

**Dustin D. Roten****Ph.D. Candidate | Atmospheric Scientist | STEM Educator**

|| William Browning Building, 135 S 1460 E, Room 819 || Salt Lake City, UT 84112 || 801-581-6136 ||

[dustin.roten@utah.edu](mailto:dustin.roten@utah.edu)

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**SUMMARY**

- Enthusiastic scientist with experience in both atmospheric modeling and instrumentation/monitoring networks
  - Uniquely diverse academic and professional background
  - Experience with working on interdisciplinary teams and projects related to environmental issues
  - Experienced educator in high school, community college, and university settings; including curriculum design
  - Multiple leadership positions held in student organizations
  - Experience with K-12/public outreach
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**PROFESSIONAL EXPERIENCE****Graduate Research Assistant** (The University of Utah, Salt Lake City, UT) [Fall 2018 - *current*]

Current member of the Land-Atmosphere Interactions Research (LAIR) Group. Work includes developing interpolation algorithms to reduce computing time for Lagrangian inverse modeling applications. Specifically, the Stochastic Time-Inverted Lagrangian Trajectory model (X-STILT) is augmented and used in applications related to NASA's Orbiting Carbon Observatory (OCO) mission. This project requires management of OCO-2/OCO-3 data products, efficient analysis/processing of data products using R, and application of these tools for the study of urban CO<sub>2</sub> emission dynamics. Additional work includes assisting with the maintenance of the Utah Urban Carbon Dioxide Network (UUCON). This involves continuous monitoring of instrument performance, instrument implementation, and the automation of data collection, transfer, analysis, and storage across 10+ monitoring sites in the Salt Lake Valley.

**Adjunct Instructor, Mathematics** [Online] (Forsyth Technical Community College, Winston Salem, NC) [Fall 2020 - *current*]

As an instructor of both lecture and lab sections, responsibilities included restructuring and delivering course content in an online Statistical Methods I course.

**Global Change & Sustainability Center Fellow** (The University of Utah, Salt Lake City, UT) [Fall 2018 – Summer 2019]

The Global Change & Sustainability Center (GCSC) offers first-year graduate students a competitive opportunity to work with an interdisciplinary cohort of peers. Research conducted by this group centered around themes of local environmental and sustainability issues. Fellows participated in a GCSC seminar series as well as the project-based course "Global Changes and Society" in which local air quality was identified as the theme. Deliverables included: qualitative research on air quality communication to the public, effects of air quality on outdoor activities, recommendations for an improved air quality monitoring system, and a city-wide charter for an air quality legislative board.

**Graduate Research Assistant** (Appalachian State University, Boone, NC) [Fall 2016 – Spring 2018]

Research conducted at Appalachian State University was funded by the Graduate Research Associate Mentoring (GRAM) Program. The responsibilities associated with this role included 20+ weekly hours of research work and professional development trainings related to the responsible conduct of research. The research conducted included an investigation into identifying required parameters for the accurate modeling of CO<sub>2</sub> emissions from large industrial sources. This work resulted in a poster presentation and submitted manuscript.

**Upward Bound Academic Instructor** (Appalachian State University, Boone, NC) [Summers 2016, 2017, 2018]

Funded by the U.S. Department of Education's TRIO Programs, Upward Bound provides academic support to high school students (who meet certain criteria) to ensure the completion of high school and enrollment in college. Responsibilities included providing targeted preparation in physics and mathematics for students in a classroom setting, structuring curricula, and coordinating STEM based extra-curricular opportunities.

**Adjunct Instructor, Physics** (Wilkes Community College, Wilkesboro, NC) [Spring 2016]

As an instructor of both lecture and lab sections, responsibilities included restructuring and delivering course content in a hybrid online/face-to-face Physics I course. This role also required the planning, setup, and maintenance of all relevant laboratory exercises and instrumentation. The on-campus components of both lecture and laboratory exercises were held on a satellite campus of the community college, requiring coordinated scheduling and transport of laboratory instruments with other instructors.

**High School Teacher, Mathematics** (Ashe County High School, West Jefferson, NC) [Fall 2015 – Spring 2016]

Responsibilities included instructing multiple sections of Common Core Math III in addition to a section of Advanced Functions and Modeling. Other instructional obligations included one-on-one tutoring and attending professional development seminars.

## **RESEARCH INTERESTS**

### ***Urban CO<sub>2</sub> Emissions – The Orbiting Carbon Observatory (OCO) Project***

Launched in 2014, the Orbiting Carbon Observatory-2 (OCO-2) is a NASA affiliated satellite used to characterize CO<sub>2</sub> sources and sinks. Current work involves using these data to understand urban CO<sub>2</sub> emissions by linking OCO-2 observations to urban areas of interest via the column-averaged Stochastic Time-Inverted Lagrangian Transport (X-STILT) model. Prior urban flux estimates are retrieved from the Open-source Data Inventory for Anthropogenic CO<sub>2</sub> (ODIAC). Future work will involve data provided by OCO-3 and GeoCarb, NASA's future geosynchronous satellite to monitor emissions over the United States.

### ***Uncertainty in Gridded Emissions Inventories***

This work, conducted at Appalachian State University, explored uncertainties introduced in gridded emissions inventories (EIs) due to proxy data selected for construction. The current focus of this work is to quantify the emissions and the associated uncertainty of large point sources (power plants, paper mills, cement factories, etc.) with as fine a resolution as possible. Current methods include the implementation and automation of the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model and the application of spatiotemporal metrics to understand the uncertainties introduced from unknown, yet crucial power plant parameters in the context of emissions inventory based atmospheric CO<sub>2</sub> models. Specifically, the role that stack height and exhaust velocity played in dispersion characteristics was investigated. Implications include quantifying uncertainties for coupled EIs and Lagrangian inverse models.

### ***Ion Trapping / Plasma Diagnostics / Ion Chemistry***

The reactive and radiative properties of intermediately charged neon ions are of interest to a variety of applications including terrestrial and astronomical plasma diagnostics. In order to study their reactivity, a time-of-flight mass spectrometer (TOFMS) was used in tandem with a radio-frequency ion trap to bombard gases of interest at nanoTorr pressures with electrons. These ions were then ejected from the trap into the TOFMS for measurements.

## **EDUCATION**

### ***Ph.D. – Atmospheric Sciences*** (Emphasis: Urban Carbon Cycle, Air Quality) [GPA: 3.71]

University of Utah, Salt Lake City, UT  
(*in progress*)

### ***M.S. – Engineering Physics*** (Concentration: Systems and Laboratory Automation) [GPA: 3.76]

Appalachian State University, Boone, NC  
(Fall 2016 – Summer 2018)

### ***M.A. – Mathematics*** (Concentration: College Teaching; Emphasis: Mathematical Modeling) [GPA: 3.80]

Appalachian State University, Boone, NC  
(Fall 2016 – Summer 2018)

### ***B.S. – Physics & Mathematics*** (Concentrations: Mathematical Physics, General Mathematics) [GPA: 2.75]

Appalachian State University, Boone, NC  
(Fall 2010 – Spring 2015)

## **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

### ***Programming/Scripting Skills***

Languages: R/RStudio, MATLAB, Arduino, C, Assembly

Skills: data acquisition, data analytics, hardware/software interfacing, parallel processing, workflow development, version control, basic html

## **INSTRUCTIONAL SKILLS/INTERESTS**

**Secondary** (Grades 9<sup>th</sup> – 12<sup>th</sup>)

**Courses Taught:** Common Core Math III, Advanced Functions and Modeling, Physics, Statistics, Pre-Calculus, Problem Solving & Design, familiarity with Common Core Math I instruction

**Instructional Skills:** Experience in curriculum design, one-on-one tutoring, group tutoring, advising extracurricular activities

**Post-Secondary** (Community College & University)

**Courses Taught:** Conceptual Physics I (instructor of record), Conceptual Physics I Laboratory (instructor of record), familiarity with Calculus I and Linear Algebra instruction

**Instructional Skills:** Experience in curriculum design, content development and delivery in online courses, one-on-one tutoring, group tutoring, hiring/mentoring undergraduates in a research setting

## **PUBLICATIONS**

**D. Roten**, D. Wu, B. Fasoli, D. Mallia, J. C. Lin. *Design and Characterization of an Interpolation Method for Lagrangian Inverse Modeling*. Journal of Geoscientific Model Development (*in preparation*)

**D. Roten**, P. Spell, E. Marland, G. Marland. *Characterizing the Sensitivities of Emission Inventory Based Atmospheric FFCO<sub>2</sub> Models to Point Source Parameters*. Journal of Geophysical Research: Atmospheres (submitted: Dec. 2018, *under revision*)

S. Hogue, **D. Roten**, E. Marland, G. Marland. *Gridded Estimates of CO<sub>2</sub> Emissions: Uncertainty as a Function of Scale*. Mitigation and Adaptation Strategies for Global Change. (doi: 10.1007/s11027-017-9770-z)

## **PRESENTATIONS**

**D. Roten**, P. Spell, S. Hogue, E. Marland, G. Marland, C. Thaxton. (Poster), *Spatiotemporal Metrics for the Characterization of Point Source FFCO<sub>2</sub> Emissions and Dispersion*, American Geophysical Union (AGU) 2017 Fall Meeting, New Orleans, LA. (Dec. 13, 2017)

**D. Roten**, P. Spell, S. Hogue, E. Marland, G. Marland, C. Thaxton. (Poster), *Spatiotemporal Metrics for the Characterization of Point Source FFCO<sub>2</sub> Emissions and Dispersion*, Celebration of Student Research and Creative Endeavors at Appalachian State University Boone, NC. (April 2017)

**D. Roten**, *Modeling with 9-12 Mathematics*, North Carolina Council of Teachers of Mathematics (NCCTM) 2016 State Conference, Greensboro, NC. (Oct. 28, 2016)

**D. Roten**, T. Dula, C. Patteson, B. Johnson, A. G. Calamai. (Poster), *Production & Storage of Ne<sup>3+</sup> for Radiative Lifetime Measurements*, Celebration of Student Research and Creative Endeavors at Appalachian State University, Boone, NC. (April 2015)

**D. Roten**, T. Dula, C. Patteson, B. Johnson, A. G. Calamai. (Poster), *Production & Storage of Ne<sup>3+</sup> for Radiative Lifetime Measurements*, State of North Carolina Undergraduate Research and Creativity Symposium (SNCURCS) at North Carolina State University. Raleigh, NC. (Nov. 22, 2014)

**D. Roten**, J. Meyer, B. Johnson, A. G. Calamai. (Poster), *A Search for Multiply-Charged Ion Production in a Low Energy Ion Trap*, Celebration of Student Research and Creative Endeavors at Appalachian State University Boone, NC. (April 2014)

**D. Roten**, J. Meyer, B. Johnson, A. G. Calamai. (Poster), *A Search for Multiply-Charged Ion Production in a Low Energy Ion Trap*, State of North Carolina Undergraduate Research and Creativity Symposium (SNCURCS) at the University of North Carolina- Charlotte. Charlotte, NC. (Nov. 16, 2013)

## **PROFESSIONAL ROLES & MEMBERSHIPS (PAST & PRESENT)**

### ***Leadership***

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

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

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

### ***Membership***

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

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]

### ***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)