Identifying regional methane isotopic source signatures from $\delta^{13}C$ measurements at European stations in the InGOS TNA program

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Transnational access in the INGOS project (TNA 5) has enabled $\delta^{13}C$ analysis of methane in air bags collected regularly at sites across Europe.

The background annual methane isotopic cycle is dominated by a relative ^{13}C-enrichment in the N. hemisphere summer when destruction by OH is at its maximum and deviations from this cycle are caused by source emissions during the year. An increase has been observed in methane mole fraction in late summer and autumn at the Zeppelin station (Spitsbergen) and Pallas (Northern Finland). This was concurrent with depletion in ^{13}C, implying the cause was emissions from northern wetlands (around -70 ‰). Methane mole fraction peaks in the winter, when the isotopic signature of the emissions is then more enriched in ^{13}C, reflecting the input of methane from fossil fuel sources (around -50 ‰), which dominate in winter.

At Egham (WSW of London) and Hegyhátsál (a tower site in the west of Hungary) weekly samples shows large variability in mole fraction. This is dependent on meteorology as well as seasonal changes. At both sites elevated methane mole fractions (frequently above 2 ppm) can be either relatively enriched or depleted in ^{13}C, depending on where the air has arrived from. The seasonal variation in ^{13}C is less distinct than at the Arctic sites.

Temporal changes in methane mixing ratio and $\delta^{13}C$ along with back trajectory analysis have allowed regional isotopic source signatures to be calculated, facilitating assessment of the inputs to the bulk source mix.