Mobile laboratory for quantification of stable isotopes and greenhouse gases

David Johnson, N8 Chair in Microbial Ecology, The University of Manchester

Richard Bardgett, Chair in Ecology, The University of Manchester

We have recently taken delivery of a next-generation mobile isotope-ratio greenhouse gas laboratory (GasLab) thanks to two recent major NERC Capital Awards of £590k and £300k. The vehicle will be available for use by researchers and businesses alike for investigation and quantification of greenhouse gas fluxes from agri-ecosystems, forestry, and other land-use types. The mobile lab uses a 4 x 4 Mercedes van as a base, and has been custom fitted with a 'wet' laboratory, air-conditioning, climate sensors and a suite of state-of-the-art greenhouse and trace gas flux and stable isotope analysers. The laboratory will be deployable across the UK and mainland Europe for field, greenhouse and laboratory-based campaigns to facilitate the delivery of high-impact research relevant to sustainable agri-ecosystems that underpins much research in the UK, including that funded by the NERC Soil Security programme, and many of the key research needs of the N8 AgriFood community. GasLab will be a facility for the UK and EU bioscience research community that is unique in providing 'one-stop shop' quantification at high precision of i) fluxes of the major greenhouse and trace gases (CO_2, CH_4, N_2O and NH_3) from land surfaces, ii) isotope ratios of both carbon and nitrogen (i.e. relative abundance of ^{13}C and ^{15}N) in CO_2, CH_4, and N_2O fluxes, including isotopologues of CO_2 and N_2O, and iii) quantification of total carbon and ^{13}C in liquids and solids, and iv) supporting key meteorological data. GasLab fulfils the UK requirement for a field-deployable laboratory with multi-analytical capability that opens-up significant opportunities for research and environmental monitoring in the sustainable agriculture remit. Sustainable intensification necessitates that agriculture considers wider environmental impacts on soil, biodiversity, water and atmosphere, and GasLab will ensure the research community is globally-competitive in addressing issues related to sustainable agri-ecosystem functioning.

Recent N8 pump-priming funding will see GasLab deployed across the N8 farm network at Lancaster, Leeds and Newcastle, with the aim of investigating how grassland management affects fluxes of greenhouse gases. These data will help provide novel baseline data related to greenhouse gas fluxes and help launch the N8 farm network as a key resource for the Agri-food community.

A further example of the kind of capability GasLab will offer is in being able, for the first time, to quantify *in situ* temporal changes in carbon flows through the atmosphere-plant-microbe-soil continuum linked to release of N_2O, to identify sustainable management options for enhancing soil carbon stocks alongside productivity. We are currently generating data in real time to link these fluxes through our research funded by the NERC Soil Security programme.

One of the 12 automated soil gas flux chambers to allow continuous monitoring of greenhouse gases

Internal arrangement of instrumentation showing cutting-edge laser absorption spectrometers for real-time measurement of isotope ratios in gases

Lab area inside the vehicle