Hannah Nesser

EDUCATION

HARVARD UNIVERSITY — Cambridge, MA
Ph.D. Candidate, School of Engineering and Applied Sciences — 2017 - 2023

YALE UNIVERSITY — New Haven, CT
B.S., Environmental Engineering, with Distinction — 2012 - 2016

SCHOOL FOR INTERNATIONAL TRAINING — Fort Dauphin, Madagascar
August - December 2014

APPOINTMENTS

NASA JET PROPULSION LABORATORY (JPL) — Pasadena, CA
NASA Postdoctoral Program (NPP) Fellow, Carbon Cycle Ecosystems Group — 2023 - present

AWARDS

- NASA Postdoctoral Program (NPP) Fellowship (2023 - present)
- National Science Foundation Graduate Research Program Fellowship (2017 - 2022)
- Harvard University Department of Earth and Planetary Sciences Graduate Teaching Award, awarded in recognition of superior service and excellence in teaching (Spring 2020)
- Special Commendation for Extraordinary Teaching in Extraordinary Times (COVID-19), awarded to 10% of Harvard instructors based on nomination by students (Spring 2020)
- Bok Center Certificate of Distinction in Teaching, awarded to Harvard Teaching Fellows who received an average score of 4.5 or above (2019)
- D. Allan Bromley Prize in Environmental Engineering, awarded to a Senior who has exhibited superior accomplishment and scholarly achievement in Environmental Engineering (2016)
- Richter Summer Fellowship (2015)

RESEARCH

NASA JET PROPULSION LABORATORY (JPL) — Pasadena, CA
Advisor: Kevin Bowman — 2023 - present

- Works to improve constraints on the magnitude and distribution of carbon dioxide fluxes using high-resolution analytic inversions of observations from the OCO-2 and OCO-3 satellite instruments.
- Develops and applies methods to improve estimates of uncertainties in initial flux estimates and in model transport.

HARVARD UNIVERSITY — Cambridge, MA
Advisor: Daniel Jacob — 2017 - present

- Worked to improve constraints on the magnitude and distribution of methane emission sources using high-resolution analytic inversions of observations from the TROPOMI instrument aboard the Sentinel-5 Precursor satellite.
- Developed and applied methods to conduct high-resolution analytic inversions at reduced

computational cost while preserving information content.
- Implemented those methods to improve estimates of methane emission sources at high resolution over North America using TROPOMI observations.
- Studies the influence of boundary condition errors on regional inverse analyses.

YALE UNIVERSITY — New Haven, CT
Advisor: Drew Gentner — 2015 - 2016

- Served as Design Lead for a senior research team developing a first-generation operational prototype of portable and stationary air quality monitors measuring concentrations of greenhouse gases and EPA criteria pollutants using low-cost sensors. The sensors were designed for deployment in Baltimore, MD as part of an EPA SEARCH Center.

TEACHING

HARVARD UNIVERSITY | Department of Earth and Planetary Sciences — Cambridge, MA
Atmospheric Chemistry, Teaching Fellow — Spring 2020

Taught weekly section and office hours, including material preparation. Created and graded homework assignments. Developed and taught midterm review session. Helped lead the transition to remote learning following COVID-19 adjustments.

HARVARD UNIVERSITY | Department of Earth and Planetary Sciences — Cambridge, MA
Atmospheric Chemistry, Teaching Fellow — Spring 2019

Taught weekly section and office hours, including material preparation. Created and graded homework assignments. Contributed to exam development and grading. Developed and taught midterm and final review sessions.

MENTORSHIP

Margaux Winter, undergraduate thesis student, An MGWR Framework for Improving Source Attribution of Inversion-Derived Methane Emissions, Harvard University, September 2019 - December 2021.

PRESENTATIONS

INVITED

High-resolution U.S. methane emissions inferred from an inversion of 2019 TROPOMI satellite data: contributions from states, urban areas, and landfills, Netherlands Institute for Space Research (SRON), Leiden, Netherlands, June 10, 2023.

Reduced-rank inversion of TROPOMI methane observations to infer 2019 North American methane emissions at 0.25° × 0.3125° resolution: implications for urban emissions, GHGSat and C-CORE telecon, Remote, December 8, 2022.

Reduced-rank inversion of TROPOMI methane observations to infer 2019 North American methane emissions at 0.25° × 0.3125° resolution, Orbiting Carbon Observatory (OCO) Flux telecon, Remote, July 27, 2022.

High-resolution 2019 North American methane emissions inferred from TROPOMI satellite observations of atmospheric methane, NASA Jet Propulsion Laboratory's (JPL's) Carbon Club seminar, Remote, February 17, 2022.

Decreasing the computational cost of analytic inversions of high-resolution satellite observations, presentation at the Netherlands Institute for Space Research (SRON), Utrecht, Netherlands, June 11, 2019.

ORAL PRESENTATIONS

High-resolution U.S. methane emissions inferred from an inversion of 2019 TROPOMI satellite data: contributions from states, urban areas, and landfills, 19th International Workshop on Greenhouse Gas Measurements from Space (IWGGMS-19), Paris, France, July 6, 2023.

Quantification of methane flux uncertainties using optimal estimation, CEOS Side Meeting at the International Workshop on Greenhouse Gas Measurements from Space (IWGGMS-19), Paris, France, July 3, 2023.

High-resolution 2019 North American methane emissions inferred from TROPOMI satellite observations of atmospheric methane, 10th International GEOS-Chem Meeting (IGC10), St. Louis, MO, June 8, 2022.

Reduced-Cost Construction of Jacobian Matrices for High-Resolution Inversions of Satellite Observations of Atmospheric Composition, presentation at the North American Carbon Project (NACP) 7th Open Science Meeting, Remote, March 12, 2021.

Reduced-Cost Construction of Jacobian Matrices for High-Resolution Inverse Modeling, presentation at the 2020 American Meteorological Society (AMS) Annual Meeting, Boston, MA, January 17, 2020.

POSTERS

High-resolution U.S. methane emissions inferred from an inversion of 2019 TROPOMI satellite data, World Meteorological Organization International Greenhouse Gas Monitoring Symposium, Geneva, Switzerland, January 30, 2023.

High-resolution 2019 North American methane emissions inferred from TROPOMI satellite observations of atmospheric methane, NASA Carbon Monitoring System Science Team Meeting, Washington, DC, September 28, 2022.

High-resolution 2019 North American methane emissions inferred from TROPOMI satellite observations of atmospheric methane, 2019 American Geophysical Union (AGU) Fall Meeting, New Orleans, LA, December 17, 2021.

Reduced Cost Construction of Jacobian Matrices for High-Resolution Inverse Modeling, poster at the 2019 American Geophysical Union (AGU) Fall Meeting, San Francisco, CA, December 12, 2019.

Reduced-rank Jacobians: Decreasing the computational cost of high-resolution analytic inversions, 9th International GEOS-Chem Meeting (IGC9), Cambridge, MA, May 7, 2019.

PUBLICATIONS

SELECTED

Nesser, H., D.J. Jacob, J.D. Maasakkers, A. Lorente, Z. Chen, X. Lu, L. Shen, Z. Qu, M.P. Sulprizio, M. Winter, S. Ma, A. A. Bloom, J.R. Worden, R.N. Stavins, C.A. Randles, High-resolution U.S. methane emissions inferred from an inversion of 2019 TROPOMI satellite data: contributions from individual states, urban areas, and landfills, Atmos. Chem. Phys. Discuss. [preprint], https://doi.org/10.5194/egusphere-2023-946, in review, 2023.

Nesser, H., D.J. Jacob, J.D. Maasakkers, T.R. Scarpelli, M.P. Sulprizio, Y. Zhang, and C.H. Rycroft, Reduced-cost construction of Jacobian matrices for high- resolution inversions of satellite observations of atmospheric composition, Atm. Meas. Tech., 14, 5521–5534, https://doi.org/10.5194/amt-14-5521-2021, 2021.

ALL

Chen, Z., D.J. Jacob, N. Balasus, H. Lin, and H. Nesser, African rice cultivation linked to growing methane, submitted to Nature Food, 2023.

Pendergrass, D.C., D.J. Jacob, H. Nesser, D.J. Varon, M. Sulprizio, K. Miyazaki, and K.W. Bowman, CHEEREIO 1.0: a versatile and user-friendly ensemble-based chemical data assimilation and emissions inversion platform for the GEOS-Chem chemical transport model, EGUsphere [preprint], https://doi.org/10.5194/egusphere-2023-616, in review, 2023.

Balasus, N., D.J. Jacob, A. Lorente, J.D. Maasakkers, R.J. Parker, H. Boesch, Z. Chen, M.M. Kelp, H. Nesser, and D.J. Varon, A blended TROPOMI+GOSAT satellite data product for atmospheric methane using machine learning to correct retrieval biases, Atmos. Meas. Tech. Discuss. [preprint], https://doi.org/10.5194/amt-2023-47, in review, 2023.

Varon, D.J., D.J. Jacob, B. Hmiel, R. Gautam, D.R. Lyon, M. Omara, M. Sulprizio, L. Shen, D. Pendergrass, H. Nesser, Z. Qu, Z.R. Barkley, N.L. Miles, S.J. Richardson, K.J. Davis, S. Pandey, X. Lu8, A. Lorente, T. Borsdorff, J.D. Maasakkers, and I. Aben, Continuous weekly monitoring of methane emissions from the Permian Basin by inversion of TROPOMI satellite observations, Atmos. Chem. Phys., 23, 7503–7520, https://doi.org/10.5194/acp-23-7503-2023, 2023.

Chen, Z., D.J. Jacob, R. Gautam, M. Omara, R.N. Stavins, R.C. Stowe, H. Nesser, M.P. Sulprizio, A. Lorente, D.J. Varon, X. Lu, L. Shen, Z. Qu, D.C. Pendergrass, and S. Hancock, Satellite quantification of methane emissions and oil/gas methane intensities from individual countries in the Middle East and North Africa: implications for climate action, Atmos. Chem. Phys., 23, 5945–5967, https://doi.org/10.5194/acp-23-5945-2023, 2023.

Shen, L., R. Gautam, M. Omara, D. Zavala-Araiza, J.D. Maasakkers, T.R. Scarpelli, A. Lorente, D. Lyon, J. Sheng, D. Varon, H. Nesser, Z. Qu, X. Lu, M.P. Sulprizio, S.P. Hamburg, and D.J. Jacob, Satellite quantification of oil and natural gas methane emissions in the US and Canada including contributions from individual basins, Atmos. Chem. Phys., 22, 11203–11215, https://doi.org/10.5194/acp-22-11203-2022, 2022.

Chen, Z., D.J. Jacob, H. Nesser, M.P. Sulprizio, A . Lorente, D.J. Varon, X. Lu, L. Shen, Z. Qu, E. Penn, and X. Yu, Methane emissions from China: a high-resolution inversion of TROPOMI satellite observations, Atmos. Chem. Phys., 22, 10809–10826, https://doi.org/10.5194/acp-22-10809-2022, 2022.

Varon, D.J., D.J. Jacob, M. Sulprizio, L.A. Estrada, W.B. Downs, L. Shen, S.E. Hancock, H. Nesser, Z. Qu, E. Penn, Z. Chen, X. Lu, A. Lorente, A. Tewari, and C.A. Randles, Integrated Methane Inversion (IMI 1.0): A user-friendly, cloud-based facility for inferring high-resolution methane emissions from TROPOMI satellite observations, Geophys. Model Dev., 15, 5787-5805, https://doi.org/10.5194/gmd-15-5787-2022, 2022.

Lu, X., D. J. Jacob, H. Wang, J.D. Maasakkers, Y. Zhang, T.R. Scarpelli, L. Shen, Z. Qu, M.P. Sulprizio, H. Nesser, A. A. Bloom, S. Ma, J.R. Worden, S. Fan, R. J. Parker, H. Boesch, R. Gautam, D. Gordon, M.D. Moran, F. Reuland, C.A.O. Villasana, and A. Andrews, Methane emissions in the United States, Canada, and Mexico: Evaluation of national methane emission inventories and sectoral trends by inverse analysis of in situ (GLOBALVIEWplus CH_4 ObsPack) and satellite (GOSAT) atmospheric observations, Atmos. Chem. Phys., 22, 395-418, https://doi.org/10.5194/acp-22-395-2022, 2022.

Qu, Z. D.J. Jacob, L. Shen, X. Lu, Y. Zhang, T.R. Scarpelli, H. Nesser, M.P. Sulprizio, J.D. Maasakkers, A.A. Bloom, J.R. Worden, R.J. Parker, and A.L. Delgado, Global distribution of methane emissions: a comparative inverse analysis of observations from the TROPOMI and GOSAT satellite instruments, Atmos. Chem. Phys., 21, 14159-14175, https://doi.org/10.5194/acp-21-14159-2021, 2021.

Nesser, H., D.J. Jacob, J.D. Maasakkers, T.R. Scarpelli, M.P. Sulprizio, Y. Zhang, and C.H. Rycroft, Reduced-cost construction of Jacobian matrices for high- resolution inversions of satellite observations of atmospheric composition, Atm. Meas. Tech., 14, 5521–5534, https://doi.org/10.5194/amt-14-5521-2021, 2021.

Lu, X., D.J. Jacob, Y. Zhang, J.D. Maasakkers, M.P. Sulprizio, L. Shen, Z. Qu, T.R. Scarpelli, H. Nesser, R.M. Yantosca, J. Sheng, A. Andrews, R.J. Parker, H. Boesch, A.A. Bloom, S. Ma, Global methane budget and trend, 2010-2017: complementarity of inverse analyses using in situ (GLOBALVIEWplus CH_4 ObsPack) and satellite (GOSAT) observations, Atmos. Chem. Phys., 21, 4637–4657, https://doi.org/10.5194/acp-21-4637-2021, 2021.

Maasakkers, J.D., D.J. Jacob, M.P. Sulprizio, T.R. Scarpelli, H. Nesser, J. Sheng, Y. Zhang, X. Lu, A.A. Bloom, K.W. Bowman, J.R. Worden, and R.J. Parker, 2010-2015 North American methane emissions, sectoral contributions, and trends: a high-resolution inversion of GOSAT satellite observations of atmospheric methane, Atmos. Chem. Phys., 21, 4339–4356, https://doi.org/10.5194/acp-21-4339-2021, 2021.

Zhang, Y., P. Sadavarte, R. Gautam, M. Omara, J.D. Maasakkers, S. Pandey, D. Lyon, H. Nesser, M.P. Sulprizio, R. Zhang, S. Houweling, D. Zavala-Araiza, R.A. Alvarez, A.L. Delgado, S.P. Hamburg, I. Aben, and D.J. Jacob, Quantifying methane emissions from the largest oil producing basin in the U.S. from space, Science Advances, 6, eaaz5120, https://doi.org/10.7910/DVN/NWQGHU, 2020.

Maasakkers, J.D., D.J. Jacob, M.P. Sulprizio, T. Scarpelli, H. Nesser, J.-X. Sheng, Y. Zhang, M. Hersher, A.A. Bloom, K.W. Bowman, J.R. Worden, G. Janssens-Maenhout, and R.J. Parker, Global distribution of methane emissions, emission trends, and OH concentrations and trends inferred from an inversion of GOSAT satellite data for 2010-2015, Atmos. Chem. Phys., 19, 7859-7881, https://doi.org/10.5194/acp-19-7859-2019, 2019.

DIVERSITY, INCLUSION, AND BELONGING EFFORTS

- Co-founder and Co-lead, Harvard Atmospheric Chemistry Modeling Group Diversity, Inclusion, and Belonging (DIB) subgroup, Cambridge, MA, 2020 - 2021.
- Graduate Student Representative, Harvard Earth and Planetary Sciences and Environmental Science and Engineering Diversity, Inclusion, and Belonging (DIB) Committee, Cambridge, MA, 2020 - 2021.
- Co-lead of Harvard Earth and Planetary Sciences Unlearning Racism in Geoscience (URGE) pod, Cambridge, MA, 2020.

POLICY EXPERIENCE

- Member (5 months) and Co-president (16 months), Harvard Graduate Environmental Action Team (GrEAT), Cambridge, MA, Fall 2019 - Spring 2021.
  - Contributed to a public comment on a proposed rollback of oil and natural gas methane standards and led efforts to write public comments on proposed regulations on the disposal of coal combustion residuals and on the transparency of science used for rule making.
- Volunteer, Harvard Emmet Environmental Law and Policy Clinic, Cambridge, MA, Fall 2019.
  - Contributed to a white paper project on EPA PM2.5 measurement standards.
- Legislative Assistant, Union of Concerned Scientists, Washington, D.C., January 2017 - August 2021.

  - Led organization efforts to track federal budget and appropriations processes for EPA, DOE, NOAA, NASA, FEMA, and the State Department in the House, Senate, White House, and Agencies.
- Affiliate, ParisAgreement.org, Paris, France and New Haven, CT, December 2015 - May 2016.
  - Attended COP21 to support the launch of ParisAgreement.org, an analysis and media platform designed to increase pressure on negotiators to achieve consensus, which received media coverage by The Economist, The New York Times Dot Earth blog, and The Guardian.