

Research Experience Placement (REP) Scheme Project Form 2024**Project Supervisors:**

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Host Organization and Department (if applicable):

UK Centre for Ecology & Hydrology (Edinburgh site)

Project Title:

Quantifying hydrogen uptake from different soil types

Project Description:

If fossil fuel energy is replaced with hydrogen energy (the hydrogen economy), soil H₂ uptake is hoped to counter predicted increased atmospheric H₂ emissions (accidental system losses). If this is not the case, increased global H₂ emissions (inevitable system leaks) may increase the warming impact of methane (CH₄) by interfering with atmospheric destruction processes (removal of *OH radicals). An improved quantification of the soil sink and understanding of its response to a changing climate is needed as well as an understanding of interactions with other greenhouse gases. Many soil microbes utilise H₂ as an energy source but emission of H₂ from soils is also possible via microbial processes. The current understanding of these processes is severely understudied due to the logistical difficulties and technical restraints of H₂ flux measurements, as well as prior irrelevance. The aim of this project is to investigate the capacity of different soil types to act as a sink or source of hydrogen, and it is part of a larger NERC funded project investigating hydrogen dynamics by the UKCEH. Through laboratory incubations at controlled temperature, the response of soil hydrogen fluxes to soil moisture will be characterised from different types of soils (e.g. with contrasting pH levels and from different parts of the world) to develop response curves. In addition, direct field measurements at a Scottish grazed grassland and birch forest will inform on within-field spatial and temporal variability and effects of land-management which will be used to inform and improve advanced global flux models.

Skills and Career-Development Opportunities:

The student will receive training in field sampling methods (soil cores 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 instruments (ECD/FID for greenhouse gas analysis and PDHID for hydrogen analysis) as well as on how to use an infrared gas analyser for soil respiration (IRGA). Training will also be given on data analysis including flux calculations and statistical analyses using R. The student will also be included in project meetings during the time of the placement to develop a wider awareness of the research topics and researchers involved. The data generated by this student project will feed into the larger NERC project (ELGAR) and inform future global modelling scenarios.

Wider context of research:

This REP will be imbedded into a larger NERC funded research project (Topic B: The Enigma of soil hydrogen sink controls and variations (ELGAR)) addressing the role of the terrestrial hydrogen sink within NERC's "Environmental response to hydrogen emissions" programme. The aim of ELGAR is to better understand the soil hydrogen (H₂) sink using a combination of laboratory-based experiments and field observations which will be used in process-based modelling. There is a severe lack of H₂ flux data in soils at the global scale,

meaning that even the most advanced global and regional models are severely limited in terms of development and verification opportunities. This student project will generate highly valuable data for the growing H₂ flux community from laboratory experiments and direct field flux measurements.

Project Timeframe:

6 weeks over the summer between mid-June and mid-September would suit (with some flexibility depending on the successful candidate's needs)