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**Dustin D. Roten, Ph.D.**  
**Atmospheric Scientist || STEM Educator**  
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## PROFESSIONAL EXPERIENCE

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### **Postdoctoral Research Fellow** [January 2023 - *current*]

Earth Science Division – Tropospheric 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

### **Graduate Research Assistant** [Fall 2018 – Fall 2022]

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

### **Adjunct Instructor, Math** [Fall 2020 – Spring 2022]

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

### **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

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## EDUCATION

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

Emphases: carbon cycle science, space-based remote sensing of CO<sub>2</sub>, ground-based CO<sub>2</sub> observing networks  
University of Utah, Salt Lake City, UT

### **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

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## TECHNICAL SKILLS

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### ⇒ 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

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## PROJECTS

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| Title   | Amount    | Role         |
|---|-----------|--------------|
| <b>[Funded] NASA ROSES – Carbon Monitoring System</b> (NNH23ZDA001N-CMS)<br>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. |
| <b>[Submitted] NASA ROSES – Carbon Cycle Science</b> (NNH24ZDA001N-CARBON)<br>STREAM: Small Tributaries Releasing Emissions in the Appalachian Mountains (2025-2028)  | \$772,370 | Science P.I. |

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## PUBLICATIONS

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### ⇒ Peer-Reviewed Publications (<sup>†</sup>Co-first authors)

**D. Roten<sup>†</sup>**, C. Brooks<sup>†</sup>, S. Tuberty, M. Bowles, T. Pavelsky, W. Roten, A. Chatterjee. *Monitoring the Health of the Appalachian Carbon Sink: The Potential of Observing Riverine CO<sub>2</sub> and CH<sub>4</sub> Emissions from Space*. Limnology & Oceanography Letters. Special Issue: *Methane in Freshwater, Brackish and Marine Environments*. 2025. (in prep.)

**D. Roten** and A. Chatterjee. *Coverage-Limiting Factors Affecting the Monitoring of Urban Emissions with the Orbiting Carbon Observatory Missions*. AGU Advances. 2025. (in press)

**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. (DOI: [10.22541/essoar.172485642.21372186/v1](https://doi.org/10.22541/essoar.172485642.21372186/v1))

**D. Roten**, J. C. Lin, D. Wu, T. Oda, E. Kort. *Constraining Sector-specific CO<sub>2</sub> Fluxes using Space-based XCO<sub>2</sub> Observations over the Los Angeles Basin*. Geophysical Research Letters. Special Issue: *Observing CO<sub>2</sub> 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 XCO<sub>2</sub> 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 CO<sub>2</sub> 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 CO<sub>2</sub> 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. *CO<sub>2</sub> 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 CO<sub>2</sub> and other Trace Gases*. Elsevier. 2022. (ISBN: [978-0-12-814952-2](https://doi.org/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)

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## PRESENTATIONS

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### ⇒ Lead Author Presentations [\*presenter]

#### *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) 11<sup>th</sup> International Carbon Dioxide Conference (ICDC11), Buenos Aires, Brazil (Poster; July, 2024)

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

#### *Zooming in on the Carbon Cycle: Monitoring Urban CO<sub>2</sub> 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 CO<sub>2</sub> Emissions Using OCO-3: A Case Study in the Los Angeles Basin*

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

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

#### *Detecting Changes in Sector-specific CO<sub>2</sub> 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) 18<sup>th</sup> International Workshop on Greenhouse Gas Measurements from Space (IWGGMS), Virtual (Poster; Jul. 13, 2022)

#### *The Information Content of Dense XCO<sub>2</sub> 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 CO<sub>2</sub> Emissions from World Megacities with Emerging Dense Urban CO<sub>2</sub> 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 FFCO<sub>2</sub> 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 Ne<sup>3+</sup> 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 CO<sub>2</sub> 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 (*upcoming*; 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

11<sup>th</sup> International Carbon Dioxide Conference (ICDC11), Manaus Amazonas, Brazil (*upcoming*; July, 2024)

***Monitoring Urban CO<sub>2</sub> 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 CO<sub>2</sub> 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 CO<sub>2</sub> 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 XCO<sub>2</sub> 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 CO<sub>2</sub> 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)

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## IN THE MEDIA

***Students, NASA Has Space for You.*** NASA Internship Recruitment. (Oct. 8<sup>th</sup>, 2024)

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

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

[https://www.youtube.com/watch?v=-mwAsL-V\\_-4](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. 19<sup>th</sup>, 2024)

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

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

**Al Gore's Climate Watchdog Spots Rogue Emissions.** Science Magazine. (Dec. 3<sup>rd</sup>, 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.** Wired Magazine. (Jun. 22<sup>nd</sup>, 2021)

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

*Cites Kiel et al., 2021.*

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## TEACHING & MENTORING

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### ⇒ 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; transferrable to 4-year university]

**Physics I (Mechanics) [PHY-131] and Laboratory** – Mechanics course for Engineering Technology students  
[hybrid; non-transferrable]

### ⇒ Forsyth Technical Community College

**Statistical Methods I [MAT-152] and Laboratory** – Prerequisite statistics course for multiple majors  
[online/asynchronous; transferrable to a 4-year university]

### ⇒ Upward Bound [Grades 10 – 12]

**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 Connections

#### Student

Ani Hakobyan

#### Position

Undergraduate - Electrical Engineering  
Pasadena City College  
Pasadena, CA

#### Project

The potential of observing trends in on-road fuel efficiency with  
space-based instruments

### ⇒ Caltech Accountability Partners Program (CAPP)

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

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## LEADERSHIP, AWARDS, AND MEMBERSHIPS (PAST & PRESENT)

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### ⇒ Leadership

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

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

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

### ⇒ 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]