UNIVERSITY OF LEICESTER

# Job Summary

**Job Title:** Research Associate in Atmospheric Dispersion Modelling (SENTINEL project)
**Grade:** 7
**Salary:** £40,704 per annum, pro-rata if part-time
**Department:** School of Engineering
**Hours/Contract:** Full time or job share, fixed term from 01 January 2027 to 31 March 2028
**Job Family:** Teaching and Research
**Reference:** 14073

## Role Purpose

To lead the physics-based dispersion modelling and validation strand of the SENTINEL project. You will set up and run established atmospheric dispersion models (such as ADMS, Met Office NAME and CALPUFF) to provide the scientific benchmark against which SENTINEL's AI forecasts are judged, design and run hindcasting experiments, and help make sure the AI system is physically plausible and trusted by regulators and public health agencies. You will work collaboratively and independently as part of a research team to achieve defined milestones and produce high quality research as part of the wider programme.

## About the SENTINEL Project

Air pollution is the UK's biggest environmental threat to public health, yet fugitive emissions – uncontrolled releases from landfill, water treatment, agricultural and industrial sites – remain almost impossible to forecast. Conventional dispersion models need to know how much is being emitted, and for fugitive sources that is rarely known.

SENTINEL (Source Emissions forecasting for NoTIficatioN of Exposure and Localised impact threats) is a new project funded by UKRI under Phase 1 of NERC's Artificial Intelligence (AI) for Environmental Science programme, and it turns this problem on its head. Rather than simulating a plume from an assumed source, SENTINEL learns the link between site operations, weather and what nearby communities actually experience, directly from real-world data. The aim is to build the UK's first physics-informed AI forecasting system for chemical fugitive emissions: predicting community exposure events and breaches of WHO health guidelines 24–72 hours ahead, so that site operators and public health agencies can act before people are affected. In short, SENTINEL aims to do for chemical exposure what machine learning has done for weather forecasting.

Phase 1 uses hydrogen sulphide ($H_2S$) emissions from a representative UK landfill site as a real-world testbed, backed by years of air quality monitoring, operational logs, meteorological ensembles and community odour reports. Our proof-of-concept 'nowcasting' model already predicts WHO health categories with 82.9% accuracy from weather data alone. SENTINEL will turn this into genuine multi-day forecasting using generative AI downscaling, graph neural networks and explainable AI, rigorously benchmarked against established dispersion models such as ADMS and the Met Office NAME model.

SENTINEL is designed as a two-phase programme. This post is part of Phase 1, which builds and validates the forecasting system. NERC will invite the most successful Phase 1 teams to apply for Phase 2, which would extend the project by a further 42 months to scale SENTINEL to multiple pollutants and types of industrial site, building towards a National Industrial Emissions Digital Twin – a UK-led capability for real-time environmental protection with the potential for global uptake. If Phase 2 funding is secured, there may be an opportunity to continue in the role, subject to funding.

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You will join an interdisciplinary team spanning AI, atmospheric dispersion, chemical fate and public health, led by Dr Tim Pearce with Dr Calvin Jephcote and Prof Mick Whelan in the School of Engineering at the University of Leicester, with links to the Institute for Environmental Futures and the NIHR Health Protection Research Unit in Chemical Threats and Hazards. You will work closely with project partners at the UK Health Security Agency (UKHSA) and the Met Office, and the project will draw on national computing infrastructure (the AI Research Resource and JASMIN) alongside the University's ALICE HPC. This is a rare chance to help shape a new field at the intersection of AI, atmospheric science and public health, and to see your research used by regulators and public health agencies.

## Main Duties and Responsibilities

**Research**

- To take responsibility for the physics-based dispersion modelling and validation strand of the SENTINEL project, setting up, configuring and running atmospheric dispersion models such as ADMS, Met Office NAME and CALPUFF for $H_2S$ emissions at the case-study landfill site, to provide benchmarks for the SENTINEL AI forecasts.
- To lead the collection, processing, evaluation and interpretation of research data, including meteorological inputs from ECMWF and Met Office forecast and observational data, and geospatial inputs covering terrain, land use, and source and receptor locations, working autonomously to achieve agreed project milestones.
- To contribute to the selection and development of research techniques, approaches, models and methods, including designing and leading 'virtual time machine' hindcasting experiments on held-out data using only weather forecasts available at the time, and evaluating forecast skill using measures such as ROC-AUC, Brier and CRPS skill scores against WHO health guideline categories and community odour reports.
- To contribute to the overall research programme through innovative research models, approaches and techniques, including testing the robustness of forecasts under changing site conditions, such as before and after operational changes.
- To liaise with project collaborators to progress the research, in agreement with the line manager, working closely with the AI Research Associate to assess whether SENTINEL's predictions respect physical principles, including mass conservation and plume behaviour, and contributing to explainable AI (XAI) audits of physical plausibility.
- To lead the preparation of research findings for dissemination within the research team and the wider international community, including Model Cards, interpretability reports and user guidance for UKHSA and regulators, and to develop ideas and contributions for future grants and technical outputs.
- To represent the research group through the dissemination of results and findings at national and international conferences and to the wider community.
- To contribute as a co-author to research publications, including journal articles, technical papers, monographs and book chapters.

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- To develop and carry out a plan to extend an area of personal research, or contribute as a team member to the development of a broader research programme, including contributing to research bids and grant applications.
- To identify opportunities to apply for fellowships and further project grants, with the support of colleagues.
- To provide guidance to other staff and students involved in the research programme.
- To actively seek opportunities for multidisciplinary research with other University research groups and external stakeholders, with the approval of the Principal Investigator.

**Professional Development**

- Duties and opportunities to engage in work that support your own professional development.

**Impact and Knowledge Exchange**

- Network and contribute to the maintaining and furthering of the wider research programme and research area
- To contribute to industry collaborations
- To consult effectively on own specialism directly with people external to the University
- To engage positively and pro-actively in research impact

**Leadership and Citizenship**

- Guidance to other team members both research staff and students
- Pro-actively build networks and collaborations.
- Providing mentoring and coaching to Early Career Researchers and research students.

## Internal and External Relationships

Regular meetings with members of the programme research group

Meeting members of the department for critical discussion of the research and exchange of new ideas and approaches that might benefit the research

Liaison with external collaborators

Close day-to-day collaboration with the SENTINEL AI Research Associate

Liaison with project partners at the UK Health Security Agency (UKHSA) and the Met Office, and with the case-study site operator and regulators

## Planning and Organising

You will be required to effectively manage your time to plan your research activity and to deliver on the priorities of the project:

- Prioritise tasks within agreed work schedules;

- Plan for specific aspects of research incorporating issues such as deadlines, project milestones and overall research aims;
- Adapt daily and weekly plans to accommodate new developments and be flexible to the changing priorities of the research project;

## Qualifications, Knowledge and Experience

**Essential**

- PhD or equivalent in atmospheric science, meteorology, environmental science or engineering, physics, applied mathematics or a related discipline, or the equivalent professional qualification and experience *
- Demonstrated experience or ability in physical modelling of environmental processes, such as atmospheric dispersion of air pollutants, odours or chemical releases *
- Evidence of a contribution to peer-reviewed journal papers or equivalent e.g technical report/writing a piece of software *
- Evidence of proven analytical problem solving capability *
- Expertise in relevant approaches/models and analytical techniques and ability to develop new ones where required.

## Skills, Abilities and Competencies

**Essential**

- Experience of running an atmospheric dispersion model such as Met Office NAME, CALPUFF or ADMS, or a strong background in physics-based or numerical environmental modelling and the ability to become proficient in these tools quickly *
- Coding ability in Python and/or R for scientific data processing, analysis and visualisation *
- Willingness and ability to work with internal and external stakeholders*
- Evidence of continued development of subject expertise*
- Excellent communication skills – written and verbal evidenced by the ability to communicate complex information *
- Evidence of working effectively as part of a team and the ability to work independently *
- Working towards independence and ability to be involved in collaborative research
- Evidence and commitment to Continuous Professional Development (CPD) for yourself, and encourage commitment to learn and develop in others
- Collegiate member of a research team

**Desirable**

- Hands-on experience with NAME, CALPUFF and/or ADMS, ideally including model intercomparison or evaluation against monitoring data
- Familiarity with AI and machine learning tools (e.g. scikit-learn, PyTorch, TensorFlow) or explainable AI methods

- Experience working with weather data (e.g. ECMWF/ERA5 reanalysis, numerical weather prediction output, ensembles) and/or geospatial data and GIS (e.g. QGIS, ArcGIS, GeoPandas)
- Knowledge of air quality standards, health-based guidance values or odour assessment
- Experience of working within high performance computing (HPC) environments (e.g. running models and batch jobs on Linux clusters with schedulers such as Slurm)
- Budget management skills

**Criteria to be used in shortlisting candidates for interview*

**Reason for Fixed Term Contract**

The reason for the fixed term contract is stated in section 1.9 in the summary of contractual terms in your contract of employment.

**Criminal Declaration**

If you become an employee, you must inform your manager immediately, in writing, if you are the subject of any current or future police investigations/legal proceedings, which could result in a criminal offence, conviction, caution, bind-over or charges, or warnings.

**Supporting University Activities**

As a University of Leicester citizen, you are encouraged to support key university activities such as clearing, graduation ceremonies, student registration and recruitment open days. We encourage all staff as citizens to work flexibly across the University if required. If supporting these activities is likely to affect your workload, please speak to your line manager in the first instance

**University Values**

**Inclusive** - We are diverse in our makeup and united in ambition. Our diversity is our strength and makes our community stronger.

**Inspiring** - We are passionate about inspiring individuals to succeed and realise their ambitions. We challenge our community to think differently, to get involved, and to constantly embrace new ideas.

**Impactful** - As Citizens of Change we will generate new ideas which deliver impact and empower our community

**Freedom of Speech**

The University is committed to upholding freedom of speech and academic freedom within the law throughout our recruitment processes. We ensure that all candidates are considered based on merit and suitability for the role, without regard to their lawful viewpoints or the expression of challenging or controversial ideas. Our recruitment policies and practices are designed to protect applicants from discrimination or adverse treatment on the basis of their opinions, and to foster an environment where open debate and diverse perspectives are valued as essential to our academic mission.

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| Equity and Diversity |
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| We believe that equity, diversity and inclusion is integral to a successful modern workplace. By developing and implementing policies and systems that challenge stereotypes across all aspects of our work, we have a culture that recognises and values the diverse contributions of our staff which benefits everyone. Our strong values of inclusivity and equality support our efforts to attract a diverse range of high quality staff and students, and identify our University as a progressive and innovative workplace that mainstreams equality, diversity and inclusion. |

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