japan (Poster; June 9, 2025)

Physical and Environmental Factors Limiting the Measurement of Anthropogenic Carbon Dioxide Emissions from Space

D. Roten* and A. Chatterjee*

17) American Geophysical Union (AGU) 2024 Fall Meeting, Washington D.C., (Poster; Dec. 9, 2024)

16) 11th International Carbon Dioxide Conference (ICDC11), Buenos Aires, Brazil (Poster; July, 2024)

15) 20th International Workshop on Greenhouse Gas Measurements from Space (IWGGMS), Boulder, CO (Poster; May 30, 2024)

Zooming in on the Carbon Cycle: Monitoring Urban CO₂ emissions from Space

D. Roten*

14) NASA-Jet Propulsion Laboratory, Center for Climate Sciences, Pasadena, CA. (Oral; Mar. 29, 2024)

How Well do OCO-2 and OCO-3 Monitor the United States? Implications for Current and Future Space-based Carbon-observing Systems

D. Roten*, T. Wilmot, J. C. Lin, S. Das, E. A. Kort, A. Chatterjee

13) American Geophysical Union (AGU) 2023 Fall Meeting, San Francisco, CA. (Oral; Dec. 15, 2023)

Detecting Changes in Sector-specific CO₂ Emissions Using OCO-3: A Case Study in the Los Angeles Basin

D. Roten*, T. Wilmot, J. C. Lin, A. Chatterjee, E. Kort

12) 19th International Workshop on Greenhouse Gas Measurements from Space (IWGGMS), Paris, France (Oral; July 6, 2023)

Detecting Changes in Sector-specific CO₂ Emissions from Space: an Application of OCO-3 over the Los Angeles Basin

D. Roten*, J. C. Lin, E. A. Kort

11) American Geophysical Union (AGU) 2022 Fall Meeting, Chicago, IL (Oral; Dec. 12, 2022)

The Information Content of Dense Carbon Dioxide Measurements from Space: A Case Study with OCO-3

D. Roten*, J. C. Lin, L. Kunik, D. Mallia, D. Wu, T. Oda, E. Kort

10) 18th International Workshop on Greenhouse Gas Measurements from Space (IWGGMS), Virtual (Poster; Jul. 13, 2022)

The Information Content of Dense XCO₂ Retrievals: The Potential of Extracting Sector-Specific Fluxes with OCO-3

D. Roten*, D. Wu, B. Fasoli, L. Kunik, D. Mallia, J. C. Lin, T. Oda, E. Kort

9) American Geophysical Union (AGU) 2021 Fall Meeting, New Orleans, LA (Oral; Dec. 17, 2021)

Quantifying CO₂ Emissions from World Megacities with Emerging Dense Urban CO₂ Satellite Data: Using Lagrangian Particle Dispersion Modeling in a Los Angeles Case Study

D. Roten*, D. Wu, J.C. Lin, T. Oda, M. Kiel, E. Kort

8) American Geophysical Union (AGU) 2020 Fall Meeting, Virtual (Oral; Dec. 16, 2020)

Spatiotemporal Metrics for the Characterization of Point Source FFCO₂ Emissions and Dispersion

D. Roten*, P. Spell, S. Hogue, E. Marland, G. Marland, C. Thaxton

7) American Geophysical Union (AGU) 2017 Fall Meeting, New Orleans, LA. (Poster; Dec. 13, 2017)

6) Celebration of Student Research and Creative Endeavors, Appalachian State University, Boone, NC. (Poster; April 2017)

Modeling with 9-12 Mathematics

D. Roten*

5) North Carolina Council of Teachers of Mathematics (NCCTM) 2016 State Conference, Greensboro, NC. (Oral; Oct. 28, 2016)

Production & Storage of Ne³⁺ for Radiative Lifetime Measurements

D. Roten*, T. Dula*, C. Patteson, B. Johnson, A. G. Calamai

4) Celebration of Student Research and Creative Endeavors, Appalachian State University, Boone, NC. (Poster; April 2015)

3) State of North Carolina Undergraduate Research and Creativity Symposium (SNCURCS), North Carolina State University, Raleigh, NC. (Poster; Nov. 22, 2014)

A Search for Multiply-Charged Ion Production in a Low Energy Ion Trap

D. Roten*, J. Meyer, B. Johnson, A. G. Calamai

2) Celebration of Student Research and Creative Endeavors, Appalachian State University, Boone, NC. (Poster; April 2014)

1) State of North Carolina Undergraduate Research and Creativity Symposium (SNCURCS), University of North Carolina – Charlotte, Charlotte, NC. (Poster; Nov. 16, 2013)

⇒ Contributions to Presentations [*presenter, †student]

The Potential of Monitoring CO₂ Emissions from On-road Emissions with Space-based Observing Platforms

A. Hakobyan^{†*} and **D. Roten**

Caltech Connections 2025, California Institute of Technology, Pasadena, CA (Poster; May 30, 2025)

Keeping a Finger on the Pulse of the Earth: NASA's Orbiting Carbon Observatory-3 (OCO-3) Mission on the International Space Station

T. Kurosu*, A. Chatterjee, B. Fisher, M. Kiel, R. Nelson, Z. Pierrat, **D. Roten**, G. Spiers, V. Payne, OCO Science Team
International Space Station Research and Development Conference, Boston, MA (July, 2024)

Are Our Greenhouse Gas (GHG) Emissions Inventories Truly Application Ready for Science and Climate Mitigation Actions?

T. Oda*, R. Bun, E. Puliafito, L. Feng, P. Palmer, Z. Wang, J. Lin, **D. Roten**, E. Kort, T. Lauvaux, B. Weir, L. Ott

11th International Carbon Dioxide Conference (ICDC11), Manaus Amazonas, Brazil (July, 2024)

Monitoring Urban CO₂ Emissions from Space: Insights from NASA's Orbiting Carbon Observatory-3 (OCO-3) Mission

A. Chatterjee*, M. Kiel, R. Nelson, D. Wu, **D. Roten**, A. Danjou, R. Lei, T. Kurosu, S. Pandey, J. Laughner, T. Taylor, J. C. Lin, J. Liu, P. Wennberg, T. Lauvaux, S. Feng, T. Oda, C. O'Dell, V. Payne, G. Spiers
American Geophysical Union (AGU) 2022 Fall Meeting, Chicago, IL (Oral; Dec. 14, 2022)

Urban CO₂ Emissions from Cities around the World and their Scaling Relationships with Socioeconomic Variables, determined with Orbiting Carbon Observatory-2

T. Y. Wilmot*, J. C. Lin, D. Wu, **D. Roten**, T. Oda, E. A. Kort

American Geophysical Union (AGU) 2022 Fall Meeting, Chicago, IL (Oral; Dec. 12, 2022)

Monitoring Anthropogenic Emissions: Insights from OCO-3's Snapshot Area Mapping (SAM) Mode

A. Chatterjee*, R. Nelson, M. Kiel, S. Pandey, B. Fisher, G. Spiers, E. Bell, A. Eldering, T. Kurosu, J. C. Lin, J. Liu, C. O'Dell, V. Payne, **D. Roten**, T. Taylor, P. Wennberg, D. Wu, C. Cheng, R. Basilio

18th International Workshop on Greenhouse Gas Measurements from Space, Virtual (Oral; Jul. 13, 2022)

Urban-focused Satellite CO₂ Observations from the Orbiting Carbon Observatory-3: a First Look at the Los Angeles Megacity

M. Kiel*, A. Eldering, **D. Roten**, R. Lei, S. Feng, J. C. Lin, T. Lauvaux, C. M. Roehl, T. Oda.

European Geosciences Union (EGU) General Assembly 2021, Virtual. (Oral; April 2021)

OCO-3 SAM mode: Spatiotemporal Variability of XCO₂ Over the Los Angeles Megacity

M. Kiel*, A. Eldering, **D. Roten**, R. Lei, S. Feng, J. C. Lin, T. Lauvaux, C. M. Roehl, T. Oda.

American Geophysical Union (AGU) 2020 Fall Meeting, Virtual. (Oral; Dec. 16, 2020)

Overcoming challenges in using satellite-based CO₂ data to understand carbon emissions from cities around the world

J. C. Lin*, D. Wu, **D. Roten**, B. Fasoli, T. Oda, E. Kort

American Geophysical Union (AGU) 2019 Fall Meeting, San Francisco, CA. (Oral; Dec. 13, 2019)

Utah-Atmospheric Trace Gas & Air Quality Lab (U-ATAQ).

R. Bares*, L. E. Mitchell, B. Fasoli, D. Eriksson, A. Meldrum, **D. Roten**, J. C. Lin

The Air We Breathe: A Multidisciplinary Perspective on Air Quality, University of Utah, Salt Lake City, UT. (Poster; Oct. 3, 2019)

IN THE MEDIA

Coverage Factors Affect Urban CO₂ Monitoring from Space.

Editor Highlight written by Donald Wuebbles. (June 12th, 2025)

<https://eos.org/editor-highlights/coverage-factors-affect-urban-co2-monitoring-from-space>

highlights Roten and Chatterjee 2025.

Students, NASA Has Space for You.

NASA Internship Recruitment. (Oct. 8th, 2024)

<https://www.facebook.com/NASAInterns/videos/895104662160165>

<https://x.com/NASAInterns/status/1843724695356461275>

https://www.youtube.com/watch?v=-mwAsL-V_-4

Includes an interview about my trajectory from first-generation college student to carbon cycle scientist

Satellite Data to Help Measure Impact of Los Angeles Climate Solutions.

U.S. Greenhouse Gas Center Stories. (Sept. 19th, 2024)

<https://earth.gov/ghgcenter/stories/losangeles>

References Roten et al., 2023; includes quotes from interview.

Al Gore's Climate Watchdog Spots Rogue Emissions.

Article written by Paul Voosen for Science Magazine. (Dec. 3rd, 2023)

<https://www.science.org/content/article/al-gore-s-climate-watchdog-spots-rogue-emissions>

Cites Roten et al., 2023.

An Observatory Spied on LA's Carbon Emissions – From Space.

Written by Katrina Miller for Wired Magazine. (Jun. 22nd, 2021)

<https://www.wired.com/story/an-observatory-spied-on-las-carbon-emissions-from-space/>

Cites Kiel et al., 2021.

TEACHING & MENTORING

⇒ Lenoir-Rhyne University

Energy, Technology, and Society [PHY-115] and Laboratory – Semester-length conceptual physics course

[online/asynchronous]

⇒ Wilkes Community College

General Physics I [PHY-251] and Laboratory – Calculus-based course focusing on classical mechanics

[online/asynchronous; transferable to 4-year university]

General Physics II [PHY-252] and Laboratory – Calculus-based course focusing on electricity and magnetism

[online/asynchronous; transferable to 4-year university]

Physics I (Mechanics) [PHY-131] and Laboratory – Mechanics course for Engineering Technology students

[hybrid; non-transferable]

⇒ Forsyth Technical Community College

Statistical Methods I [MAT-152] and Laboratory – Prerequisite statistics course for multiple majors

[online/asynchronous; transferable to a 4-year university]

⇒ Upward Bound [Grades 10 – 12]

UB is a summer program for potential first-generation college students to live and take courses at nearby universities. Funded is provided by the federal TRIO programs.

(Information about this program can be found at <https://gocollege.appstate.edu/student-support-programs/upward-bound>)

Design and Problem Solving – A one-week hands-on course requiring students to work within design constraints

Brief Statistics – A four week “preview” course designed to prepare students for AP Statistics

Brief Physics – A four week “preview” course designed to prepare student for AP Physics

Brief Pre-calculus – A four week “preview” course designed to prepare student for high school Pre-Calculus

Brief Calculus – A four week “preview” course designed to prepare student for AP Calculus

⇒ Ashe County High School

Math III – NC Common Core Curriculum (similar to a Pre-calculus course)

Advanced Functions and Modeling (AFM) – Application-based advanced mathematics course

⇒ Caltech Connection (See program website at <https://connection.caltech.edu>)

Student	Position	Project
Ani Hakobyan 2024-2025	Undergraduate - Electrical Engineering Pasadena City College	The potential of observing trends in on-road fuel efficiency with space-based instruments
Kellyann “Kel” Bassetti-Ring 2025-2026	Undergraduate Los Angeles City College	Reductions in the utility of the world’s commercial airports in a warming climate
Blake Rugh 2025-2026	Undergraduate Santa Monica College	Are the Blue Ridge Mountains Losing Their Blue? Modeling Long-term Trends in Isoprene Concentrations

⇒ Caltech Accountability Partners Program (CAPP)

Mentoring undergraduate students through the graduate school application process, providing long-term support as they prepare their materials.

LEADERSHIP, AWARDS, AND MEMBERSHIPS (PAST & PRESENT)

⇒ Leadership

National President-Elect/President, Technology & Engineering Education Collegiate Association (TEECA) (2010-2013)

This role required me to serve as the liaison between student members of TEECA and the parent organization, the International Technology and Engineering Educators Association (ITEEA), representing all chapters across the United States.

Club President, Physics and Astronomy (PandA) Club, Appalachian State University (2013-2014)

This role required me to serve as the club representative department- and university-level business related to student organizations, work with the treasurer to manage the club budget, organize outreach events, and plan socials.

Club Vice-President, Physics and Astronomy (PandA) Club, Appalachian State University (2012-2013)

This role required me to organize, script, and perform physics demo shows for public outreach events.

⇒ Awards

TEECA Special Recognition Award of Outstanding Service as President (Columbus, Ohio; 2013)

TEECA Special Recognition Award of Outstanding Service as President-Elect (Long Beach, California; 2012)

⇒ Membership (Past & Present)

NASA Orbiting Carbon Observatory (OCO-2/3) Science Team Affiliation

NASA Carbon Monitoring System (CMS) Team Affiliation

Land-Atmosphere Interactions Research (LAIR) Group, University of Utah, Salt Lake City, UT

American Association for the Advancement of Science (AAAS)

American Geophysical Union (AGU)

American Meteorological Society (AMS)

Sigma Pi Sigma (SPS)

International Technology and Engineering Educators’ Association (ITEEA)

Technology & Engineering Education Collegiate Association (TEECA)

Technology Student Association (TSA) [high school]

PROFESSIONAL REFERENCES

Dr. Abhishek Chatterjee
OCO-3 Project Scientist
OCO-2 Deputy Project Scientist
Jet Propulsion Laboratory, California Institute of Technology
abhishek.chatterjee@jpl.nasa.gov

Dr. Ken Jucks
Program Manager
Upper Atmosphere Research Program
NASA HQ
kenneth.w.jucks@nasa.gov

Dr. Tomohiro Oda
Interim Director
Earth from Space Institute
Universities Space Research Association
toda@usra.edu

Dr. John Lin
Associate Director, Professor
Wilkes Center for Climate Science & Policy
Department of Atmospheric Sciences
john.lin@utah.edu

Dr. Sharilyn Owens
Dean of Transformative Learning
Forsyth Technical Community College
sowens@forsythtech.edu

Dr. Courtney McGahee
Associate Professor (Physics)
College of Natural Sciences and Mathematics
Lenoir-Rhyne University
Courtney.mcgahee@lr.edu