

**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

SUMMARY

- Atmospheric scientist with experience in both atmospheric modeling and instrumentation/monitoring networks
 - Uniquely diverse academic and professional background
 - Experience working with interdisciplinary teams on environmental issues
 - Educator in high school, community college, and university settings; including curriculum design
 - Multiple leadership positions held in student organizations (local and national levels)
 - 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 CO₂ 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 CO₂ 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 CO₂ 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 CO₂ sources and sinks. Current work involves using these data to understand urban CO₂ 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 CO₂ (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 CO₂ 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)

University of Utah, Salt Lake City, UT

(in progress)

M.S. – Engineering Physics (Concentration: Systems and Laboratory Automation)

Appalachian State University, Boone, NC

(Fall 2016 – Summer 2018)

M.A. – Mathematics (Concentration: College Teaching; Emphasis: Mathematical Modeling)

Appalachian State University, Boone, NC

(Fall 2016 – Summer 2018)

B.S. – Physics & Mathematics (Concentrations: Mathematical Physics, General Mathematics)

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

Modeling/Programming/Scripting Skills

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

Skills: X-STILT, HYSPLIT, data acquisition, data analytics, hardware/software interfacing, parallel processing, workflow development, version control, LaTeX

INSTRUCTIONAL SKILLS/INTERESTS

Secondary (Grades 9th – 12th)

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: Statistical Methods I, Conceptual Physics I, Conceptual Physics I Laboratory, 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

In Preparation

D. Roten, T. Oda, J. C. Lin. *Resolving Features in the “Urban CO₂ Dome” with Satellite Observations: Investigating Intra-city XCO₂ Gradients with the Orbiting Carbon Observatory-3 and the X-STILT Model*. XXX. (in preparation)

D. Roten, P. Spell, E. Marland, G. Marland. *Characterizing the Sensitivities of Emission Inventory Based Atmospheric FFCO₂ Models to Point Source Parameters*. Atmospheres (in preparation)

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 the Environment (submitted: August 27th, 2020)

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. (submitted: July 30th, 2020)

Published

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

PRESENTATIONS [*presenter]

Lead Author Presentations

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

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

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

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

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

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

Modeling with 9-12 Mathematics

D. Roten*

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

Production & Storage of Ne³⁺ for Radiative Lifetime Measurements

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

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

Production & Storage of Ne³⁺ for Radiative Lifetime Measurements

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

State of North Carolina Undergraduate Research and Creativity Symposium (SNCURCS) at 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

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

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

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

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

Contributions to Presentations

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. (Dec. 13, 2019)

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

Ryan Bares*, Logan E. Mitchell, Ben Fasoli, Dave Eiriksson, Andrew Meldrum, **Dustin Roten**, John C. Lin

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

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)