E5 NERC Summer Research Experience Placements 2026

Please return to e5dtp.info@ed.ac.uk

A. Supervisor (s) - Name, email and affiliation

List up to three supervisors. The first supervisor listed will act as the line-manager.

I. **David Stevenson David.S.Stevenson@ed.ac.uk (University of Edinburgh)**
II. **Julia Drewer juew@ceh.ac.uk (UKCEH)**
III. **Nick Cowan nicwan11@ceh.ac.uk (UKCEH)**

B. Student Mentor (current PhD student) Name, email and affiliation

Ruby Devlin rubdev@ceh.ac.uk (E4 DTP, University of Edinburgh and UKCEH)

C. Department/School

School of GeoSciences

D. Placement Project Title

Hydrogen in soils: measurements and modelling

E. Job purpose

To increase our understanding of how hydrogen (H_2) gas behaves in soils. Measurements of fluxes of hydrogen to/from soil will be taken in a variety of field and lab settings. Together with wider datasets of similar measurements, a model will be developed that describes the behaviour of hydrogen in soils and its dependence on key environmental variables, such as temperature, soil moisture, and soil organic carbon content.

F. Host and project outline

The placement will be hosted at both The School of GeoSciences at the University of Edinburgh and UK Centre for Ecology and Hydrology at the Bush Estate, just outside Edinburgh, with roughly half the time spent at each institute. Research is being conducted at both locations on the environmental impacts of hydrogen (H_2) gas.

Hydrogen is increasingly being used as a fuel, mainly as a long-term energy store coupled to variable wind and solar energy sources. As hydrogen's use increases, leakage is likely, and

questions are being asked about potential environmental impacts. Hydrogen is understood to be an indirect greenhouse gas[1], as it reacts with hydroxyl radicals, increasing methane's atmospheric lifetime and producing ozone and stratospheric water vapour. The magnitude of this indirect impact on climate is important for quantifying the net benefits of greater hydrogen use in our energy supply systems[2]. In addition to chemical removal by OH, a large sink for atmospheric hydrogen is through uptake by soil microbes, but the size of this sink is highly uncertain, which leads to uncertainties in its climate impact. Various models of the soil sink have been proposed (e.g., ref. 3); these typically depend on diffusion of H_2 gas through a porous soil layer, followed by consumption by microbes at a few centimetres' depth. Soil properties, such as moisture content, exert a strong influence on the effective porosity. Soil microbial activity also depends on moisture, as well as temperature, and the availability of organic carbon[4]. The species of microbes present, and in particular their preference for consuming H_2, are also important[5].

In this placement, you will help develop a model based on these physical principles, and compare it with measurements of H_2 fluxes. The model development work will mainly be based in the School of GeoSciences at the University of Edinburgh. In addition, you will spend several weeks taking measurements, using existing field and laboratory setups and equipment[6] at UKCEH (at/near the Bush Estate, just outside Edinburgh with good bus links to the city). You will have some freedom in how the model is developed, but we envisage a computer code using either Python or R.

References

1. Sand, M., Skeie, R.B., Sandstad, M. et al. A multi-model assessment of the Global Warming Potential of hydrogen. Commun Earth Environ 4, 203 (2023). https://doi.org/10.1038/s43247-023-00857-8
2. Hauglustaine, D., Paulot, F., Collins, W. et al. Climate benefit of a future hydrogen economy. Commun Earth Environ 3, 295 (2022). https://doi.org/10.1038/s43247-022-00626-z
3. Bertagni, M. B., Paulot, F., & Porporato, A. (2021). Moisture fluctuations modulate abiotic and biotic limitations of H_2 soil uptake. Global Biogeochemical Cycles, 35, e2021GB006987. https://doi.org/10.1029/2021GB006987
4. Cowan, N., Roberts, T., Hanlon, M., Bezanger, A., Toteva, G., Tweedie, A., Yeung, K., Deshpande, A., Levy, P., Skiba, U., Nemitz, E., and Drewer, J.: Quantifying the soil sink of atmospheric hydrogen: a full year of field measurements from grassland and forest soils in the UK, Biogeosciences, 22, 3449–3461, https://doi.org/10.5194/bg-22-3449-2025, 2025.
5. Reji, L., Bertagni, M.B., Paulot, F. et al. Global implications of a low soil moisture threshold for microbial hydrogen uptake. Nat Commun 17, 515 (2026). https://doi.org/10.1038/s41467-025-67208-3
6. Drewer, Julia and Cowan, Nicholas J. and Hanlon, Mark and Roberts, Toby and Karbin, Saeed and Devlin, Ruby and Nalavade, Rujuta and Nemitz, Eiko and Tweedie, Alex and Bezanger, Aurelia, Characterizing Environmental Drivers of the Soil Hydrogen Sink Through Controlled Laboratory Experiments. http://dx.doi.org/10.2139/ssrn.6222017

G. Main responsibilities

- (=1) Sampling of air from static flux chambers in field and lab (15%)
- (=1) Sample analysis in the laboratory (15%)
- (=1) Flux calculation, data analysis (15%)
- (=1) Model development, evaluation and application (45%)
- (2) Writing project report (10%)

Key contacts and relationships

- David Stevenson, supervisor at University of Edinburgh
- Julia Drewer, primary supervisor at UKCEH
- Nick Cowan, supervisor at UKCEH
- Ruby Devlin, PhD student, practical work mentor and supervisor
- Hannah Bryant, PDRA at UoE, modelling mentor
- Alex Chaudhri, PDRA at UoE, modelling mentor

A key member of the supervisory team is PhD student Ruby Devlin, who was an undergraduate student intern herself a few years ago, and who has written this statement in support of the project:

"During my undergraduate degree in Environmental Sciences, I was lucky enough to participate in two internships, in both professional and academic sectors. My academic internship was undoubtedly one of the most rewarding experiences in terms of developing my independent research skills, evolving solution focused thinking, and directing my career as a scientist. Exposure to soil gas fluxes and biogeochemistry through my internship gave insight into an area of science that was not part of the generic curriculum and revealed possible career paths. I champion the opportunity for undergraduates to experience science as a career, not just an academic activity, before graduating. The experience gained through my university internship was instrumental in directing me to my PhD. I look forward to mentoring another undergraduate student through this project and helping forge their own path in scientific research."

H. Knowledge, skills and experience required for the role

Attribute	Essential	Desirable
Education, Qualifications & Training	• Studying on a quantitative science/engineering degree	• Environmental Physics/Science
Knowledge & Experience	• Coding in Python, R or similar	• Gathering data in lab and/or field • Environmental modelling and data analysis

I. Planning and organising

- Organise, plan, and conduct field and lab experiments (with supervision)
- Plan, develop and implement computer model code (with supervision)

J. Problem solving

- Recognise and respond to problems in field and lab experiments
- Build well-structured and clear model code; find and debug errors

K. Decision making

- Decide what makes a good measurement
- Decide what makes a good model

L. Length and timing of placement
6 to 8 weeks and preferred start/ end date if relevant

8 Weeks:

- 4 weeks mainly based at UKCEH, learning measurement techniques and taking measurements, in both the field and laboratory, laboratory analysis and data processing.
- 4 weeks mainly based at UoE, building the model and comparing model results to measurement datasets.

Start date to be agreed.

M. Budget

Laboratory consumables:
Vials for GHG & H2 sampling (re-useable: 2x £50 for 100)
Vial caps for GHG & H2 vials (£150 for 500)
Carrier gases for GCs (£250 proportionally for gas chromatography analysis)
Total: £500

N. Location and Equipment

UoE: Desk will be made available in the Crew Building. As necessary, a UoE laptop will be provided, and access to GeoSciences computing network.

UKCEH: Desk will be made available in the student room (own laptop can be connected via eduroam), access to Soils lab and Instrument Room for experimental work and sample analysis.

O. Health & Safety requirements

UoE work will be desk based. Induction for working in the School of GeoSciences will be provided.

UKCEH risk assessments for lab and fieldwork will be provided in addition to induction process for lab and fieldwork.

The student will receive training in field sampling methods (soil, litter and air samples from static flux chambers) as well as setting up controlled laboratory experiments. Full training will be given on UKCEH's gas chromatography instrument (PDHID for hydrogen analysis) as well as on how to use a portable gas analyser for soil respiration and methane (LICOR LI-7810 trace gas analyser). Training will also be given on data analysis including flux calculations and statistical analyses using R. The student will also be included in team meetings during the time of the placement to develop a wider awareness of the research topics and researchers involved.

P. Job hazards specific to the role

This role may result in potential exposure to certain hazards as listed below. These will be risk assessed by the school or department, which may require you to participate in, for example, health surveillance or follow other health and safety requirements.

• Other - Please specify:

The proposed field and laboratory work involved no significant hazards, and training and supervision will be provided.

Q. Alternative/adjusted placement (remote placement only).

If the placement needs to be remote, it could be adapted to remove the field and lab-work components and purely be about data analysis and building the soil model.