# Lewis T. Kunik

## Contact Information

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## Research Interests

I'm an ecologist and Earth scientist with an interest in understanding climate controls on carbon cycling in temperate forest ecosystems, particularly how stress (heat, drought) and disturbance (bark beetle outbreaks, fire) impact forest productivity at regional scales. I use a wide array of geostatistical and high-performance computing techniques to analyze satellite-based remote sensing data, tower-based proximal remote sensing and eddy covariance flux measurements, and climatological and machine-learning land surface data products. More broadly, I'm motivated to explore creative solutions to society's environmental problems using emerging analytical techniques that leverage geospatial statistics, machine learning and artificial intelligence.

## Education

*Ph.D. (In Progress)* Atmospheric Sciences, University of Utah, Salt Lake City — 2021-present
GPA: 3.99
*Expected graduation: May 2026*

*B.S.* Computer Engineering & Computer Science, University of Wisconsin, Madison — 2016
GPA: 3.76

## Publications

In Revision:

**Kunik, L.,** Bowling, D.R., Raczka, B., Hicke, J.A., Frankenberg, C., Cheng, R., Slaton, M.R., and Lin, J.C. Characterizing the effects of tree mortality from wildfire and bark beetles using satellite observations of solar-induced chlorophyll fluorescence. In Revision at Remote Sensing of Environment.

Published:

Roten, D.R., Lin, J.C., **Kunik, L**., Mallia, D.V., Wu, D., Oda, T., and Kort, E. The Information Content of Dense Carbon Dioxide Measurements from Space: An Urban-Focused Inversion Approach with Synthetic Data from the OCO-3 Instrument. *ESS Open Archive.* August 28, 2024. DOI: 10.22541/essoar.172485642.21372186/v1

Yang, J.C., Bowling, D.R., Smith, K.R., **Kunik, L**., Raczka, B., Anderegg, W.R.L., Bahn, M., Blanken, P., Richardson, A.D., Burns, S.P., Bohrer, G., Desai, A.R., Altaf Arain, M., Staebler, R.M., Ouimette, P.A.,

Munger, J.W. and Litvak, M.E., 2024. Forest carbon uptake as influenced by snowpack and length of photosynthesis season in seasonally snow-covered forests of North America. Agric For Meteorol, 353, 110054. DOI: https://doi.org/10.1016/j.agrformet.2024.110054

**Kunik, L**., Bowling, D.R., Raczka, B., Frankenberg, C., Köhler, P., Cheng, R., Smith, K.R., Goulden, M., Jung, M. and Lin, J.C., 2023. Satellite-based solar-induced fluorescence tracks seasonal and elevational patterns of photosynthesis in California's Sierra Nevada mountains. Environ Res Lett, 19(1), 014008. DOI: http://doi.org/10.1088/1748-9326/ad07b4

Mallia, D.V., Mitchell, L.E., Gonzalez Vidal, A.E., Wu, D., **Kunik, L.**, and Lin, J.C. 2023. Can We Detect Urban-Scale CO2 Emission Changes Within Medium-Sized Cities? J Geophys Res Atmos, 128, e2023JD038686. https://doi. org/10.1029/2023JD038686

Mallia, D.V., Mitchell, L.E., **Kunik**, **L.,** Fasoli, B., Bares, R., Gurney, K., Mendoza, D., and Lin, J.C. 2020. Constraining urban CO2 emissions using mobile observations from a light-rail public transit platform, Environ Sci Technol, 54(24), p15613-15621. DOI: http://doi.org/10.1021/acs.est.0c04388

**Kunik, L**., Mallia, D.V., Gurney, K.R., Mendoza, D.L., Oda, T. and Lin, J.C., 2019. Bayesian inverse estimation of urban CO2 emissions: Results from a synthetic data simulation over Salt Lake City, UT. Elem Sci Anth, 7(1), p.36. DOI: http://doi.org/10.1525/elementa.375

## Workshops and First-author Presentations

*2025*

Monitoring photosynthetic responses of wildfire and bark beetle-induced tree mortality using satellite observations of solar-induced chlorophyll fluorescence (SIF) [Oral Presentation] *American Geophysical Union Fall Meeting.* New Orleans, LA.

Mapping conifer forest drought response with photoprotective pigment dynamics across North America using the MODIS Chlorophyll-Carotenoid Index (CCI) [Oral Presentation] *American Geophysical Union Fall Meeting.* New Orleans, LA.

*2024*

What is the utility of satellite-based solar-induced fluorescence (SIF) for predicting drought-induced forest mortality in the Western US? [Poster Presentation] *American Geophysical Union Fall Meeting Innovation Session.* Washington, DC.

*2023*

Satellite-based solar-induced fluorescence tracks seasonal and elevational patterns of photosynthesis in California's Sierra Nevada mountains. [Oral Presentation] *AmeriFlux Annual Meeting.* Garner, MA.

Early-career remote sensing workshop instructor. *AmeriFlux Annual Meeting.* Garner, MA.

Satellite-based solar-induced fluorescence tracks seasonal and elevational patterns of photosynthesis in California's Sierra Nevada mountains. [Poster Presentation] *American Geophysical Union Fall Meeting Innovation Session.* San Francisco, CA.

*2022*

Multi-scale Constraints Towards Understanding Conifer Forest Carbon Uptake in Complex Terrain within the Carbon Monitoring System-Mountains Project. [Poster Presentation] *American Geophysical Union Fall Meeting.* Chicago, IL.

Participant in Fluxcourse: two week early-career workshop focusing on foundations of land-atmosphere flux measurement, modeling and synthesis. *University of Colorado Mountain Research Station.* Niwot Ridge, CO.

*2016*

Multiscale Observational Constraints on $CO_2$ Flux Estimation using an Inverse Modeling Approach. [Poster Presentation] *University of Wisconsin – Madison Atmospheric, Oceanic and Space Sciences Poster Reception* Madison, WI.

*2015*

Multiscale Observational Constraints on $CO_2$ Fluxes. [Oral Presentation] *NOAA OEd Science and Education Symposium.* Silver Spring, MD.

## Awards and Honors

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| Future Investigators in NASA Earth and Space Science and Technology (FINESST) Fellow | 2025 |
| Graduate Fellow – Wilkes Center for Climate Science & Policy, University of Utah | 2025 |
| FLUXNET Secondment Award Recipient | 2023 |
| National Science Foundation Graduate Research Fellow | 2022 |
| Distinction in Computer Sciences & Computer Engineering Majors - UW-Madison | 2016 |
| U.S. DOE Science Undergraduate Laboratory Internship (SULI) Scholar | 2016 |
| Best Oral Presentation Award – NOAA Student Science and Education Symposium | 2015 |
| Meyerhoff Undergraduate Excellence Award for Leadership, Service, and Scholarship | 2015 |
| NOAA Ernest F. Hollings Undergraduate Fellow | 2014 |

## Technical Skills

Statistical and Geospatial Data Analysis:

- Python: Jupyter, scipy, scikit-learn, xarray, xESMF, geopandas, cartopy, rasterio, rioxarray, dask
- R: tidyverse (dplyr, ggplot2, tidyr), sf, ncdf4, raster, sp, rgdal
- ArcGIS, QGIS: Raster and Vector data visualization

High Performance Computing & Data Management:

- Advanced Linux/Unix environment expertise including shell scripting
- SLURM job scheduling and monitoring
- parallel batch processing
- automated backup systems (cron jobs, rclone)
- large-scale dataset management across distributed storage systems (Google Drive, Box)

- Software development with AI tools: CoPilot, OpenAI, Claude
- Git version control and repository management

Extensive experience with Earth science data products, models and data archives including:

- Satellite remote sensing datasets: MODIS, VIIRS, SMAP, ECOSTRESS, TROPOMI (S5P-PAL)
- Climate reanalysis: SNODAS, GRIDMET, TerraClimate, ERA, nClimGrid, SPEIbase
- Land surface characteristics: NLCD, ESA CCI Land Cover, SRTM and NOAA ETOPO DEMs
- Biogeochemical model-data fusion products: FLUXCOM, MODIS GPP, CarbonTracker, Solar-Induced Fluorescence products (GOSIF, CSIF, SIF-ESDR, RTSIF)
- Proficient in data acquisition through USGS LPDAAC, NASA AppEARS and Google Earth Engine platforms
- Experience producing datasets using NetCDF Climate and Forecasting (CF) metadata standards
- Community Land Model-5.0 and Community Earth System Model-2: proficiency running and analyzing model output
- Atmospheric dispersion modeling (WRF-STILT, HYSPLIT, AERMOD)

Eddy covariance flux data processing: partitioning of ecosystem fluxes through REddyProc R package and ONEFLUX processing routines

Advanced Statistical Methods: Bayesian inverse modeling, spatial bootstrapping, multivariate kernel density estimation, generalized linear/additive models (GLM/GAM), and spatiotemporal analysis and resampling techniques

Additional experience in programming and analysis with Excel, JavaScript, MATLAB, Android Studio, HTML, Java, C

## Professional Experience

Graduate Research Assistant, University of Utah, Salt Lake City, UT 2021-present

• Conducted research on forest carbon cycling over Western US mountain regions.

Air Quality Consultant, Ramboll Group, Salt Lake City, UT 2019-2021

• Performed comprehensive regulatory emissions and modeling analyses for industrial and commercial clients.

Research Associate, Land-Atmosphere Interactions Research Group, University of Utah, Salt Lake City, UT 2017-2019

• Applied Bayesian statistics to urban greenhouse gas data and models to constrain emissions and quantify uncertainties.

Secondary Education Math Teacher, U.S. Peace Corps, Lesotho 2018

• Taught high school math in a rural district of Lesotho (sub-Saharan Africa) using English and Sesotho.

Contract Researcher, NOAA Earth System Research Laboratory, Boulder, CO 2017

- Assessed network densities and meteorological drivers for data assimilation studies using aircraft and in-situ $CO_2$ data.

Electrical Engineering Intern, National Renewable Energy Laboratory, Golden, CO 2016

- Developed a custom control board and solid-state relay configuration for residential "smart" appliances.

Research Assistant, Desai Ecometeorology Lab, Dept. of Atmospheric Sciences, University of Wisconsin, Madison, WI, 2015-2016

- Integrated ground-based spectrometer data into regional Bayesian inversion techniques to constrain upper tropospheric carbon fluxes.

Hollings Fellow, NOAA Earth System Research Laboratory, Boulder, CO 2015

- Performed synthetic data analyses of Bayesian statistical modeling techniques to aid in regional $CO_2$ flux model development.

Chainsaw Crew Member, Rocky Mountain Conservancy, Grand Lake, CO 2014

- Felled hazardous beetle kill trees near high-use recreation areas in response to Mountain Pine Beetle outbreak

Lab Member, Holloway Air Quality Research Group, University of Wisconsin, Madison, WI 2013

- Examined trends in air pollution and temperature extremes over cities in the US Midwest.

## Teaching and Mentoring Experience

*2024-present*
Adult English Language Tutor, Guadalupe School, Salt Lake City, UT

*2022*
Software programming mentor, REALM– Research Experience for Undergraduates (REU) program, University of Utah, Salt Lake City, UT

*2018*
Instructor, U.S. Peace Corps Math Education Sector, Lesotho

*2017*
Instructor, Bayesian Inverse Modeling Workshop, University of Utah, Salt Lake City, UT

Instructor, Bayesian Inverse Modeling Workshop, NOAA Earth System Research Lab, Boulder, CO

## Professional Service and Volunteerism

Manuscript referee: Science of the Total Environment, Geophysical Research Letters, Environmental Research Letters, Forest Ecology and Management Journals
IOP Trusted reviewer status

Software programming and English language mentor volunteer, Smithsonian Tropical

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| Research Institute, Gamboa, Panama | 2023 |
| Mentor, City of South Salt Lake Promise Program, South Salt Lake, UT | 2020 |
| Mentor, Madison Middle School Science Symposium, Wright Middle School, Madison, WI | 2016 |
| Vice President and Project Manager, Engineers without Borders, University of Wisconsin, Madison, WI | 2015-2016 |
| Education Outreach Coordinator, Engineers without Borders, University of Wisconsin, Madison, WI | 2014 |
| STEM Education Volunteer, Madison Children's Museum, Madison, WI | 2014 |
| Mentor, Science Olympiad, Edgewood High School, Madison, WI | 2013 – 2014 |

## Professional Organizations and Certifications

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| Member - American Geophysical Union | 2022-present |
| Member - Air & Waste Management Association, Great Basin Chapter | 2019-2020 |
| EPA Method 9 Visible Emissions Certification (through AeroMet Engineering) | 2020 |

## Languages Spoken

English (native), Spanish (working proficiency)

## Personal Interests and Accomplishments

Long distance hiking: completion of Superior Hiking Trail (2015), Pacific Crest Trail (2017), Arizona Trail (2018), Uinta Highline Trail (2018), Hayduke Trail (2021), and Wind River High Route (2022)

Cross country skiing: 11-time finisher of American Birkebeiner (Cable, WI)

Curling Instructor at the Utah Olympic Oval, Kearns, UT (2018 – 2022)

Backcountry skiing, canoeing, mountain biking, trail running, climbing, bicycle touring, canyoneering, classical piano