Drew Pendergrass

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Pierce Hall G3G
29 Oxford Street
Cambridge, MA 02138

EDUCATION

Harvard University — Cambridge, Mass.
Ph.D. student, Environmental Science and Engineering. June 2020 – Present
Advisor: Daniel J. Jacob.

Harvard University — Cambridge, Mass.
B.A., Physics and Mathematics; minor in English. May 2020
Summa cum laude and highest departmental honors.

PROFESSIONAL EXPERIENCE

Graduate research assistant — June 2020 – Present.
Harvard School of Engineering and Applied Sciences — *Advisor: Daniel J. Jacob*

Undergraduate research assistant — May 2019 – August 2019
Geophysical Fluid Dynamics Laboratory (GFDL/NOAA) — *Advisor: Larry Horowitz*

Undergraduate research assistant — January 2019 – May 2020
Harvard University School of Public Health — *Advisor: Samuel Myers*

Undergraduate research assistant — June 2018 – August 2018
Chinese University of Hong Kong — *Advisor: Amos Tai*

Undergraduate research assistant — December 2016 – February 2019
Harvard School of Engineering and Applied Sciences — *Advisors: Daniel J. Jacob, Loretta Mickley*

SCIENTIFIC PUBLICATIONS (*submitted; †undergraduate advisee)

*12. Beaudry E., D. J. Jacob, K. H. Bates, S. Zhai, L. H. Yang, **D. C. Pendergrass**, N. K. Columbi, I. Simpson, A. Wisthaler, J. R. Hopkins, K. Li, and H. Liao. Ethanol and Methanol in South Korea and China: evidence for large emissions of volatile chemical products (VCPs). *In prep.*

*11. Dang, R., D. J. Jacob, S. Zhai, L. H. Yang, **D. C. Pendergrass**, P. Coheur, L. Clarisse, M. Van Damme, J.-S. Choi, J.-S. Park, Z. Liu, P. Xie, and H. Liao. A satellite-based indicator for diagnosing particulate nitrate sensitivity to precursor emissions: application to East Asia, Europe, and North America. *In review at Environmental Science and Technology.*

*10. **Pendergrass, D.C.**, D. J. Jacob, Y. J. Oak, J. Lee, M. Kim, J. Kim, S. Lee, S. Zhai, H. Irie, and H. Liao. A continuous 2011-2022 record of fine particulate matter ($PM_{2.5}$) in East Asia at daily 2-km resolution from geostationary satellite observations: population exposure and long-term trends. *Submitted to Atmos. Env.*

*9. Liu, T., F.M. Panday†, M.C Caine†, M. Kelp, **D. C. Pendergrass**, L. J. Mickley. Is the smoke aloft? Caveats of using the Hazard Mapping System (HMS) smoke product as a proxy of surface smoke presence across the United States. *In revision at International Journal of Wildland Fire.*

8. Yang, L. H., Jacob, D. J., Dang, R., Oak, Y. J., Lin, H., Kim, J., Zhai, S., Colombi, N. K., **Pendergrass, D. C.**, Beaudry, E., Shah, V., Feng, X., Yantosca, R. M., Chong, H., Park, J., Lee, H., Lee, W.-J., Kim, S., Kim, E., … Liao, H. (2024). Interpreting Geostationary Environment Monitoring Spectrometer (GEMS) geostationary satellite observations of the diurnal variation in nitrogen dioxide (NO2) over East Asia. *Atmospheric Chemistry and Physics*, 24(12), 7027–7039. https://doi.org/10.5194/acp-24-7027-2024.

7. Dang, R., Jacob, D. J., Zhai, S., Coheur, P., Clarisse, L., Van Damme, M., **Pendergrass, D. C.**, Choi, J., Park, J., Liu, Z., & Liao, H. (2023). Diagnosing the Sensitivity of Particulate Nitrate to Precursor Emissions Using Satellite Observations of Ammonia and Nitrogen Dioxide. *Geophysical Research Letters*, 50(24), e2023GL105761. doi:10.1029/2023GL105761

6. **Pendergrass, D. C.**, Jacob, D. J., Nesser, H., Varon, D. J., Sulprizio, M., Miyazaki, K., & Bowman, K. W. (2023). CHEEREIO 1.0: A versatile and user-friendly ensemble-based chemical data assimilation and emissions inversion platform for the GEOS-Chem chemical transport model. *Geoscientific Model Development*, 16(16), 4793–4810. doi:10.5194/gmd-16-4793-2023

5. Varon, D. J., Jacob, D. J., Hmiel, B., Gautam, R., Lyon, D. R., Omara, M., Sulprizio, M., Shen, L., **Pendergrass, D. C.**, Nesser, H., Qu, Z., Barkley, Z. R., Miles, N. L., Richardson, S. J., Davis, K. J., Pandey, S., Lu, X., Lorente, A., Borsdorff, T., … Aben, I. (2023). Continuous weekly monitoring of methane emissions from the Permian Basin by inversion of TROPOMI satellite observations. *Atmospheric Chemistry and Physics*, 23(13), 7503–7520. doi:10.5194/acp-23-7503-2023

4. Chen, Z., Jacob, D. J., Gautam, R., Omara, M., Stavins, R. N., Stowe, R. C., Nesser, H., Sulprizio, M. P., Lorente, A., Varon, D. J., Lu, X., Shen, L., Qu, Z., **Pendergrass, D. C.**, & Hancock, S. (2023). Satellite quantification of methane emissions and oil–gas methane intensities from individual countries in the Middle East and North Africa: Implications for climate action. *Atmospheric Chemistry and Physics*, 23(10), 5945–5967. doi:10.5194/acp-23-5945-2023

3. Zhai, S., Jacob, D. J., **Pendergrass, D. C.**, Colombi, N. K., Shah, V., Yang, L. H., Zhang, Q., Wang, S., Kim, H., Sun, Y., Choi, J.-S., Park, J.-S., Luo, G., Yu, F., Woo, J.-H., Kim, Y., Dibb, J. E., Lee, T., Han, J.-S., … Liao, H. (2023). Coarse particulate matter air quality in East Asia: Implications for fine particulate nitrate. *Atmospheric Chemistry and Physics*, 23(7), 4271–4281. doi:10.5194/acp-23-4271-2023

2. **Pendergrass, D. C.**, S. Zhai, J. Kim, J-H. Koo, S. Lee, M. Bae, S. Kim, H. Liao, and D. J. Jacob. (2022). Continuous mapping of fine particulate matter (PM$_{2.5}$) air quality in East Asia at daily 6x6 km^2 resolution by application of a random forest algorithm to 2011-2019 GOCI geostationary satellite data. *Atmospheric Measurement Techniques*, 15, 1075–1091, doi: 10.5194/amt-15-1075-2022

1. **Pendergrass, D. C.**, Shen, L., Jacob, D. J., & Mickley, L. J. (2019). Predicting the Impact of Climate Change on Severe Wintertime Particulate Pollution Events in Beijing Using Extreme Value Theory. *Geophysical Research Letters*, 46(3), 1824–1830. doi: 10.1029/2018GL080102.

SCIENTIFIC DATASETS

Pendergrass, D. C., Jacob, D. J., Oak, Y. J., Lee, J., Kim, M., Kim, J., Lee, S., Zhai, S., Irie, H., & Liao, H. (2024). *Continuous 2011-2022 record of fine particulate matter (PM2.5) in East Asia at daily 2-km resolution from GOCI I and II satellite observations* [dataset]. Harvard Dataverse. doi:10.7910/DVN/0GO7BS

Pendergrass, D. C., S. Zhai, J. Kim, J-H. Koo, S. Lee, M. Bae, S. Kim, H. Liao, and D. J. Jacob. (2021). *Continuous daily maps of fine particulate matter (PM$_{2.5}$) air quality in East Asia by application of*

a random forest algorithm to GOCI geostationary satellite data [Data set]. Harvard Dataverse. doi: 10.7910/DVN/0L3IP7

SELECTED SCIENTIFIC CONFERENCE PRESENTATIONS

D. C. Pendergrass, D. J. Jacob, N. Balasus, L. Estrada, D. J. Varon, T. A. Mooring, J. D. East, E. Penn, and H. O. Nesser. Continuous sub-weekly monitoring of global methane emissions from an ensemble Kalman filter at 2°×2.5° degrees using TROPOMI observations.
- 11th International GEOS-Chem Meeting (IGC11), St. Louis, Mo., June 2024. Poster.

Pendergrass, D. C., D. J. Jacob, Y. Oak, J. Kim, J. Lee, S. Lee, S. Zhai, and H. Liao. High spatiotemporal resolution trends of fine particulate matter ($PM_{2.5}$) in East Asia inferred from the GOCI geostationary instrument, 2011-2022.
- GEMS science meeting, Jeju, S. Korea, September 2023. Talk.
- American Meteorological Society meeting, Baltimore, Md., February 2024. Poster.

Pendergrass, D. C., D. J. Jacob, H. O. Nesser, D. J. Varon, M. Sulprizio, K. Miyazaki, and K. W. Bowman. CHEEREIO: a generalized, open-source ensemble-based chemical data assimilation and emissions inversion platform for the GEOS-Chem chemical transport model.
- American Geophysical Union Fall Meeting, Chicago, Ill., December 2022. Poster.
- GEMS science meeting, Seoul, S. Korea, November 2022. Talk.
- 10th International GEOS-Chem Meeting (IGC10), St. Louis, Mo., June 2022. Talk.

Pendergrass, D. C., D. J. Jacob, S. Zhai, J. Kim, J-H. Koo, M. Bae, and S. Kim. Continuous Mapping of Fine Particulate Matter ($PM_{2.5}$) Air Quality in East Asia by Application of a Random Forest Algorithm to GOCI Geostationary Satellite Data.
- American Geophysical Union Fall Meeting, New Orleans, La., December 2021. Talk.
- GEMS science meeting, Seoul, S. Korea, November 2022. Poster.

Pendergrass, D. C., L.W. Horowitz, and V. Naik. Modeling impact of strong regulation of near-term climate forcers in China on mid-21st century air quality and climate using the GFDL-ESM4 coupled model. American Geophysical Union Fall Meeting, San Francisco, Calif., December 2019. Talk.

Pendergrass, D. C., L. Shen, D. J. Jacob, and L. J. Mickley. Predicting the impact of climate change on severe winter haze pollution events in Beijing using extreme value theory. American Geophysical Union Fall Meeting, Washington D.C., December 2018. Talk.

SELECTED INVITED TALKS

"Using CHEEREIO," IGC11 workshop, St. Louis, Mo.	June 2024
Yonsei University, Seoul, S. Korea (remote)	October 2023
George Mason University, Fairfax, Va. (remote)	September 2023
Harvard Grad Student Postdoc Seminar, Cambridge, Mass.	February 2023
Ajou University, Suwon, S. Korea	November 2022
Seoul National University, Seoul, S. Korea	November 2022
Yonsei University, Seoul, S. Korea	November 2022

TEACHING

ESE 6: Introduction to Environmental Science and Engineering (Teaching Fellow)   Spring 2023
   Rewrote existing R curriculum for a Python track

EPS 200: Atmospheric Chemistry and Physics (Teaching Fellow)   Fall 2021
   Awarded Certificate of Distinction in Teaching by Harvard Office of Undergraduate Education

MENTORSHIP

Stephen Shek (Chinese University of Hong Kong, class of 2026)   Jan. 2024 – Present
  - Project: Extreme springtime particulate formation events over South Korean farmland. Co-mentor with Ellie Beaudry.

Greta Schultz (University of Wisconsin, class of 2025)   June 2023 – Aug. 2023
  - Project: Emergency Mobile Monitoring for California Wildfire Smoke. Co-mentor with Makoto Kelp and Loretta Mickley. NSF REU student. **Presented at AMS 2024 meeting**.

Maggie Schultz (Harvard University, class of 2022)   Jan. 2022 – Dec. 2022
  - Project: Using machine learning to downscale real-time pollution data. Co-mentor with Makoto Kelp and Loretta Mickley. **Senior thesis for environmental engineering**.

Sanjna Kedia (Harvard University, class of 2025)   Jan. 2022 – Aug. 2022
  - Project: Application of deep learning to detection of wildfire smoke in the NOAA Hazard Mapping System over North America. Co-mentor with Makoto Kelp and Loretta Mickley

Lewis McAllister (Harvard University, class of 2022)   June 2021 – Jan. 2022
  - Project: Extreme springtime particulate formation events over South Korean farmland. Co-mentor with Ellie Beaudry and Daniel Jacob.

Marie Panday (University of Maryland, class of 2022)   June 2021 – Aug. 2021
  - Project: Agreement between the NOAA Hazard Mapping System product and ground-level airport smoke in the US. Co-mentor with Tina Liu, Makoto Kelp, and Loretta Mickley. NSF REU student. **Presented at AGU 2021 fall meeting; work led to coauthorship on manuscript**.

Miah Caine (Harvard University, class of 2023)   June 2020 – May 2021
  - Project: Agreement between the NOAA Hazard Mapping System product and ground-level airport smoke in the US. Co-mentor with Tina Liu, Makoto Kelp, and Loretta Mickley. **Work led to coauthorship on two manuscripts**.

Kent Toshima (Harvard University, class of 2021)   June 2020 – Aug. 2021
  - Project: Application of deep learning to detection of wildfire smoke over North America. Co-mentor with Tina Liu, Makoto Kelp, and Loretta Mickley.

HONORS AND AWARDS

CASE Grand Gold Circle of Excellence Award for column and opinion writing   2021
Stonington Graduate Fellowship in Environmental Science and Engineering   2020-21
Sigma Xi associate member (Scientific Research Honor Society)   June 2020
NSF Graduate Research Fellowship (GRFP)   April 2020
Phi Beta Kappa   2019
NOAA Ernest F. Hollings Scholarship   April 2018
Jacob Wendell Scholarship Prize   April 2018

Detur Book Prize	February 2018
Harvard College Veritas Award	April 2017
National Courage in Student Journalism prize	November 2016
National Merit Scholarship	2016

MEMBERSHIPS

American Meteorological Society	2021 – Present
American Geophysical Union	2018 – Present

SCIENTIFIC LEADERSHIP AND OUTREACH

Co-leader of Statistical Learning in Atmos. Chem. group	October 2022 – Present
Steward for Harvard Graduate Student Union	January 2021 – Present
Co-president of GeoClub (Harvard grad students in Earth Science)	September 2022 – May 2024
Co-leader of Jacob Lab Diversity, Inclusion, and Belonging team	September 2021 – April 2024
Co-leader of the Jacob Lab's machine learning subgroup	January 2021 – October 2022
Group representative to the Harvard Engineering Lab Open House	October 2020 – October 2021

OTHER SCIENTIFIC SERVICE

Peer reviewer for *Environmental Research Letters*, *Geoscientific Model Development*, *Competition and Change*, *Environmental Research Communications*, and *Environmental Science and Technology*.

SELECTED GENERAL-AUDIENCE WRITING

"Our global fire crisis […]" (*The Guardian*, with Troy Vettese)	December 2020
"Ground Control" (*Harper's Magazine*)	June 2020
"Covid-19 and the Environmental Crisis…" (*Jacobin*, with Troy Vettese)	May 2020
translated into Spanish, Portuguese, and Turkish	

BOOK

Pendergrass, D.C. and Vettese, T.G.W (2022). *Half-Earth Socialism: A Plan to Save the Future from Extinction, Climate Change and Pandemics*. Verso Books.
  - o Translated into Spanish (Levanta Fuego), Korean (Econ Publishers), Thai (Sam Yan Press), Danish (Økotopia), Swedish (Verbal Förlag), and Italian (Mimesis)

NON-SCIENTIFIC PEER-REVIEWED ARTICLES AND BOOK CHAPTERS (*submitted)

***Pendergrass, D.C**. (2024). Geoengineering. In I. Szeman and J. Wenzel (Eds.), *Energized: Keywords for a New Politics of Energy and Environment*. West Virginia University Press. (*Forthcoming*).

***Pendergrass, D.C**. and Vettese, T.G.W (2024). Every Cook Can Plan: Economic Democracy Against Catastrophe. In O. Halpern (Ed.), *Against Catastrophe*. (*In revision for edited volume*)

***Pendergrass, D.C**. (2024). From planetary scenarios to planetary sensing: models, observations, and political legibility. *The Anthropocene Review*. (*In revision for invited contribution to special issue*).

Vettese, T.G.W, **Pendergrass, D.C**., and Mesko, F. (2022). Town, Country, and Wilderness: Designing the Half-Earth. *Architectural Design*. 92(1), 112–119. doi:10.1002/ad.2780

Pendergrass, D.C., & Vettese, T. (2021). The Humanization of Nature and Half-Earth Socialism. *International Labor and Working-Class History*, 99, 15–23. doi:10.1017/S0147547920000198

SELECTED NON-SCIENTIFIC CONFERENCE PRESENTATIONS

"Three Problems with Utopia: Hayek, Kornai, Gorgias," **Keynote**, 'Utopia and the Return of History' conference, Manchester University, Manchester, U.K. (in person), April 2024. With Troy Vettese.

"Salvaging the Anthropocene," Historical Epistemologies of Planetary Modelling workshop, Max Planck Institute for the History of Science, Berlin, Ger. (remote), June 2023. With Troy Vettese.

"Iterative Democracy." Workshop on "Socialism: Rationality and Distribution," Free University of Berlin, Berlin, Germany (remote), June 2022. Talk.

"Brutus and the 'bourgeois chill,'" Antiqui et Moderni: Harvard Undergraduate Medieval and Early Modern Symposium, Cambridge, Mass., May 2019.

SELECTED NON-SCIENTIFIC INVITED TALKS

"The Museum of the Future," lecture, Muséum National d'Histoire Naturelle, Paris, France (in person), May 2024. With Francis Tseng and Troy Vettese.

"Governing the Global Polis," visiting faculty lecture, Paris Institute for Critical Thinking, Paris, France (in person), May 2024. With Troy Vettese.

"Half-Earth Socialism," Housmans Books, London, U.K. (in person). May 2024. With Troy Vettese.

"Which Role can Digital Technology play in Our Struggle for Democratically Planned Economies," panel with transform!europe (remote). April 2024. With Anaïs Fley and Walter Zeug.

"Half-Earth Socialism," lecture to the Institute for Political and Economic Alternatives, Seoul, South Korea (remote). November 2023. With Minhyoung Kang.

"Half-Earth Socialism," lecture in the Global Marxism Online Talks series, Gyeongsang National University, Jinsu, South Korea (remote). October 2023. With Guhyeon Jeong.

"Half Earth Socialism: Design, Democracy, and Planning in the Anthropocene," **lecture in the Advanced Architectural Design Arguments series at Columbia University**, New York, NY (in person). July 2023. With Elise Misao Hunchuck, Marco Ferrari, and Troy Vettese.

"Utopian politics, from the Victorians to today," guest lecture in the *Ecological Utopia* series given by Deanna K. Kreisel, Dickens Project, Univ. of Calif. Santa Cruz (remote). June 2023.

"Planning and the environmental crisis," workshop at U. Mass. Economics Dept., Environmental Interest Group, Amherst, Mass. (in person). May 2023.

"How to Upend the Upending with Half-Earth Socialism," panel at Santa Clara University, Santa Clara, Calif. (remote). April 2023. With Dennis Gordon and Daniel Press.

"Does it do us any good to dream of the future?" lecture at Outer Coast College, Sitka, Alaska (remote). December 2022.

"Eco-Socialist Futures: Strategies for Building a Fighting Left Climate Movement," panel at the Socialism Conference, Chicago, Ill. (in person). October 2022. With Matthew Huber and Kate Aronoff.

"Mindful Utopianism: Real Possibilities for Solving the Ecological Crisis," **Ethics, Religion and Society Program Distinguished Speakers Series at Xavier University**, Cincinnati, Ohio (in person). October 2022.

"Life in the Woods: *The Moon and Sledgehammer, De Natura*, and *Half-Earth Socialism,*" Independent Cinema Office, London, U.K. (remote), September 2022. With Troy Vettese and Julia Brow.

Book talk on *Half-Earth Socialism* and accompanying video game, Jain Family Institute, New York, N.Y. (remote), June 2022. With Troy Vettese and Francis Tseng.

Round Table and Book Talk on *Breaking Things at Work* and *Half-Earth Socialism*, University of Groningen, Groningen, Neth. (in person), May 2022. With Troy Vettese and Gavin Mueller.

Book talk and discussion on *Half-Earth Socialism*, Diffrakt, Berlin, Ger. (in person), May 2022. With Troy Vettese, Francis Tseng, and Leigh Claire La Berge.

Book talk on *Half-Earth Socialism*, Greenpoint Library and Environmental Education Center, Brooklyn, N.Y. (in person), May 2022. With Troy Vettese and Alyssa Battistoni.

"Designing Half-Earth", The Ground Lab at the Architectural Association School of Architecture, London, U.K. (remote), March 2021. With Filip Mesko and Troy Vettese.

"Half-Earth Socialism", History and Theory of Capitalism Workshop, University of Chicago, Chicago, Ill. (remote), October 2020. With Troy Vettese.

TECHNICAL SKILLS

Programming: R, Python, Matlab, Mathematica, Fortran90, Java, C/C++
Web: JavaScript, PHP, HTML/CSS, WordPress
Music: Finale, Ableton for Live, Max for Live, ProTools, Audacity
Other: LaTeX, Unix, Git, InDesign, Photoshop

Last updated June 2024.