Sudhanshu Pandey, Ph.D.

Scientist, Earth Science Section,
Jet Propulsion Laboratory, California Institute of Technology
4800 Oak Grove Drive, Pasadena, CA 91109
Email: sudhanshu.pandey@jpl.nasa.gov
LinkedIn, Web, Google Scholar

Professional Experience

- **Scientist** 1/2022 - Present
  NASA Jet Propulsion Laboratory (JPL), Pasadena, CA, USA

- **Scientist** 8/2016 - 1/2022
  SRON Netherlands Institute for Space Research, Utrecht, The Netherlands

Education

- **Ph.D. in Physics** 8/2012 – 2/2017
  Utrecht University, Utrecht, the Netherlands
- **BS-MS in Earth Sciences** 7/2007 – 5/2012
  Indian Institute of Science Education & Research, Kolkata, India

Research Interests

My research focuses on atmospheric chemistry and physics, with a specialization in remote sensing and modeling to enhance our understanding of the Earth's carbon cycle. I focus on two critical aspects of carbon cycle science: monitoring and enhancing future carbon cycle predictions. By leveraging extensive satellite observation capabilities, I model the atmospheric transport of trace gases and develop quantitative methods for estimating trace gas emissions from both anthropogenic and natural sources. Key highlights of my research include:

- Remote sensing using satellites
- Plume detection and quantification
- Atmospheric transport models to track trace gas movements
- Bayesian atmospheric flux inversions using variational and analytical approaches
- Machine learning tools to detect and estimate point sources and emission fields
- Theoretical development to improve understanding of carbon cycle and observing systems
- Improving the carbon growth rate estimates to reduce Earth's carbon budget imbalance

Awards and Grants

- NASA ROSES Early Career Investigator Program in Earth Science (ECIP-ES) Grant, 2023
- Best Oral Presentation Award, SRON Netherlands Science Day, 2019
- INSPIRE Fellowship, Department of Science & Technology (DST), India, 2008

Select Conference Presentations

- American Geophysical Union (AGU) Fall meetings in 2015, 2018, 2019, 2021, 2022, 2023 & 2024
- European Geosciences Union (EGU) General Assembly in 2017, 2018 & 2019
- ESA Living Planet Symposium in 2013 & 2016
- International Carbon Dioxide Conference (ICDC) in 2017
- International Workshop on Greenhouse Gas Measurements from Space (IWGGMS) in 2014, 2018, 2021 & 2023

Invited Talks

- **NASA JPL, 2018:** CH4 monitoring using ESA's TROPOMI satellite
- **NASA GISS, 2018:** TROPOMI detection of CH4 leakage from a gas well blowout
- **NASA JPL, 2019:** Satellite reveals extreme CH4 leakage from a natural gas well blowout
- **Indian Institute of Tropical Meteorology (IIT-M), Pune, India, 2019:** Atmospheric monitoring using ESA's TROPOMI satellite
- **US-EPA, 2021:** Satellite reveals extreme leakage from a natural gas well blowout
- **NOAA, 2023:** Global growth rate estimates of CO_2 from satellite observations

Mentoring and Supervision

- Master's thesis project (9 months, full time): Main supervisor for Dr. Simon van Diepen (Delft University), and Dr. Maria Tsivilidou (Utrecht University). Co-supervisor for Peter Bijh (Delft University)
- Internship Supervision at JPL: Julia Gao (Caltech), Kayley Butler (USC, CA), Zijian Qiu (Harvard University), Monica Amezquita (California Polytechnic University – Pomona via JPL's MSP Program)
- Supervised seven university student projects at SRON, Leiden, each lasting between 3-6 months

Teaching Experience

- Teaching Assistant for *Introduction to Climate Change* (2012 and 2013)
  Main Lecturer: Prof. Thomas Röckmann, Utrecht University, Netherlands
- Teaching Assistant for *Remote Sensing of the Earth* (2014 and 2015)
  Main Lecturer: Prof. Sander Houweling, Utrecht University, Netherlands

Community Service

- Reviewer for scientific journals: Nature, Science Advances, Nature Climate Change, Atmospheric Measurement Techniques, Atmospheric Chemistry and Physics, Carbon Management, Journal of Geophysical Research, Remote Sensing of Environment, Environmental Science & Technology, Environmental Research Letters, Geophysical Research Letters, and Remote Sensing.
- Review Editor: Frontiers
- Scientific research proposals review for NOAA and NASA
- Poster presentation judge at EGU and AGU annual meetings
- Hosted remote sensing session at the CEOS-GHG (Paris) 2023 meeting

Publications

34 Published peer-reviewed publications. H-index: 26 Google Scholar.

Peer-reviewed Publications

*under review

1. **Pandey**, S., et al. (2025). Relating multi-scale plume detection and area estimates of methane emissions: A theoretical and empirical analysis. *Environmental Science & Technology*, 59(16), 7931–7947. doi:10.1021/acs.est.4c07415

2. *Ke, X., et al. (2025). Low-latency global carbon budget reveals a continuous decline of the land carbon sink during the 2023/24 El Niño event. under review at *National Science Review*. *arXiv preprint*. doi:10.48550/arXiv.2504.09189

3. Albuhaisi, A., et al. (2025). Integrating satellite observations and hydrological models to unravel large TROPOMI methane emissions in South Sudan wetlands. *Remote Sensing*, 16, 4744. doi:10.3390/rs16244744

4. ***Pandey**, S., et al. (2025). Quantitative evidence of improved estimates of Earth's carbon cycle components. *Under review at Nature Communications.* [Preprint] doi:10.22541/essoar.172405915.56306923/v1

5. **Pandey**, S., et al. (2024). Toward low-latency estimation of atmospheric CO_2 growth rates using satellite observations: Evaluating sampling errors of satellite and in situ observing approaches. *AGU Advances*, 5, e2023AV001145. doi:10.1029/2023AV001145

6. Varon, D. J., et al. (2024). Quantifying NO_x point sources with Landsat and Sentinel-2 satellite observations of NO_2 plumes. *Proceedings of the National Academy of Sciences*, 121, e2317077121. doi:10.1073/pnas.2317077121

7. Byrne, B., et al. (2024). Carbon emissions from the 2023 Canadian wildfires. *Nature*. doi:10.1038/s41586-024-07878-z

8. **Pandey**, S., et al. (2023). Daily detection and quantification of methane leaks using Sentinel-3: A tiered satellite observation approach with Sentinel-2 and Sentinel-5P. *Remote Sensing of Environment*, 296, 113716. doi:10.1016/j.rse.2023.113716

9. Schuit, B. J., et al. (2023). Automated detection and monitoring of methane super-emitters using satellite data. *Atmospheric Chemistry and Physics*, 23, 9071–9098. doi:10.5194/acp-23-9071-2023

10. Worden, J. R., et al. (2023). Verifying methane inventories and trends with atmospheric methane data. *AGU Advances*, 4. doi:10.1029/2023AV000871

11. Naus, S., et al. (2023). Assessing the relative importance of satellite-detected methane superemitters in quantifying total emissions for oil and gas production areas in Algeria. *Environmental Science & Technology*. doi:10.1021/acs.est.3c04746

12. Varon, D. J., et al. (2023). Continuous weekly monitoring of methane emissions from the Permian Basin by inversion of TROPOMI satellite observations. *Atmospheric Chemistry and Physics*, 23, 7503–7520. doi:10.5194/acp-23-7503-2023

13. Maasakkers, J. D., et al. (2022). Reconstructing and quantifying methane emissions from the full duration of a 38-day natural gas well blowout using space-based observations. *Remote Sensing of Environment*, 270, 112755. doi:10.1016/j.rse.2021.112755

14. Maasakkers, J. D., et al. (2022). Using satellites to uncover large methane emissions from landfills. *Science Advances*, 8, 1–9. doi:10.1126/sciadv.abn9683

15. Sadavarte, P., et al. (2022). A high-resolution gridded inventory of coal mine methane emissions for India and Australia. *Elementa*, 10, 1–14. doi:10.1525/elementa.2021.00056

16. **Pandey**, S., et al. (2022). Order of magnitude wall time improvement of variational methane inversions by physical parallelization: A demonstration using TM5-4DVAR. *Geoscientific Model Development*, 15, 4555–4567. doi:10.5194/gmd-15-4555-2022

17. **Pandey**, S., et al. (2021). Using satellite data to identify the methane emission controls of South Sudan's wetlands. *Biogeosciences*, 18, 557–572. doi:10.5194/bg-18-557-2021

18. Cusworth, D. H., et al. (2021). Multi-satellite imaging of a gas well blowout enables quantification of total methane emissions. *Geophysical Research Letters*, 48(2), 1–9. doi:10.1029/2020GL090864

19. Sadavarte, P., et al. (2021). Methane emissions from super-emitting coal mines in Australia quantified using TROPOMI satellite observations. *Environmental Science & Technology*, 55(24), 16573–16580. doi:10.1021/acs.est.1c03976

20. Mazzini, A., et al. (2021). Relevant methane emission to the atmosphere from a geological gas manifestation. *Scientific Reports*. doi:10.1038/s41598-021-83369-9

21. Zavala-Araiza, D., et al. (2021). A tale of two regions: Methane emissions from oil and gas production in offshore/onshore Mexico. *Environmental Research Letters*. doi:10.1088/1748-9326/abceeb

22. Ma, S., et al. (2021). Satellite constraints on the latitudinal distribution and temperature sensitivity of wetland methane emissions. *AGU Advances*, 2(3), 1–12. doi:10.1029/2021AV000408

23. Zhang, Y., et al. (2020). Quantifying methane emissions from the largest oil-producing basin in the United States from space. *Science Advances*. doi:10.1126/sciadv.aaz5120

24. **Pandey**, S., et al. (2019). Satellite observations reveal extreme methane leakage from a natural gas well blowout. *Proceedings of the National Academy of Sciences*, 116(52), 26376–26381. doi:10.1073/pnas.1908712116

25. **Pandey**, S., et al. (2019). Influence of atmospheric transport on estimates of variability in the global methane burden. *Geophysical Research Letters*, 46, 2302–2311. doi:10.1029/2018GL081092

26. Ganesan, A. L., et al. (2019). Advancing scientific understanding of the global methane budget in support of the Paris Agreement. *Global Biogeochemical Cycles*, 33(12), 1475–1512. doi:10.1029/2018GB006065

27. Varon, D. J., et al. (2019). Satellite discovery of anomalously large methane point sources from oil/gas production. *Geophysical Research Letters*. doi:10.1029/2019GL083798

28. Dekker, I. N., et al. (2019). What caused the extreme CO concentrations during the 2017 high pollution episode in India? *Atmospheric Chemistry and Physics*, 19, 3433–3445. doi:10.5194/acp-19-3433-2019

29. Borsdorff, T., et al. (2019). Carbon monoxide air-pollution on sub-city scales and along arterial roads detected by the Tropospheric Monitoring Instrument. *Atmospheric Chemistry and Physics*, 19, 3579–3588. doi:10.5194/acp-19-3579-2019

30. Naus, S., et al. (2019). Constraints and biases in a tropospheric two-box model of OH. *Atmospheric Chemistry and Physics*, 19(1), 407–424. doi:10.5194/acp-19-407-2019

31. Nechita-Banda, N., et al. (2018). Monitoring emissions from the 2015 Indonesian fires using CO satellite data. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 373(1760), 20170307. doi:10.1098/rstb.2017.0307

32. Bruhwiler, L. M., et al. (2017). US CH_4 emissions from oil and gas production: Have recent large increases been detected? *Journal of Geophysical Research: Atmospheres*, 122(7), 4070–4083. doi:10.1002/2016JD026157

33. Worden, J. R., et al. (2017). Reduced biomass burning emissions reconcile conflicting estimates of the post-2006 atmospheric methane budget. *Nature Communications*, 8(1), 2227. doi:10.1038/s41467-017-02246-0

34. **Pandey**, S., et al. (2017). Enhanced methane emissions from tropical wetlands during the 2011 La Niña. *Scientific Reports*, 7. doi:10.1038/srep45759

35. **Pandey**, S., et al. (2016). Inverse modeling of GOSAT-retrieved ratios of total column CH_4 and CO_2 for 2009 and 2010. *Atmospheric Chemistry and Physics*, 16(8), 5043–5062. doi:10.5194/acp-16-5043-2016

36. **Pandey**, S., et al. (2015). On the use of satellite-derived CH_4:CO_2 columns in a joint inversion of CH_4 and CO_2 fluxes. *Atmospheric Chemistry and Physics*, 15(15), 8615–8629. doi:10.5194/acp-15-8615-2015

Other Publications

1. Varon, D.J., et al.: Coarse simulations overestimate the distance to recover NO–NO2–O3 photochemical steady state in fresh NOx plumes, Proc. Natl. Acad. Sci. U.S.A. 122 (7) e2425976122, DOI 2025.

2. Sadavarte, P., et al. Rebuttal to Correspondence on "Methane Emissions from Superemitting Coal Mines in Australia Quantified Using TROPOMI Satellite Observations." *Environmental Science and Technology.* link, 2024.

3. Maity, A., et al. Atmospheric CO2 inversion models overestimate northern extratropical land and ocean carbon uptake as assessed at background in-situ sites. [**Preprint**] Research Square. Under review. link, 2024.

4. Bergamaschi, P., et al. Atmospheric monitoring and inverse modeling for verification of greenhouse gas inventories. *Publications Office of the European Union.* link, 2018.

5. **Pandey**, S. Advancing the use of satellites to constrain atmospheric methane fluxes. Ph.D. Dissertation. Utrecht University. link, 2017.

6. Chevallier, F., et al. Climate Assessment Report for the GHG-CCI project of ESA's Climate Change Initiative. *Publications Office of the European Union.* link, 2017.