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The impact and importance of intercalibration and intercomparisons for greenhouse gas observational networks

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Motivated by the UK 2008 Climate Change Act, which requires the UK to decrease its greenhouse gas (GHG) emissions by 80% of 1990 levels by 2050, the Greenhouse gAs Uk and Global Emissons (GAUGE) project aims to better quantify UK CO_2, CH4 and N2O emissions. As part of this project a UK-focused GHG observational network has been established, drawing together new and existing GHG data streams from regional to global scales. These included high-density regional studies, tall-tower sites, moving platforms (ferry and aircraft) and satellite observations. Under the project these observations will be combined with modelling approaches to better quantify and characterise UK GHG emissions and place them within a global context.

This presentation will describe the efforts made to ensure that common calibration scales were used within the GAUGE project and an assessment of the intercomparability of the stationary sites and moving platforms (including 6 near surface regional focused sites, 6 tall tower sites, ferry and aircraft measurements). This assessment was undertaken using both a cylinder intercomparison program (ICP) and a comparison between co-located flask and in situ measurements. The majority of the sites agreed within the WMO comparability guidelines, however, small relative biases in CO_2 and CH4 were identified at some sites. These biases generally increased with concentration, with differences up to 0.3ppm in CO_2 and 3ppb CH4 observed between tall tower sites and mobile platforms, while larger biases were found at some of the regional study sites.

In order to investigate the impact of biases of these types an experiment using pseudo emissions and observations was conducted. To achieve this, sets of emissions estimates for key GHG sources (e.g. for CH4 the sum of anthropogenic, biomass burning, wetlands, rice and oceans and other natural sources) were used to estimate the GHG concentrations at the GAUGE observation sites and mobile platforms via the Met office NAME model. These pseudo observations were then adjusted using a range of biases and simulated calibration offsets. Regional UK emissions were then determined based on inversions performed using the Met office NAME model and hierarchical Bayesian inversion method. Using these emissions estimates we quantified the impact of systematic site biases on derived fluxes, assessing the relevance of the WMO comparability guidelines for our UK study and highlighting the importance of rigorous inter-calibration and comparability of data streams for regional emissions estimation.