Samuel J. Cliff, PhD

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Education

PhD in Atmospheric Chemistry 2020–2023
University of York, UK
Thesis: *"Emissions measurement applications for understanding the evolution of urban air pollution sources."*
Advisor: Prof. James D. Lee, Dr. Sarah J. Moller, Dr. Marvin Shaw

Master of Chemistry – First Class Hons. with Distinction (1*) 2016–2020
University of York, UK
Thesis: *"Characterisation of VUV fluorescence and mid IR OA-ICOS for their suitability for airborne atmospheric measurement of carbon monoxide."*
Class rank: 1/180

Publications

Peer-Reviewed Articles

1. Cheng, Z., Hu, D., Flynn, M., Nemitz, E., Langford, B., Drysdale, W., Helfter, C., **Cliff, S. J.**, Liu, D., Joshi, R., Cash, J., Lee, J., Coe, H., Allan, J., Quantifying black carbon emissions from traffic and construction in central London using eddy covariance. *Environ. Sci.: Atmos.*, 2025, 5, 7, 785–800.

2. **Cliff, S. J.**, McNamara-Byrne, H., Goldstein, A. H., Apte, J. S., Dramatic air quality improvements after the complete electrification of a commuter rail system. *Environ. Sci. Technol. Lett.*, 2025, 12, 5, 587–592.

3. **Cliff, S. J.**, Drysdale, W. S., Lewis, A. C., Moller, S. J., Helfter, C., Metzger, S., Nemitz, E., Barlow, J., Lee, J. D., Evidence of heating-dominated urban NO_x emissions. *Environ. Sci. Technol.*, 2025, 59, 9, 4399–4408.

4. **Cliff, S. J.**, Lewis, A. C., Shaw, M. D., Lee, J. D., Flynn, M., Andrews, S. J., Hopkins, J. R., Purvis, R. M., Yeoman, A. M., Unreported VOC emissions from road transport including electric vehicles. *Environ. Sci. Technol.*, 2023, 57, 8026–8034.

5. **Cliff, S. J.**, Drysdale, W. S., Lee, J. D., Helfter, C., Nemitz, E., Metzger, S., Barlow, J., Pandemic restrictions in 2020 highlight the significance of non-road NO_x sources in central London. *Atmos. Chem. Phys.*, 2023, 23, 2315–2330.

6. Shaw, J. T., Foulds, A., Wilde, S. E., Barker, P., Squires, S., Lee, J., Purvis, R. M., Burton, R., Colfescu, I., Mobbs, S., **Cliff, S. J.**, Bauguitte, S. J. B., Young, S., Schwietzke, S., Allen, G., Flaring efficiencies and NO_x emission ratios measured for offshore oil and gas facilities in the North Sea. *Atmos. Chem. Phys.*, 2023, 23, 1491–1509.

7. Drysdale, W. S., Vaughan, A. R., Squires, F. A., **Cliff, S. J.**, Metzger, S., Durden, D., Pingintha-Durden, N., Helfter, C., Nemitz, E., Grimmond, C. S. B., Barlow, J., Beevers, S., Stewart, G., Dajnak, D., Purvis, R. M., Lee, J. D., Eddy covariance measurements highlight sources of nitrogen oxide emissions missing from inventories for central London. *Atmos. Chem. Phys.*, 2022, 22, 9413–9433.

8. Barker, P., Allen, G., Pitt, J. R., Bauguitte, S. J. B., Pasternak, D., **Cliff, S. J.**, France, J. L., Fisher, R. E., Lee, J. D., Bower, K. N., Nisbet, E. G., Airborne quantification of net methane and carbon dioxide fluxes from European Arctic wetlands in Summer 2019. *Philos. Trans. Royal Soc. A*, 2022, 380, 2215.

9. Lee, J. D., Squires, F., Sherwen, T., Wilde, S. E., **Cliff, S. J.**, Bauguitte, S. J. B., Reed, C., Barker, P., Bannan, T. J., Matthews, E., Mehra, A., Percival, C., Heard, D., Whalley, L. K., Ronnie, G. V., Seldon, S., Ingham, T., Keller, C. A., Knowland, E., Ozone production and precursor emission from wildfires in Africa. *Environ. Sci.: Atmos.*, 2021, 1, 524–542.

10. Barker, P. A., Allen, G., Bannan, T. J., Nisbet, E. G., Pitt, J. R., Bauguitte, S. J. B., Pasternak, D., **Cliff, S. J.**, Schimpf, M., Mehra, A., Airborne measurements of fire emission factors for African biomass burning sampled during the MOYA campaign. *Atmos. Chem. Phys.*, 2020, 20, 15443–15459.

11. Yu, C., Pasternak, D., Lee, J., Yang, M., Bell, T. G., Bower, K. N., Wu, H., Liu, D., Reed, C., Bauguitte, S. J. B., **Cliff, S. J.**, Trembath, J., Coe, H., Allan, J. D., Characterizing the particle composition and cloud condensation nuclei from shipping emission in Western Europe. *Environ. Sci. & Technol.*, 2020, 54, 15604–15612.

Submitted / In Review

1. **Cliff, S. J.**, et al. (2025). Design, operation and characterization of a mobile laboratory for community-scale atmospheric research. *Submitted*, *Atmospheric Measurement Techniques*.

2. Byrne, H. M., Katz, E., **Cliff, S. J.**, et al. (2025). Urban natural gas seasonality is associated with commercial areas in Berkeley, California. *Submitted*, *Environmental Science & Technology*.

Research Experience

Postdoctoral Scholar 2024–present

University of California Berkeley, Department of Civil and Environmental Engineering

- Designed and constructed a mobile air pollution laboratory for high-resolution gas and particle phase atmospheric characterisation, now supporting a $28M statewide monitoring initiative.
- Developed data acquisition and processing pipelines for production of real-time geolocated data streams and calibrated QA/QC final datasets.
- Completed over 1,000 hours of instrument operation and live-route planning during mobile monitoring drives in disadvantaged communities across California.
- Led mobile and stationary field measurements quantifying air quality benefits of the Caltrain commuter rail system electrification.

Graduate Research Student 2020–2023
University of York, Department of Chemistry

- Operated a remote field station for long-term eddy covariance flux measurements over 3 years, contributing to 5 peer-reviewed publications.
- Quantified air quality benefits of low-emissions zones and identified emerging pollutant sources following mitigation policies.
- Conducted stationary and mobile measurements of speciated VOC emissions from road transport, discovering unreported emissions from electric vehicles.

Masters Research Student 2019–2020
Facility for Airborne Atmospheric Measurements

- Operated and maintained the core chemistry payload onboard the UK's large atmospheric research aircraft for >40 science flights across Europe and Africa.
- Performed extensive characterisation of instrumentation for measurement under challenging aircraft conditions.
- Contributed to greenhouse gas flux quantification from wetlands and oil/gas facilities in Scandinavia.

Undergraduate Research Student 2018
University of York, Wolfson Atmospheric Chemistry Laboratories

- Conducted remote sensing field measurements characterising vehicle exhaust emissions.
- Contributed data towards the discovery of ineffective diesel emissions control technologies in heavy-duty vehicles under certain driving conditions.

Grants & Funding

- **NERC Graduate Student Fellowship**, 2020–2024.
  Role: PI (individual fellowship). Amount: £90,000.
- **Statewide Mobile Monitoring Initiative**, 2024–present.
  Role: Key personnel; designed mobile laboratory platform, leading data processing and analysis.
  Amount: $28,000,000 (total award).
- **Investigating Changes in Urban Methane using a Multiplatform Approach**, 2023–present.
  Role: Key personnel; sample design, mobile monitoring and flux tower operations, data processing and analysis.
  Amount: $750,000 (total award).

Awards & Honours

- *Kathleen Mary Stott Prize* (2023) – Awarded to final year PhD students for outstanding research performance.

- *IGAC Poster Prize* (2022) – Best early career researcher poster at the International Global Atmospheric Chemistry Conference.
- *Whinfield Medal* (2020) – Awarded for graduating top of class in chemistry at the University of York.

Technical Skills

Instrumentation

- Extensive experience with atmospheric measurement techniques including mass spectrometry (PTR-ToF-MS, Q-SIFT-MS) and optical spectroscopy (cavity near- and mid-IR, UV/Vis, filter-based, chemiluminescence, CPCs).
- Operation and maintenance of gas calibration systems; inlet and sampling line design; field integration of multi-instrument platforms.

Computing & Data Analysis

- High proficiency in R, Python, Linux, IgorPro, SQL/DuckDB, and Git/GitHub.
- Experience with high-performance computing, workflow automation, and Google Cloud Platform.
- Geospatial statistics, OSM and Places API extraction, interactive and web-based visualisation.

Field Systems & Engineering

- High-capacity battery-electric systems; data transmission protocols; electrical wiring and integration.
- Mechanical design for long-duration deployments including vibration isolation and thermal management.

Teaching Experience

Graduate Teaching Assistant 2020–2023
University of York

- Delivered over 250 hours of practical experiment demonstrating in the Undergraduate Chemistry Teaching Laboratory.
- Taught full range of courses from introductory to final year undergraduate level, including: Basic Synthesis, Recrystallisation, Distillation, Volumetric Solutions, UV-Vis Spectroscopy, Column Chromatography, Grignard Reagent Preparation, and Concentration-Dependent Kinetics.
- Graded Laboratory Skills Final Assessments (Year 1 and Year 2) and laboratory reports.

Student Mentoring

- **Mobile laboratory operation, instrument maintenance, and spatial data analysis:** Kyle Huang, Kaiulani Larson, Arielle Susanto, Jude Hebert, Claire Maxey (Undergraduate Research).
- **Stationary and field measurements of air pollution emissions from rail:** Annika Menefee Skov (Undergraduate Research).

- **Departmental carbon emissions budget calculation:** Megan Goss (Undergraduate Research), Jordan Goodnough (Postgraduate Research).

Presentations

Invited Talks

1. **Cliff, S. J.** (2023). Unreported VOC emissions from road transport including from electric vehicles. International Global Atmospheric Chemistry ECR Conference Highlight Talk.
2. **Cliff, S. J.** (2023). Evolving NO_x sources in a megacity with future implications from net zero pledges. Department for Environment, Food and Rural Affairs (DEFRA, UK Government) Air Quality Evidence Team meeting.
3. **Cliff, S. J.** (2023). Evolving NO_x sources in a megacity. National Centre for Atmospheric Science Seminar Series.
4. **Cliff, S. J.** (2021). Characterisation of atmospheric trace gases on and beside the road. 3rd European SIFT-MS User Group Meeting.

Lead Author Conference Presentations

1. **Cliff, S. J.**, et al. (2025). Characterising sources of air pollution in West Oakland, California, with intensive mobile monitoring. Gordon Research Conference: Atmospheric Chemistry, Newry, ME, USA (Poster).
2. **Cliff, S. J.**, et al. (2023). Evolving NO_x sources in a megacity with future implications from net zero pledges. American Geophysical Union, San Francisco, CA, USA (Oral).
3. **Cliff, S. J.**, et al. (2023). Unreported VOC emissions from road transport including from electric vehicles. European Geosciences Union, Vienna, Austria (Oral).
4. **Cliff, S. J.**, et al. (2022). Speciated VOC emissions from road transport. International Global Atmospheric Chemistry, Manchester, UK (Poster).
5. **Cliff, S. J.**, et al. (2021). Using eddy covariance flux measurements made at the BT Tower to understand policy and pandemic reductions in central London NO_x emissions. American Geophysical Union, Remote (Oral).

Professional Service

- **Peer Review:** *Atmospheric Chemistry and Physics*, *Environmental Science & Technology*.
- **Community Engagement:** Collaborated with local community groups for mobile laboratory tours and air pollution education: West Oakland Environmental Indicators Project, Hope Collaborative (Greater Oakland, CA), Acterra (Palo Alto, CA), Citizen Air Monitoring Network (Vallejo, CA).
- **School Outreach:** Presentation and student discussions on air pollution with the Stockton Unified School District at elementary, middle, and high school levels.

Selected Media Coverage

- Electric trains are quieter, more reliable than diesel. New study finds they're healthier, too. April 2025, *UC Berkeley News*.
- Gas boilers now the biggest source of air pollution in central London. April 2025, *The Times*.
- Unequal burden: Addressing air quality disparities through data and policy. November 2024, *Berkeley Engineer Magazine*.
- Hidden in plain sight: Windshield washer fluid is an unexpected emission source. May 2023, *Science Daily*.
- London observatory reveals traffic reduction success but points to future pollution challenge. March 2023, *National Centre for Atmospheric Science*.
- Pollutionwatch: London Ulez cuts traffic fumes but heating is concern. February 2023, *The Guardian*.