The spatio-temporal evolution of black carbon in the North-West European 'air pollution hotspot': initial findings from a new long-term network

K.P. Wyche[1], R.L. Cordell[2], M.L. Smith[1], K.L. Smallbone[1], P. Lyons[1], S.M.L. Hama[2,3], P.S. Monks[2], J. Staelens[4], J. Hofman[4,5], C. Stroobants[4], E. Roekens[4], G.P.A. Kos[6], E.P. Weijers[7], P. Panteliadis[8] and M.B.A. Dijkema[8,9]

[1]School of Environment and Technology, University of Brighton, Brighton, BN2 4GJ, UK
[2]Department of Chemistry, University of Leicester, Leicester, LE1 7RH, UK
[3]Department of Civil and Environmental Engineering, University of Surrey, Guildford, GU2 7XH, UK
[4]Flanders Environment Agency, Department Air, Environment and Communication, Antwerp, Belgium
[5]Holst Centre, High Tech Campus 31, 5656 Eindhoven, the Netherlands
[6]Netherlands Organisation for Applied Scientific Research, the Netherlands
[7]National Institute for Public Health and the Environment, RIVM, Bilthoven, the Netherlands
[8]Public Health Service of Amsterdam, Amsterdam, the Netherlands
[9]Institute for Risk Assessment Science, Utrecht University, Utrecht, the Netherlands
Keywords: Black carbon, particulate matter, air quality, North-West Europe, health
Presenting author email: k.p.wyche@brighton.ac.uk

Particulate black carbon (BC) has a range of negative impacts on health, the environment and climate, however despite this there are relatively few long-term studies on its ambient distribution as a tropospheric air pollutant (*e.g.* Janssen *et al.*, 2011). In order to address this lack of data, to help to provide greater insight into the spatio-temporal distribution of particulate black carbon and to assess potential influencing factors, a new, permanent suburban monitoring network was established with sites in four northwest European cities: London (UK), Leicester (UK), Amsterdam (the Netherlands) and Antwerp (Belgium). We report here an analysis of the first measurements made by the network over a twenty-seven-month period (01/01/2013 - 01/04/2015), alongside data from pre-existing comparator urban roadside (AURN Marylebone Road, London, UK) and rural background (AURN Auchencorth Moss, Scotland) sites.

The temporal evolution of BC was investigated at each site (Figure 1), as were associations with other commonly monitored pollutants (*e.g.* O_3, NO_x, $PM_{2.5}$, PM_{10}) and wind fields. Results showed clear anthropogenic signatures across the diurnal, weekly and annual timeframes, and positive correlations were obtained between black carbon measurements and other common traffic-related pollutants, highlighting the importance of vehicle emissions as a major contributor to ambient black carbon concentration in northwest Europe. Average black carbon concentrations varied from 6.6 µg m^{-3} at the urban roadside, to 0.2 µg m^{-3} in the rural background, with suburban and urban background sites having average concentrations in the range of 1.0 – 2.4 µg m^{-3}. Wind field analysis further highlighted the importance of road traffic as a source of BC and demonstrated the importance of local emission sources at the various receptor locations. Statistical analysis of data between sites generally indicated a weak correlation (r_s = -0.03 – 0.68, COD = 0.32 – 0.91), further highlighting the importance of local emissions in determining ambient black carbon concentration. It was also found that BC comprised a significant portion of total ambient particulate matter (PM), particularly at sites with the larger traffic volumes and during rush-hour (*e.g.* ~45% of $PM_{2.5}$ at Marylebone Road), however, its contribution to total PM was found to decrease on days of high pollution, indicating the importance of other PM components when air quality is particularly poor.

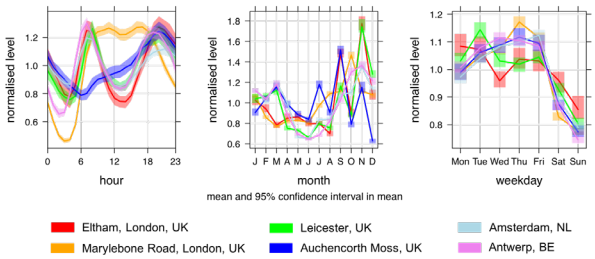

Figure 1. Temporal evolution of BC at each site for (left) each hour over 24 hrs, (middle) each month over 1 year and (right) each day over 1 week, over the study period

This study was funded under the Joaquin (Joint Air Quality Initiative), an EU cooperation project supported by the INTERREG IVB North West Europe programme (www.nweurope.eu).

References

Janssen, N.A., Hoek, G., Simic-Lawson, M., Fischer, P., van Bree, L., ten Brink, H., Keuken, M., Atkinson, R.W., Anderson, H.R., Brunekreef, B., Cassee, F.R. (2011) Black carbon as an additional indicator of the adverse health effects of airborne particles compared with PM_{10} and $PM_{2.5}$. Environ Health Perspect 119, 1691-1699.