

# DANIEL A. ROTHENBERG

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## RESEARCH INTERESTS

As a leader and innovator in the atmospheric sciences, I've employed novel analytical, modeling, "big data", and AI/ML techniques to help pioneer the field of "atmospheric data science" and tackle cutting-edge research questions in the world of weather and climate.

In my professional career I've championed the application of AI and ML to build new weather forecast and analysis products by both leading and working hands-on with inter-disciplinary teams of research scientists, software engineers, and data scientists. I've also worked with product, strategy, and business teams to develop and execute visions to productize within this space.

In my academic career I studied the multi-faceted role of aerosols in the climate system, especially their influences on clouds and their indirect effects on climate; I've also studied the role of climate variability in driving air quality as a means for better understanding the impacts of climate air pollution policy.

Throughout my research career I've been committed to helping develop open source software and tools in order to support novel applications of machine learning and data science to understanding and solving problems in meteorology. I've also strived to form a robust community of scientists, data scientists, and engineers who would also support these initiatives and themselves contribute to open science.

## EDUCATION

**Massachusetts Institute of Technology, Cambridge, MA**  
Ph.D., Atmospheric Science, Dept. of Earth, Atmospheric and Planetary Sciences OCT 2016  
*Committee:* Chien Wang, Dan Czizco, Paul O'Gorman, Steve Ghan  
*Dissertation Title:* Fundamental Aerosol Interactions and the Aerosol Indirect Effect on Climate

**Cornell University, Ithaca, NY**  
B.S., Atmospheric Science, *magna cum laude*, Honors in Research DEC 2010  
*Thesis Advisor:* Natalie Mahowald  
*Thesis Title:* Volcano Impacts on Climate and Biogeochemistry

## HONORS AND AWARDS

|   |      |
|---|------|
| Outstanding Student Presentation Award (†), AMS                               | 2015 |
| National Science Foundation Graduate Research Fellowship, NSF                 | 2012 |
| National Defense Science And Engineering Fellowship, ASEE ( <i>declined</i> ) | 2012 |
| Father James B. Macelwane Award in Meteorology, AMS                           | 2011 |
| Klein Fellowship, MIT-EAPS  | 2011 |
| Charney Prize, MIT-EAPS   | 2011 |
| Academic Excellence Award - Atmospheric Science, Cornell/CALS                 | 2011 |
| Richard and Helen Hagermeyer Scholarship, AMS                                 | 2010 |

## RESEARCH EXPERIENCE

**Center for Global Change Science, MIT, Cambridge, MA**  
*Postdoctoral Associate* DEC 2016-SEP 2017  
Studied interactions between air quality, climate variability and climate change funded through an EPA Air Quality, Climate, and Energy Center grant, supervised by Noelle Selin and Susan Solomon  
Developed and analyzed large ensemble of IGSM/GEOS-Chem coupled climate-chemistry simulations to understand state-dependence of climate penalty calculations

Studied potential short-term policy impacts on air quality, health and the economy using a novel integrated assessment framework

Instigated and co-developed open-source, Python-based toolkits for accelerating the analysis of GEOS-Chem model output and working with legacy binary file formats in modern workflows

**Program in Atmospheres, Oceans, and Climate, MIT, Cambridge, MA**

*Research Assistant*

AUG 2011-DEC 2016

Used novel uncertainty quantification techniques to develop emulator of droplet activation for parameterization in global models

Developed an open-source, modular parcel modeling framework for studying droplet activation from diverse aerosol populations and for evaluating activation schemes

Used global climate models (CESM, CMIP5 archive, AEROCOM Indirect Effects Experiment) to study aerosol indirect effects and aerosol-cloud interactions

Participated in Fifth Ice Nucleation Workshop Part 2 in Karlsruhe, Germany; assisted with the operation of the Spectrometer for Ice Nucleation (SPIN) and developed software for automating the instrument and designing experiment setups

**Department of Earth and Atmospheric Sciences, Cornell University, Ithaca, NY**

*Undergraduate Research Assistant*

FEB 2008-JUN 2011

Studied biogeochemical/climate processes and interactions with a coupled carbon-climate model

Performed and analyzed fully-coupled model simulations studying transient climate change in the 20th century

**Center for Multiscale Modeling of Atmospheric Processes, Colorado State University, Fort Collins, CO**

*Summer Intern*

SUMMER 2010

Implemented and evaluated a baroclinic instability test case on a very high resolution global atmospheric dynamical core, identifying numerical problems

Developed novel visualization tools for analyzing model data on geodesic computational meshes

**PROFESSIONAL  
ACTIVITIES**

**CMIP6 Hackathon, NCAR, Boulder, CO**

October, 2019

**Rossbypalooza, Climate/Statistics Summer School, University of Chicago, Chicago, IL**

SUMMER 2016

**NSPG, STEM on the Hill Congressional Visits Day, Washington, DC**

SPRING 2015

**AMS, Weather Water and Climate Day, Washington, DC**

JUNE 2015

**AMS, 7th Annual Geosciences Congressional Visits Day, Washington, DC**

SEPTEMBER 2014

**AMS, Summer Policy Colloquium, Washington, DC**

SUMMER 2014

**MIT/SPI, ASTE Science/Engineering Congressional Visits Day, Washington, DC**

SPRING 2012/2014

**CMMAP/NCAR/NCEP, Summer School on Atmospheric Modeling, Boulder, CO**

SUMMER 2010

**TEACHING  
EXPERIENCE**

*Graduate*

**Global Warming Science (12.340x)**

SPRING 2016

MIT-EdX and MIT, Department of Earth, Atmospheric and Planetary Sciences

Teaching Assistant

**Atmospheric Physics and Chemistry (12.806/12.306)**

SPRING 2014-2015

MIT, Department of Earth, Atmospheric, and Planetary Sciences

Teaching Assistant

**"Climate Change Science" IAP Seminar**

WINTER 2011-2013

MIT, Joint Program on the Science and Policy of Global Change

Lecturer

*Undergraduate***Object-Oriented Programming and Data Structures (CS 2110)**

2009-2010

Cornell University, Department of Computer Science

Course Consultant, Teaching Assistant

LEADERSHIP  
AND  
SERVICE**American Meteorological Society**

Committee on Open Environmental Information Services

Member

2023-PRESENT

Committee on Environmental Stewardship

Member

2019-PRESENT

Annual Meeting Oversight Committee

Member

2017-2020

Student Conference Planning Committee

Co-Chair

2015-2016

Session Chair

2011-2014

AMS Committee on Environmental Information Processing Technologies

Member, Python Symposium Committee

2018-PRESENT

Session Chair, *Teaching, Training, Outreach, and Building Communities around Python*

2018

Session Co-organizer, *Scalable Operational Artificial Intelligence Applications with Python*

2019

**Reviewer**

Proceedings of the National Academies of Science

Journal of Geophysical Research - Atmospheres

Journal of Climate

Atmospheric Chemistry and Physics

The Journal of Open Source Education

IBM World Community Grid

**Pangeo-data**

Founding Member and Developer

2016-PRESENT

Lead, Data Management Technical Working Group

2018-2021

**Graduate Climate Conference Executive Committee**

MIT/Woods Hole Oceanographic Institution/University of Washington

Co-Chair

2013

Steering Committee Member

2015

Advisor; Fundraising Chair

2015

**Atmospheric Sciences Seminar Committee**

MIT Department of Earth, Atmospheric, and Planetary Sciences

Member

2012-2014

Chair

2014-2015

**Science Policy Initiative Executive Committee**

2013-2016

Massachusetts Institute of Technology

**Climate Voices**

Speaker

2016-2018

**/r/science Moderator**  
Reddit (volunteer)

2010-2011, 2016

WORK  
EXPERIENCE

**Google Research**

*Staff Software Engineer (Bungee)*

NOVEMBER 2023-DECEMBER 2023

Developed and implemented evaluation frameworks and software to guide the development of a fourth-generation MetNet AI-based short-range forecasting system, with an emphasis on supporting downstream product applications in Africa, South America, and India

**Waymo**

*Technical Lead, Atmospheric Science (Staff Software Engineer)*

JULY 2021-OCTOBER 2023

Worked across Product, Perception, and Systems Engineering teams to develop and execute a roadmap to launch an all-weather autonomous vehicle capability, expanding Waymo One's operational design domain to encompass more than 99% of potential operating time in its San Francisco, Phoenix, and Los Angeles service territories.

Implemented a strategy to [leverage Waymo vehicles as mobile weather stations](#) by boot-strapping weather estimation capabilities on top of our existing sensor/Perception stack; this led to a significant increase in the amount of weather data we autonomously collected and labeled, accelerating the launch of product operations in inclement weather conditions

Led the development and implementation of infrastructure to collect and process fleet-borne measurements in real-time to monitor weather conditions and changes across operational territories

Established research partnerships with academic and public labs for furthering investments in sensor- and ML-based weather estimation techniques and experimental design for testing all-weather vehicle capabilities

Developed and implemented concepts of operations and safety protocols for responding to severe and hazardous weather, including winter storms and severe convective weather including hailstorms and tornadoes

Implemented strategies and infrastructure for consuming weather data and forecasts from first- and third-party vendors, and incorporated them into operational decision-making frameworks

**Tomorrow.io (formerly ClimaCell)**

*Advisor*

JULY 2021-OCTOBER 2021

*Chief Scientist*

SEP 2018-JULY 2021

*Director of Meteorology*

AUG 2017-SEP 2018

Oversaw the research, development, and implementation of a real-time, global, high-resolution precipitation observation system using commercial cellular microwave links, radars, and satellite datasets

Managed and mentored a team of 2-6 physical scientists, data scientists, and engineers across multiple offices conducting research and product development to support company initiatives; group alumni have advanced their careers in atmospheric data science at CalTech, NOAA/CIRA, Indigo, Microsoft, and other high profile institutions/companies

Established an internal applied research division (ClimaCell Labs) with a focus on develop AI-powered applications for applied weather analysis and forecasting; developed proposals for SBIR and other competitive federal funding programs sponsored by NOAA, NSF, and DOE

Created and managed long-term research and development roadmaps aligned with emerging company business and strategic opportunities

Established professional forecasting services unit within the company to broaden product portfolio in support of improving client satisfaction and retention

Developed and implemented a high-performance, Python-based quantitative precipitation nowcasting system optimized for performance on the cloud and deployed the model operationally (with >99.9% SLA) to provide nowcasts based on radar and satellite-derived datasets for domains across the world

Developed and prototyped a cloud-optimized, tera-scale geoscientific data archival system based on Pangeo stack (dask, Zarr, Intake, kubernetes) and curated over 100 TB of data from reanalysis (ERA-5), NWP (multi-year HRRR archive) and proprietary datasets

#### **Google / Ravenbrook Software**

SUMMER 2011

*Contract Developer, Google Summer of Code*

Ported a high-performance algorithm used in surface temperature analysis at the National Climatic Data Center from Fortran to Python

Developed extensive documentation and test suite for algorithm

Identified and corrected numerous numerical and programming bugs and validated algorithm against synthetic datasets

#### **Orion Network Services**

JUL 2006-AUG 2007

*Software Developer*

Developed an online river flooding visualization tool for NOAA using ArcGIS and other scripting tools

### **PUBLICATIONS**

#### *Refereed / Peer-Reviewed*

1. Eastham, S., Monier, E., **Rothenberg, D.**, Paltsev, S., Selin, N.: [Rapid estimation of climate-air quality interactions in integrated assessment using a response surface model](#), ACS Environ. AU, 3, 3, 153-163. doi:10.1021/acsenvironau.2c00054, 2023
2. Silva, S., Ma, P.-L., Hardin, J., **Rothenberg, D.**: [Physically Regularized Machine Learning Emulators of Aerosol Activation](#), Geosci. Model Dev., 14, 3067–3077, doi:10.5194/gmd-14-3067-2021, 2021.
3. Koecorius, S., **et al**: [New particle formation and its effect on CCN abundance in the summer Arctic: a case study during PS106 cruise](#), Atmos. Chem. Phys., doi:10.5194/acp-19-14339-2019, 2019.
4. Dimanchev, E. G., Paltsev, S., Yuan, M., **Rothenberg, D.**, Tessum, C. W., Marshall, J. D., and Selin, N. E.: [Health co-benefits of sub-national renewable energy policy in the US](#), Environ. Res. Lett. 14, 085012, doi:10.1088/1748-9326/ab31d9, 2019.
5. **Rothenberg, D.**, Wang, C., and Avramov, A.: [On the representation of aerosol activation and its influence on model-derived estimates of the aerosol indirect effect](#), Atmos. Chem. Phys., doi:10.5194/acp-18-7961-2018, 2018.
6. Demott, P. J., **et al**: [The Fifth International Workshop on Ice Nucleation phase 2 \(FIN-02\): Laboratory intercomparison of ice nucleation measurements](#), Atmos. Meas. Tech., 11, 6231-6257, doi:10.5194/amt-11-6231-2018, 2018.
7. Jin, Q., Grandey, B. S., **Rothenberg, D.**, Avramov, A., Wang, C.: [Impacts of Ship Emission Regulations, DMS Emissions, and Aerosol Mixing States on Cloud Radiative Effects of International Shipping Emissions](#), Atmos. Chem. Phys., Discuss., doi:10.5194/acp-2018-416, 2018
8. Tong, C. H. M., Yim, S., **Rothenberg, D.**, Wang, C., Lin, C-Y, Chen, Y., Lau, N-C: [Projecting the impacts of atmospheric conditions under climate change on air quality over the Pearl River Delta region](#), Atmos. Environ., doi:10.1016/j.atmosenv.2018.08.053, 2018
9. Tong, C. H. M., Yim, S., Chen, Y., Lau, N-C, **Rothenberg, D.**: [Assessing the Impacts of Seasonal Atmospheric Conditions on Air Quality over the Pearl River Delta Region](#), Atmos. Environ., doi:10.1016/j.atmosenv.2018.08.053, 2018
10. Grandey, B. S., **Rothenberg, D.**, Avramov, A., Jin, Q., Lee, H., Wang, C.: [Effective radiative forcing in the aerosol—climate model CAM5.3-MARC-ARG compared to default CAM5.3](#), Atmos. Chem. Phys., 18, 15783-15810, doi:10.5194/acp-18-15783-2018, 2018
11. Garimella, S., **Rothenberg, D.**, Wang, C., Cziczo, D. J.: [How uncertainty in field measurements of ice nucleating particles influences modeled cloud forcing](#), J. Atmos. Sci., doi:10.1175/JAS-D-17-0089.1, 2017

12. Garimella, S., **Rothenberg, D. A.**, Wolf, M. J., David, R. O., Kanji, Z. A., Wang, C., Roesch, M., and Cziczo, D. J.: [Uncertainty in counting ice nucleating particles with continuous diffusion flow chambers](#), *Atmos. Chem. Phys.*, 17, 10855–10864, doi:10.5194/acp-17-10855-2017, 2017.
13. **Rothenberg, Daniel** and Chien Wang: [An aerosol activation metamodel of v1.2.0 of the pyrcel cloud parcel model: development and offline assessment for use in an aerosol–climate model](#), *Geosci. Model Dev.*, 10, 1817–1833, doi:10.5194/gmd-10-1817-2017, 2017.
14. Garimella, S., Kristensen, T. B., Ignatius, K., Welti, A., Voigtländer, J., Kulkarni, G. R., Sagan, F., Kok, G. L., Dorsey, J., Nichman, L., **Rothenberg, D.**, Rösch, M., Kirchgäßner, A., Ladkin, R., Wex, H., Wilson, T. W., Ladino, L. A., Abbatt, J. P. D., Stetzer, O., Lohmann, U., Stratmann, F., and Cziczo, D. J.: [The SPectrometer for Ice Nuclei \(SPIN\): An instrument to investigate ice nucleation](#), *Atmos. Meas. Tech.*, doi:10.5194/amt-9-2781-2016, 2016.
15. **Rothenberg, Daniel** and Chien Wang: [Metamodeling of Droplet Activation for Global Climate Models](#), *J. Atmos. Sci.*, 73, 1255–1272. doi:10.1175/JAS-D-15-0223.1, 2016
16. **Rothenberg, D.**, Mahowald, N., Lindsay, K., Doney, S. C., Moore, J. K., and Thornton, P.: [Volcano impacts on climate and biogeochemistry in a coupled carbon–climate model](#), *Earth Syst. Dynam.*, 3, 121–136, doi:10.5194/esd-3-121-2012, 2012.
17. Mahowald, N., Lindsay, K., **Rothenberg, D.**, Doney, S. C., Moore, J. K., Thornton, P., Randerson, J. T., and Jones, C. D.: [Desert dust and anthropogenic aerosol interactions in the Community Climate System Model coupled-carbon-climate model](#), *Biogeosciences*, 8, 387–414, doi:10.5194/bg-8-387-2011, 2011.
18. Mahowald, N. M., Kloster, S., Engelstaedter, S., Moore, J. K., Mukhopadhyay, S., McConnell, J. R., Albani, S., Doney, S. C., Bhattacharya, A., Curran, M. A. J., Flanner, M. G., Hoffman, F. M., Lawrence, D. M., Lindsay, K., Mayewski, P. A., Neff, J., **Rothenberg, D.**, Thomas, E., Thornton, P. E., and Zender, C. S.: [Observed 20th century desert dust variability: impact on climate and biogeochemistry](#), *Atmos. Chem. Phys.*, 10, 10875–10893, doi:10.5194/acp-10-10875-2010, 2010.

#### *Other*

1. **Rothenberg, Daniel**, Michael James, and Robert Chen: [What’s in the forecast: Using cutting-edge weather research to advance the Waymo Driver](#). Waymo Blog. November 14, 2022.
2. **Rothenberg, Daniel**: [Seeing through the haze to learn how clouds shape climate](#). *Physics Today*, doi:10.1063/PT.5.4027. February 2, 2017.

#### *Software*

1. [ai-models-for-all: Run AI NWP forecasts hassle-free, serverless in the cloud!](#). Last Updated: vo.2.0, January, 2024
2. [pyrcel: cloud parcel model](#). doi: 10.5281/zenodo.163265. Last Updated: v1.3.2, September, 2023.
3. [MARC: Model for Research of Aerosols and Climate](#). doi:10.5281/zenodo.1117370. Last Updated: v1.0.4, December, 2017
4. [xbpch: xarray interface for bpch files](#). doi:10.5281/zenodo.584153. Last Updated: vo.3.0, May, 2017.
5. [py-mie: Python wrapper for Mie subroutines](#). doi: Last Updated: vo.4.0, December, 2016
6. [experiment: high-performance, distributed processing of large-scale geophysical modeling experiment output](#). Last Updated: December, 2016
7. Contributor/collaborator: [GCPy](#), [xarray](#), [pangeo-data](#)



PRESENTATIONS  
AND  
TALKS

*Invited Talks and Seminars*

- Texas A&M Atmospheric Sciences Seminar, *Invited Speaker*, College Station, TX, April 2024.
- University of Albany Atmospheric Sciences Research Colloquium, *Invited Speaker*, Albany, NY, October 2023.
- Sustainable Science Techniques for Artificial Intelligence in Weather Applications, *Panelist*, AMS Washington Forum, Washington, D.C., 2023
- Self-Driving Automated Vehicles - Role of Public and Private Sector, *Panelist*, AMS Washington Forum, Washington, D.C., 2022
- Using ML/AI for Data-Driven Decision-making. *Presenter/Panelist*, Machine Learning and Artificial Intelligence to Advance Earth System Science: Opportunities and Challenges, Washington, D.C., 2022
- Augmented Weather Applications with Artificial Intelligence. *Chair/Convener*, AMS Washington Forum, Washington, D.C., 2019
- Status of AI in the Atmospheric Sciences. *Panelist*, 18th Conference on Artificial and Computational Intelligence and its Applications to the Environmental Sciences, AMS Annual Meeting, Phoenix, AZ, 2019.
- Rothenberg, D.**, Avramov, A., Wang, C., Garimella, S., Wolf, M., and Cziczo, D. Understanding Fundamental Aerosol-Cloud Interactions and their Contributions to the Aerosol Indirect Effect. NOAA Geophysical Fluid Dynamics Laboratory. Princeton, NJ. 2016

*Conference Talks*

- Rothenberg, Daniel.** [Enabling Scalable, Serverless Weather Model Analyses by "Kerchunking" Data in the Cloud](#). AMS Annual Meeting. Baltimore, MD, 2024.
- Rothenberg, Daniel.** [Driving Hyper-Local Weather Information with Autonomous Vehicles](#). AMS Annual Meeting. Denver, CO, 2023.
- Biryukov, S., Minsk, J., and **Rothenberg, D.** [Physics-Informed Downscaling, Bias Correction, and Bayesian Probabilistic Ensembling of Weather Forecast Models](#). AMS Annual Meeting. Houston, TX / Virtual, 2022.
- Eastham, S., Monier, E., **Rothenberg, D.**, Paltsev, S., Selin, N. [Incorporating High-fidelity Air Quality Simulation into Integrated Assessment Models](#). AGU Fall Meeting. San Francisco, CA, 2020.
- Givati, A. **et al.** [Using Multiple Precipitation Inputs for Flash-Flood Forecasting in Semiarid Environments](#). 34th Conference on Hydrology, AMS Annual Meeting. Boston, MA, 2020.
- Eastham, S., Monier, E., **Rothenberg, D.**, Selin, N. [Time of Emergence for the Influence of Climate Change on Surface Ozone](#). 22nd Conference on Atmospheric Chemistry, AMS Annual Meeting. Boston, MA, 2020.
- Rothenberg, Daniel.** [Rapidly Prototyping High-performance Meteorological Data Systems Using Xarray and Numba](#). Ninth Symposium on Advances in Modeling and Analysis Using Python, AMS Annual Meeting. Phoenix, AZ, 2019.
- Rothenberg, Daniel.** [How JetBlue Airways Uses Microweather Forecasts in Daily Operations, Based on Novel Data Sources, New Nowcasting Models, and Products](#). 9th Conference on Aviation, Range, and Aerospace Meteorology, AMS Annual Meeting. Phoenix, AZ, 2019.
- Gilford, D., Solomon, S., Emanuel, K., and **Rothenberg, D.** [Seasonal Cycles in North Atlantic and Western Pacific Tropical Cyclone Maximum Intensity](#). AMS Annual Meeting. Phoenix, AZ, 2019.
- Rothenberg, D.**, Garcia-Menendez, F., Solomon, S., and Selin, N. Regional Variation in the Time of Emergence of Air Quality Climate Penalties Under Climate Change Mitigation Scenarios. AMS Annual Meeting. Austin, 2018.
- Rothenberg, D.**, Wang, C., and Avramov, A. [Contributions of Uncertainty in Droplet Nucleation to the Indirect Effect in Global Models](#). AGU Fall Meeting. San Francisco, 2016. | PPTX

- Rothenberg, Daniel.** [A Python-based Parcel Model Framework for Studying Aerosol-Cloud Processes](#). Sixth Symposium on Advances in Modeling and Analysis Using Python. New Orleans, 2016. | [PDF](#)
- Rothenberg, D.,** Wang, C., and Avramov, A. [On the Sensitivity of Model-derived Estimates of Aerosol Indirect Effects and Forcings to Activation Schemes](#). 96th Annual Meeting of the American Meteorological Society, Eighth Symposium on Aerosol-Cloud-Climate Interactions. New Orleans, LA. 2016.
- † **Rothenberg, Daniel,** Chien Wang and Alexander Avramov. [Evaluating Advanced Aerosol Activation Treatments in a Coupled Climate/Mixing-State Resolving Aerosol Model](#). 95th Annual Meeting of the American Meteorological Society, 7th Symposium on Aerosol-Cloud-Climate Interactions. Phoenix, AZ. 2015. | [PDF](#)
- Rothenberg, Daniel** and Chien Wang. Evaluating the Role of Aerosol Mixing State in Cloud Droplet Nucleation using a New Activation Parameterization. American Geophysical Union Fall Meeting, (A34D-03). 2013.
- Rothenberg, Daniel** and Chien Wang. [Cloud and Climate Impacts in a Hazy World Simulation](#). 93rd Annual Meeting of the American Meteorological Society, 5th Symposium on Aerosol-Cloud-Climate Interactions. Austin, TX. 2014.
- Rothenberg, Daniel** and Nick Barnes. [Lessons From Deploying the USHCN Pairwise Homogenization Algorithm in Python](#). 92nd Annual Meeting of the American Meteorological Society, Second Symposium on Advances in Modeling and Analysis Using Python. New Orleans, LA. 2012

#### *Proposed / Chaired Conference Sessions*

- Pure AI and Data-Driven Weather Forecasts. 23rd Conference on Artificial Intelligence for Environmental Science. AMS Annual Meeting, Baltimore, MD, 2024.
- Towards Operationalizing AI/ML Weather Forecast and Decision Support Products. Joint with the 14th Conference on Transition of Research to Operations and 23rd Conference on Artificial Intelligence for Environmental Science AMS Annual Meeting, Baltimore, MD, 2024.
- Towards Operationalizing AI-Based Weather Forecast and Decision Support Products. 22nd Conference on Artificial Intelligence for Environmental Science. AMS Annual Meeting, Denver, CO, 2023.
- Toward Operational Precipitation and Convective Weather Nowcasting Leveraging Deep Learning. 21st Conference on Artificial Intelligence for Environmental Science. AMS Annual Meeting, Houston, TX / Virtual, 2022
- Nowcasting and Short-Term Forecasting Applications Leveraging AI. 20th Conference on Artificial Intelligence for Environmental Science and 11th Symposium on Advances in Modeling and Analysis Using Python. AMS Annual Meeting, Virtual, 2021
- Scalable Operational Artificial Intelligence Applications with Python. Ninth Symposium on Advances in Modeling and Analysis Using Python. AMS Annual Meeting, Phoenix, AZ, 2019
- Augmented Weather Applications with Artificial Intelligence. AMS Washington Forum, Washington, D.C., 2019

#### *Conference Posters*

- Gilford, D., Solomon, S., Emanuel, K. and **Rothenberg, D.** [Seasonal Cycles in North Atlantic and Western Pacific Tropical Cyclone Maximum Intensity](#). 99th Annual Meeting of the American Meteorological Society. Phoenix, AZ. 2019. | [PDF](#)
- Rothenberg, Daniel** and Chien Wang. [Assessing Regional Differences in Aerosol-Cloud Interactions and their Contribution to the Global Indirect Effect](#). 97th Annual Meeting of the American Meteorological Society, Ninth Symposium on Aerosol-Cloud-Climate Interactions. Seattle, WA. 2017. | [PDF](#)
- Garimella, S., **Rothenberg, D.**, Wolf, M., Zawadowicz, M., Christopoulos, C., Froyd, K. D., Huang, Y.-w., Murphy, D., Wang, C., and Cziczo, C. Climate implications of coal fly ash particles due to ice



- cloud formation. 35th Annual Conference, American Association for Aerosol Research. Portland, OR. 2016.
- Rothenberg, D.**, Wang, C. and Avramov, A. Impacts of Droplet Activation on Fast and Slow Responses in a Coupled Aerosol-Climate Model. Gordon Research Seminar/Conference. Bates College, ME. 2015 | [PDF](#)
- Rothenberg, Daniel** and Chien Wang. Assessing the sensitivity of global aerosol indirect effects to activation treatment. Graduate Climate Conference, University of Washington. Seattle, WA. 2014
- Rothenberg, Daniel** and Chien Wang. [A Novel Parameterization of Droplet Activation Suitable for Global Climate Models](#). 14th Conference on Cloud Physics, American Meteorological Society. Boston, MA. 2014 | [PDF](#)
- Rothenberg, Daniel** and Chien Wang. [A Novel Parameterization of Droplet Activation Suitable for Global Climate Models](#). CENSAM Workshop. Singapore. 2014
- Rothenberg, Daniel** and Chien Wang. Evaluating the Role of Aerosol Mixing State in Cloud Droplet Nucleation using a New Activation Parameterization. 94th Annual Meeting of the American Meteorological Society, Sixth Symposium on Aerosol-Cloud-Climate Interactions. Atlanta, GA. 2013. | [PDF](#)
- Rothenberg, Daniel** and Chien Wang. Global Climate Response to Enhanced Anthropogenic Aerosol Emissions in a “hazy world” Experiment with the CESM. 6th Graduate Climate Conference. 2013.
- Rothenberg, Daniel** and Ross Heikes. [A baroclinic instability test case on an anelastic dynamical core](#). 91st Annual Meeting of the American Meteorological Society, 24th Conference on Weather and Forecasting/20th Conference on Numerical Weather Prediction. Seattle, WA. 2012.

#### *Technical and Programming Talks*

- Rothenberg, Daniel.** Tutorial: Moving from Single Jobs to Many Nodes: Dask, X-Array, and Pangeo. 99th Annual Meeting of the American Meteorological Society, Ninth Symposium on Advances in Modeling and Analysis Using Python. Phoenix, AZ. 2019
- Rothenberg, Daniel.** Climate Data Science: A Framework for Improving Computational Climate Analysis. 98th Annual Meeting of the American Meteorological Society, Eighth Symposium on Advances in Modeling and Analysis Using Python. Austin, TX. 2018
- Rothenberg, Daniel.** [Basic Pandas](#). 97th Annual Meeting of the American Meteorological Society, Seventh Symposium on Advances in Modeling and Analysis Using Python. Seattle, WA. 2017

#### *Patents*

- Rothenberg, Daniel.** [Improved Forecasting Method with Machine Learning](#). US Patent US20200132884A1. Pending, April 30, 2020
- Elkabetz, S. **et al.** [Real-time weather forecasting for transportation systems](#). US Patent US10962680B2. March 3, 2021.
- Elkabetz, S. **et al.** [Improved real-time weather forecasting system](#). World Patent WO2019126707A1. June 27, 2019.

#### *Public Talks and Engagement*

- [Weather Brains Episode 889: Ankle Bracelet for Highway Jerks](#) (Waymo and Weather). Weather Brains Podcast. January 31, 2023.
- Climate Chords. WUOL, WFPL, and SONICBernheim. Louisville, KY, August 2018
- [What’s the Deal with Climate Change?](#) Esplanade Association Lecture Series. Boston, MA. 2017
- Additional talks to churches, community organizations, and classrooms through [Climate Voices](#).

*Note: annotations (†, etc) correspond to “Honors and Awards” section.*

|                                     |              |
|-------------------------------------|--------------|
| American Physical Society           | 2011-PRESENT |
| American Geophysical Union          | 2013-PRESENT |
| Association for Computing Machinery | 2011-2012    |

## TECHNICAL SKILLS

*Note: Please visit my [Github](#) page for examples of projects implementing these skills*

**Data Science** - Python (*expert*), Spark/dask/MPI, Prefect/Airflow/Argo, Matlab, Java, d3.js, git/hg/svn, R (*familiar*)

**AI and Machine Learning** - Python (*expert*), TensorFlow/PyTorch/JAX; significant practical experience building CNN- and Transformer-based models for remote sensing and weather forecasting applications; operationalizing AI systems for production use cases

**Numerical Modeling** - Python/NumPy/Cython/Numba, Julia, legacy/modern Fortran, C/C++/CUDA; emphasis on scientific software design and application of software engineering to numerical codes/tools, as well as the development of high-performance, distributed analysis systems for tera/peta-scale data.

**DevOps** - Kubernetes, Argo, Helm

**Atmospheric/Climate Models** - [pyrcel](#), GEOS-Chem/GCHP, CESM, MIT-CRM, WRF (*familiar*)

**High-Performance Computing** - Google Cloud Platform/Amazon Web Services; NCAR supercomputers (bluefire/yellowstone/cheyenne); previously worked on NERSC and Oak Ridge systems

**Web Design** - Django, ghost, Pelican, HTML/CSS

## PERSONAL INTERESTS

Violin performance - classical (26 years), Winter sports, Backpacking/hiking, Software development/engineering, Meteorology education/forecasting, Debate and rhetoric, Science/Innovation policy

*Last Updated: February 6, 2024*