

Spatial Variability of Carbon Isotopic Signatures of Methane in Northern Europe: Evidence from Mobile Campaigns and Inventories

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Isotopes provide powerful insight into methane sources, discriminating well between biogenic and thermogenic emissions. Thus most methane sources have distinctive carbon isotopic signatures (Dlugokencky et al., 2011), that can be evaluated by techniques such as Keeling plots. Isotopic sampling thus helps resolve inputs at different scales from regional to national (Zazzeri et al., 2015). Knowledge of emission signatures means that it is possible to convert spatially- and source- resolved emissions data into isotopic maps that can be ground-truthed by measurement. This can be done both in complex source areas in industrial settings, such as London and SE England, or on larger scales in the natural environment,

Where major seasonal sources dominate, like the boreal wetlands of Fennoscandia or Canada, the knowledge of bulk isotopic signatures (e.g. from wetlands, boreal fires, or gasfields) means that large-scale methane plumes with fairly consistent isotopic composition can be detected thousands of kilometers from their source regions as they cross northern Europe, the North Atlantic and Arctic Oceans. Similarly plumes from mixed source regions of industrial Europe have relatively constant isotopic signatures that change slowly over long-time scales as sources and processes change. These can be detected as they pass north into the Arctic regions or out into the oceans

Continuing collaborations on the InGOS project through fixed station time-series, diurnal campaigns and source studies, are adding to our comprehension of the spatial variability of the carbon isotopic signature being released into the complex landscape of Europe.

Zazzeri, G, Lowry, D., Fisher, R.E., France, J.L., Lanoisellé, M. & Nisbet, E.G. (2015) Plume mapping and isotopic characterisation of anthropogenic methane sources. *Atmospheric Environment*, 110, 151-162.

Dlugokencky, E.J., Nisbet, E.G., Fisher, R. and **Lowry, D.** (2011). Global atmospheric methane: budget, changes, and dangers. *Phil. Trans. R. Soc. A*, 369, 2058-2072.