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

AWARDS

- NASA Postdoctoral Program (NPP) Fellowship (2023 - 2025)
- 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)

PROFESSIONAL AND RESEARCH EXPERIENCE

NASA JET PROPULSION LABORATORY (JPL) — Pasadena, CA
JPL Postdoctorate Scholar — 2025 - present
NASA Postdoctoral Program (NPP) Fellow — 2023 - 2025
Advisor: Kevin Bowman

- 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
NSF Graduate Research Fellowship Program (GRFP) Fellow — 2017 - 2023
Advisor: Daniel Jacob

- 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.

UNION OF CONCERNED SCIENTISTS — Washington, D.C.
Legislative Assistant — January 2017 - August 2017

- 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.

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

U.S. GREENHOUSE GAS CENTER — Fort Collins, CO
Summer School for Inverse Modeling of Greenhouse Gases, Instructor — Summer 2024, 2025

- Developed and taught curriculum introducing inverse modeling, including lectures on each of the key parameters for the problem and on approaches to evaluating inverse modeling.
- Developed and taught curriculum on the influence of boundary conditions on regional studies of greenhouse gases and on the design of studies that use measurements to infer greenhouse gases.
- Contributed to and taught curriculum on measurement, monitoring, reporting, and verification of greenhouse gas emissions.

HARVARD UNIVERSITY | Department of Earth and Planetary Sciences — Cambridge, MA
Atmospheric Chemistry, Teaching Fellow — Spring 2019, 2020

- Prepared and taught weekly section and office hours and midterm and final review sessions. Created and graded homework assignments. Contributed to exam development and grading.
- Led the transition to remote learning following COVID-19 adjustments.

MENTORSHIP

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

SERVICE

U.S. GREENHOUSE GAS CENTER — Fort Collins, CO
Summer School for Inverse Modeling of Greenhouse Gases — 2024, 2025
Instructor and co-organizer

- Contributed to the development of a two-week curriculum designed to teach graduate students, postdoctoral fellows, and young professionals how to use atmospheric observations to quantify fluxes of greenhouse gases.

NASA PRE-DECADAL SURVEY WORKSHOP SERIES — Pasadena, CA
Carbon-Climate Feedbacks: Stock of Stocks — 2024
Invited workshop contributor

- Helped lead workshop agenda creation and outlined and contributed to the resulting position paper summarizing needed advances in carbon cycle science in the next decade.

HARVARD UNIVERSITY — Cambridge, MA

Earth and Planetary Sciences Diversity, Inclusion, and Belonging (DIB) Committee — 2020 - 2021
Graduate student representative

Atmospheric Chemistry Modeling Group DIB Subgroup — 2020 - 2021
Co-founder and co-lead

Graduate Environmental Action Team (GrEAT) — 2019 - 2021
Member (5 months) **and co-president** (16 months)

- 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.

Harvard Law School Emmett Environmental Law and Policy Clinic — 2019
Volunteer

- Contributed to a white paper project on EPA PM2.5 measurement standards.

PARISAGREEMENT.ORG — Paris, France and New Haven, CT
Affiliate — 2015 - 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.

NASA EARTH SCIENCE GRANT PROGRAM — Remote
Invited reviewer — 2024

ASSORTED SCIENTIFIC JOURNALS — Remote
Invited reviewer — 2023 - Present

- Reviewed for Atmospheric Chemistry and Physics, Environmental Research Letters, Journal of Geophysical Research - Atmospheres, Waste Management, Nature Scientific Data, Nature Communications Earth & Environment, and Nature Scientific Reports.

PRESENTATIONS

INVITED

Space-based inverse methane estimates, U.S. Greenhouse Gas Center Stakeholder Forum, Remote, December 2024.

Evaluating methane emission inventories with satellite data, U.S. Greenhouse Gas Center Stakeholder Forum, Remote, December 2024 [invited poster].

U.S. landfill methane emissions inferred from 2019 TROPOMI satellite data, EPA Waste Sector Meeting, Remote, November 2024.

Inverse estimates of methane and carbon dioxide fluxes and uncertainties from satellite data, University of Toronto Noble Seminar, Toronto, ON, Canada, October 2024.

Predicting and correcting boundary condition biases in regional inverse analyses (of greenhouse gases), NOAA's Global Monitoring Laboratory Seminar, Remote, August 2024.

Quantifying methane emissions and information content from TROPOMI over North America for 2019, EPA Office of Research and Development Methane Inverse Modeling Technical Workshop, Research

Triangle Park, NC, July 2024.

U.S. landfill methane emissions inferred from 2019 TROPOMI satellite data, Harvard University Salata Institute Methane Cluster Landfill Convening, Cambridge, MA, January 2024.

High-resolution U.S. methane emissions inferred from an inversion of 2019 TROPOMI satellite data: contributions from states, urban areas, and landfills, 2023 American Geophysical Union (AGU) Fall Meeting, San Francisco, CA, December 2023.

High-resolution greenhouse gas fluxes inferred from satellite data: a demonstration from quantifying U.S. methane emissions using TROPOMI satellite data, 2023 American Geophysical Union (AGU) Fall Meeting, San Francisco, CA, December 2023 [invited poster].

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 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 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 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 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 2019.

ORAL PRESENTATIONS

Analytical estimation of carbon dioxide fluxes and information content from OCO-2 satellite data, 2024 American Geophysical Union (AGU) Fall Meeting, Washington, DC, December 2024.

How can we adjust activity-based emissions models to match atmospheric data from inversions?, GEIA Methane Working Group meeting at the 18th International Global Atmospheric Chemistry (IGAC) Science Conference, Remote, September 2024.

Comparing regional emission estimates to inventory data: The importance of quantifying information content and uncertainty, GEIA Methane Working Group meeting at the 18th International Global Atmospheric Chemistry (IGAC) Science Conference, Remote, September 2024.

Analytical estimation of carbon dioxide fluxes and information content from OCO-2 satellite data, 11th International GEOS-Chem Meeting (IGC11), St. Louis, MO, June 2024.

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 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 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 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 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 2020.

POSTERS

Predicting and correcting the influence of boundary conditions in regional greenhouse gas inverse analyses, 2024 American Geophysical Union (AGU) Fall Meeting, Washington, DC, December 2024.

Analytical estimation of carbon dioxide fluxes and information content from OCO-2 satellite data, OCO Science Team Meeting, Pasadena, CA, October 2024.

Analytical estimation of carbon dioxide fluxes and information content from OCO-2 satellite data, 11th International Carbon Dioxide Conference (ICDC11), Manaus, Brazil, August 2024.

Analytical estimation of carbon dioxide fluxes and information content from OCO-2 satellite data, 20th International Workshop on Greenhouse Gas Measurements from Space (IWGGMS-20), Boulder, CO, June 2024.

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 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 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 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 2019.

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

PUBLICATIONS

SELECTED

Nesser, H. , D.J. Jacob, D.V. Varon, J.D. Maasakkers, K.W. Bowman, C.A. Randles, A. Tewari, and E. Reidy, Framework for predicting and correcting the influence of boundary conditions in regional inverse analyses, in prep. for Geophys. Model Dev.

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., 24, 5069–5091, https://doi.org/10.5194/acp-24-5069-2024, 2024.

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

Parazoo, N., D. Carroll, J.B. Abshire, Y.M. Bar-On, R.A. Birdsey, A.A. Bloom, K.W. Bowman, R.K. Braghiere, L.M. Bruhwiler, B. Byrne, A. Chatterjee, D. Crisp, L. Duncanson, A.F. Feldman, A.M. Fox, C. Frankenberg, B.A. Gay, F. Hopkins, F.M. Hoffman, J.R. Holmquist, L.R. Hutyra, M. Keller, C.D. Koven, J. L. Laughner, J. Liu, N.S. Lovenduski, N. Macbean, G.A. McKinley, G. McNicol, D. Menemenlis, A.M. Michalak, C.E. Miller, **H. Nesser** , T. Oda, E.M. Ordway, L.E. Ott, K. Paustian, Z.A. Pierrat, B. Poulter, S.C. Reed, D.S. Schimel, S.P. Serbin, S.S. Saatchi, H. Suto, L. Windham-Myers, D. Wunch: A Scientific Community Vision for an Operational, Unified Greenhouse Gas Observing System to Support Earth System Science and Climate Intervention, AGU Adv [Submitted], 2025.

Pendergrass, D.C., D.J. Jacob, N. Balasus, L.A. Estrada, D.J. Varon, J.D. East, M. He, T.A. Mooring, E. Penn, **H. Nesser** , and J.R. Worden: Trends and seasonality of 2019–2023 global methane emissions inferred from a localized ensemble transform Kalman filter (CHEEREIO v1.3.1) applied to TROPOMI satellite observations, EGUsphere [preprint], https://doi.org/10.5194/egusphere-2025-1554, 2025.

Estrada, L.A., D.J. Varon, M. Sulprizio, **H. Nesser** , Z. Chen, N. Balasus, S.E. Hancock, M. He, J.D. East, T.A. Mooring, A. Oort Alonso, J.D. Maasakkers, I. Aben, S. Baray, K.W. Bowman, J.R. Worden, F.J. Cardoso-Saldaña, E. Reidy, and D.J. Jacob, Integrated Methane Inversion (IMI) 2.0: an improved research and stakeholder tool for monitoring total methane emissions with high resolution worldwide using TROPOMI satellite observations, EGUsphere [preprint], https://doi.org/10.5194/egusphere-2024-2700, 2025.

Balasus, N., D.J. Jacob, G. Maxemin, C. Jenks, **H. Nesser** , J.D. Maasakkers, D.H. Cusworth, T.R. Scarpelli, D.J. Varon, and X. Wang, Satellite monitoring of annual US landfill methane emissions and trends, Environ. Res. Lett., 20, 024007, https://doi.org/10.1088/1748-9326/ada2b1, 2025.

Penn, E., D.J. Jacob, Z. Chen, J.D. East, M.P. Sulprizio, L. Bruhwiler, J.D. Maasakkers, **H. Nesser** , Z. Qu, Y. Zhang, and J. Worden. What can we learn about tropospheric OH from satellite observations of methane?, Atmos. Chem. Phys., 25, 2947–2965, https://doi.org/10.5194/acp-25-2947-2025, 2025.

Hancock, S.E., D.J. Jacob, Z. Chen, **H. Nesser** , A. Davitt, D.J. Varon, M.P. Sulprizio, N. Balasus, L.A. Estrada, J.D. East, E. Penn, C.A. Randles, J. Worden, I. Aben, R. J. Parker, and J. D. Maasakkers. Satellite quantification of methane emissions from South American countries: A high-resolution inversion of TROPOMI and GOSAT observations, submitted to Atmos. Chem. Phys., 25, 797–817, https://doi.org/10.5194/acp-25-797-2025, 2025.

Chen, Z., D.J. Jacob, N. Balasus, H. Lin, and **H. Nesser** , African rice cultivation linked to growing methane, Nature Clim. Change, https://doi.org/10.1038/s41558-023-01907-x, 2024.

Pendergrass, D.C., D.J. Jacob, **H. Nesser** , D.J. Varon, M.P. 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, Geosci. Model Dev., 16(16), 4793–4810, https://doi.org/10.5194/gmd-16-4793-2023, 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., 16, 3787–3807, https://doi.org/10.5194/amt-16-3787-2023, 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. Lu, 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.J. 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.

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.