

## Ship-borne observations of trace gas concentrations at the UK outflow

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The United Kingdom (UK) is the third-most populous country in the European Union (EU) with a relative annual population growth of 0.75% (ONS, 2015)<sup>1</sup>. The UK also boasts the highest absolute population growth in the EU with more than 50% of net annual increase occurring in the London area, the South East and South West of England. The UK exhibits a marked North-South demographic gradient characterised by heavily urbanised conurbations in the Midlands and South and extensive rural areas with low population density in the North. As a result, greenhouse gas (GHG) emissions exhibit high spatial variability with substantial carbon dioxide (CO<sub>2</sub>) emissions in the South and significant agricultural sources of nitrous oxide (N<sub>2</sub>O) and methane (CH<sub>4</sub>) in Northern rural areas.

We report on 1.5 years of semi-continuous ship-borne measurements of CO<sub>2</sub> and CH<sub>4</sub> concentrations along the Eastern coast of the UK. Measurements are taken using a Picarro 1301 CO<sub>2</sub>/CH<sub>4</sub>/H<sub>2</sub>O cavity ring-down spectrometer installed on a DFDS Seaways freight ferry serving the Rosyth (Scotland, UK; 56°1'20'' N, 3°26'50'' W) to Zeebrugge (Belgium; 51°19'60'' N, 3°12'0'' E) route. The ship completes three return journeys per week and hugs the UK coast for ca. 500 km. The prevailing wind direction being SW, the ferry-borne system allows for repeat, direct measurements of emissions at the outflow of the country. In addition, it allows for the capture of the spatial emissions gradient and the seasonal variability in source strength. Coupled with tall tower measurements at Mace Head (53°19'29'' N, 9°54'12'' W) on the West coast of Ireland, which provide background GHG concentrations, these measurements will allow for a simple mass balance estimate of total UK and Ireland CO<sub>2</sub> and CH<sub>4</sub> emissions to be derived under favourable W/SW wind conditions.

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<sup>1</sup> Office for National Statistics, 2015.