

Attribution of Organic Aerosols in UK Cities

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Organic matter represents a major fraction of particulates in urban environments, however attempts to quantitatively predict their loadings remains elusive (Volkamer *et al.*, 2006). Part of the problem is that we still lack effective ways of comprehensively and unambiguously characterising the fraction in terms of the compounds present, the functionality and the sources. Recently the technique of positive matrix factorisation (PMF) has been employed for source apportionment of aerosols and this has been shown to be highly useful when used with organic data from the Aerodyne Aerosol Mass Spectrometer (AMS) (Lanz *et al.*, 2007).

Traditionally, organic AMS data in polluted environments has been split into hydrocarbon-like and oxygenated organic aerosols (HOA and OOA) which in turn has been ascribed to primary and secondary organic aerosols respectively (Zhang *et al.*, 2005). The use of PMF, which can deliver many factors, has shown that many more fractions can be identified and quantified. The technique has also benefited from the use of time-of-flight mass spectrometers through the increase in signal-to-noise they provide (Drewnick *et al.*, 2005).

It is known that the importance of various sources and processes vary according to geographical location and meteorology. It is therefore important to characterise the organic aerosols as extensively as possible, using data from multiple measurement campaigns. To this end, this paper presents the analysis from a number of recent studies using time-of-flight AMS instruments, including the REPARTEE experiments in London and CityFlux in Manchester during 2006 and 2007. These data were collected in conjunction with measurements of aerosol number, size distribution, equivalent black carbon mass and single particle composition (using an ATOFMS). Locations used included roadside measurements on a busy bus corridor, roof level in the city centre and urban parkland.

Several differences and similarities were noted between the different datasets. Notably, in addition to the usual HOA, OOA1 and OOA2 factors normally associated with combustion and secondary organic aerosols, an additional factor was isolated that could be associated with cooking, based on diurnal profile and similarity of its mass spectra to previously reported cooking spectra. The fractional contribution of this during the REPARTEE 1 study

was comparable to that of the primary organics from the transport sector (figure 1).

The primary factors could also be compared with measurements of carbon monoxide and black carbon to derive emission ratios representative of the sources (using roadside measurements) and the grid-scale cohort emissions (using roof-level measurements).

In common with most urban studies, large contributions from secondary organics were noted. In addition, potential biomass burning signatures were seen in Manchester, possibly coming from sources outside of the city.

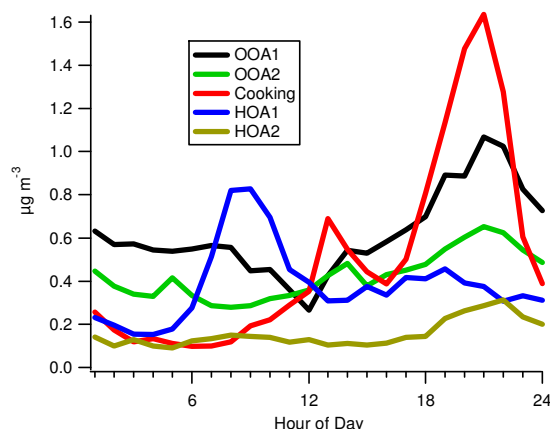


Figure 1: Median diurnal profiles from a 5-factor analysis of the REPARTEE 1 dataset in London.

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Drewnick, F., *et al.* (2005), *Aerosol Sci. Technol.*, 39, 637-658.

Lanz, V. A., *et al.* (2007), *Atmos. Chem. Phys.*, 7(6), 1503-1522.

Volkamer, R., *et al.* (2006), *Geophys. Res. Lett.*, 33(17), 4.

Zhang, Q., *et al.* (2005), *Environ. Sci. Technol.*, 39(13), 4938-4952.