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# Use of Carbon 13 data to Verify Urban Methane Inventories: A London Regional Case Study

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The London conurbation has a population of 8.3 million people in an area of approximately 5000 km$^2$. Methane mixing ratios and isotopic measurements have been continuous at the Egham site on the western edge of this conurbation since 1995, distinguishing between near-background Atlantic air from the SSW and London air from the ENE.

Over the period 1996 to 2005 the $\delta^{13}$C signature of the London region source mix changed from -48.6‰ (Lowry et al., 2001) to -50.1‰ (Fisher et al., 2006). Experiments are underway to revise this figure for 2012. The main methane sources in the London region are waste emissions (landfill, composting and sewage treatment, 70-75%) and leaks in the natural gas supply system (15-20%) with smaller emissions from vehicle combustion, ruminants and domestic heating. Each of these has a distinctive isotopic signature, with the combustion sources enriched in $^{13}$C compared to the biological sources. The change in isotopic signature has predominantly come about by better landfill practice, a reduction in gas leaks and the introduction of catalytic converters to vehicles. The regional signature from the late 1990's suggested that there was a big underestimate of landfill emissions in the inventories; the UK landfill emissions were later increased to bring them up to similar levels to other EC countries, highlighting the use of top down atmospheric validation of the bottom-up emissions estimates.

Exploration of the diurnal changes in $\delta^{13}$C over a number of daily cycles measured at the Egham station (see references above) is starting to reveal small $^{13}$C-enrichments associated with a morning domestic heating peak and rush-hour vehicle movements. At the seasonal scale winter shows an overall enrichment in $^{13}$C of emissions (heating and combustion) compared to summer (higher waste emissions during warmer months). Work is nearing completion to convert the emissions estimates for each of the major sources in the London region to an isotopic signature on a 1x1 km$^2$ grid to provide isotopic maps of the region. These will be validated by sample collection on isotopic transects across the city and circuits around it, and at major identified sources during 2012 and 2013. These will be compared with diurnal isotopic measurements upwind, downwind and in the centre of the city.

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