Understanding and quantifying greenhouse gases (GHG) emissions: the UK GHG Emissions and Feedback Programme

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We give an overview over the structure, objectives, and methods of the UK-based Greenhouse Gases Emissions and Feedback Programme. The overarching objective of this research programme is to deliver improved GHG inventories and predictions for the UK, and for the globe at a regional scale.

To address this objective, the Programme has developed a comprehensive, multi-year and interlinked measurement and data analysis programme, focussing on the major GHGs carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O).

The Programme integrates three UK research consortia with complementary objectives, focussing on observation and modelling in the atmosphere, the oceans, and the terrestrial biosphere:

- GAUGE (Greenhouse gAs Uk and Global Emissions) will produce robust estimates of the UK GHG budget, using new and existing atmospheric measurement networks and modelling activities at a range of scales. It integrates inter-calibrated information from ground-based, airborne, ferry-borne, balloon-borne, and space-borne sensors, including new sensor technology.

- The GREENHOUSE (Generating Regional Emissions Estimates with a Novel Hierarchy of Observations and Upscaled Simulation Experiments) project aims to understand the spatio-temporal patterns of biogenic GHG emissions in the UK's landscape of managed and semi-managed ecosystems. It uses existing UK field data and several targeted new measurement campaigns to build regional GHG inventories and improve the capabilities of land surface models.

- RAGNARoCC (Radiatively active gases from the North Atlantic Region and Climate Change) is an oceanographic project to investigate the air-sea fluxes of GHGs in the North Atlantic region. Through dedicated research cruises as well as data collection from ships of opportunity, it develops a comprehensive budget of natural and anthropogenic components of the carbon cycle in the North Atlantic and a better understanding of why the air-sea fluxes of CO_2 vary regionally, seasonally and multi-annually.

- Integration activities link these three projects to foster knowledge exchange across different scales, methods and sub-disciplines, both within the Programme and with the wider research community.

The three projects are integrated to improve our understanding of greenhouse gases across domains and scales. The observational components lay the foundation of new measurement infrastructure that will deliver beyond the lifetime of this Programme. Through the development of robust methods to reduce uncertainties in GHG emissions estimates, the Programme supports regulatory efforts to monitor emissions trends and the efficacy of reduction strategies.