



Development and applications of the GV Instruments Trace Gas for atmospheric methane and carbon dioxide isotope studies

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The GV Instruments Trace Gas, coupled to an IsoPrime mass spectrometer allows continuous-flow measurements of $\delta^{13}\text{C}$ of methane or $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ of carbon dioxide in small volumes of air (~ 75 mL of air at ambient concentration). Small-scale modifications to the Trace Gas have improved the repeatability of analyses to 0.05 permil for $\delta^{13}\text{C}_{\text{CH}_4}$, 0.03 permil for $\delta^{13}\text{C}_{\text{CO}_2}$ and 0.05 permil for $\delta^{18}\text{O}_{\text{CO}_2}$. The air inlet system has been fully automated, and connected to an external intake, allowing the Trace Gas to be used to analyse outside air semi-continuously at a fixed location.

Diurnal studies have been carried out at Royal Holloway in Egham, which is situated 32 km WSW of the centre of London. At this site London and continental emissions can be measured when the air is from the east, and compared with near background composition when the air is from the SW. The diurnal pattern in mixing ratio and isotopes can provide important information about the sources of the gases. This may be useful in verification of statistical emissions inventories. With the addition of an automated liquid nitrogen dispenser the Trace Gas could be run for periods of days without on-site assistance, allowing a continuous half-hourly record of $\delta^{13}\text{C}$ of CH_4 or $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ of CO_2 to be recorded. This would be particularly useful for detecting seasonal and inter-annual changes in sources of the gases at a continental site such as the Egham site. Another advantage of continuous sampling over weekly/bi-weekly flask sampling is that continuous records may record event plumes which would otherwise be missed, e.g. from the recent oil explosion at the Buncefield depot, 40 km N of the Royal Holloway sampling site.

The small sample size required with a continuous flow system such as the Trace Gas

also makes it ideal for source studies. As an example the instrumentation has been used to analyse samples collected in Irish wetlands. Samples were collected in closed chambers and upwind and downwind of the wetlands in order to estimate the isotopic composition and emission rate of the methane.

The new developments to the Trace Gas make it ideal for measuring diurnal variations at a continental site, or improved measurement precision of methane source studies and it is also approaching the precision of better than ± 0.05 permil required for measurements of the seasonal cycle at a background site.

References

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