



## **Towards a measurement-based national verification system for GHG emissions: UK emission estimates of CO<sub>2</sub> from the GAUGE experiment**

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Robust quantification of emissions of greenhouse gases (GHG) is central to the success of ongoing international efforts to slow current emissions and mitigate future climate change. The Greenhouse gAs UK and Global Emissions (GAUGE) project aims to quantify the magnitude and uncertainty of country-scale emissions of carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) using concentration measurements from a network of tall towers and mobile platforms (aircraft and ferry) distributed across the UK. The GAUGE measurement programme includes: (a) GHG measurements on a regular ferry route down the North Sea aimed at sampling UK outflow; (b) campaign deployment of the UK BAe-146 research aircraft to provide vertical profile measurements of GHG over and around the UK; (c) a high-density GHG measurement network over East Anglia that is primarily focused on the agricultural sector; and (d) regular measurements of CO<sub>2</sub> and CH<sub>4</sub> isotopologues used for GHG source attribution. We also use satellite observations from the Japanese Greenhouse gases Observing SATellite (GOSAT) to provide continental-scale constraints on GHG flux estimates. We present CO<sub>2</sub> flux estimates for the UK inferred from GAUGE measurements using a nested, high-resolution (25 km) version of the GEOS-Chem global atmospheric chemistry and transport model and an ensemble Kalman filter. We will present our current best estimate for CO<sub>2</sub> fluxes and a preliminary assessment of the efficacy of individual GAUGE data sources to spatially resolve CO<sub>2</sub> flux estimates over the UK. We will also discuss how flux estimates inferred from the different models used within GAUGE can help to assess the role of transport model error and to determine an ensemble CO<sub>2</sub> flux estimate for the UK.