Talk overview

• The Black Carbon network – structure and history

• Some features from the 2012 data

• Connections between Black Carbon network data and PAH concentrations in Northern Ireland
Black Carbon Network - Overview

Research Network to give data on potential sources of emissions and provide information on the spatial distribution of concentrations.

Black Carbon is of interest for health studies, and also warms the planet by absorbing heat in the atmosphere and by reducing albedo when deposited on snow and ice.

Black Carbon is typically formed through the incomplete combustion of fossil fuels, biofuels, and biomass.
A modern version of Black Smoke

The Network method changed from Black Smoke to Black Carbon in 2008
Instrumentation - Aethalometer

What does it measure? (Physics)

Absorption of specific wavelengths by collected PM$_{2.5}$ particles: 880 nm (near-ir) and 370 (near-uv)

Well defined (although interpretation as quantity of “soot” is complicated by particle size, loading etc)

High sensitivity and time resolution (reported hourly)

Real time data
**Instrumentation - Aethalometer**

*What does it measure?* (Non-physics)

“Black Carbon”, a component of PM$_{2.5}$, dominated by soot, expressed as $\mu g/m^3$ - assumptions and corrections are involved

Similar to Elemental Carbon, required in Directive (NB Elemental Carbon is not well defined either)

Linked to historical Black Smoke data (though the “$\mu g/m^3$” is not the same)

A good measure of combustion emissions

Differences between near-uv (370 nm) and near-ir (880 nm) (i.e. colour) provide further information
### The Black Carbon Network

**2-wavelength aethalometers**

**Hourly data**

<table>
<thead>
<tr>
<th>Emission source</th>
<th>Key</th>
<th>Site Name</th>
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<tbody>
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<td>Birmingham Urban Area</td>
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<td>Birmingham Tyburn Roadside</td>
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<tr>
<td></td>
<td>5</td>
<td>Birmingham Tyburn Background</td>
</tr>
<tr>
<td>Birmingham Urban Area + London Urban Area</td>
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<td>Harwell</td>
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<td>Domestic Emissions</td>
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Black Carbon Network Structure

CMCU – King’s College, London
LSOs – Local Authorities
ESU – Enviro Technology

Overall management and QA/QC Unit - NPL
Annual mean concentrations in 2012 (Black Carbon channel)
Annual mean concentrations in 2012 (UV channel)
<table>
<thead>
<tr>
<th>Site</th>
<th>Data Capture</th>
<th>Time Coverage</th>
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<td>Strabane</td>
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</table>
2012 periodicity data – Marylebone Road
2012 periodicity data – North Kensington
2012 periodicity data – Harwell
2012 periodicity data – Strabane
2008 BaP (PAH) emissions in grams per year
Northern Ireland PAH and Black Carbon sites

PAH site
- Derry
  - 2011: 0.95 ng.m$^{-3}$
  - 2012: 0.88 ng.m$^{-3}$
- Ballymena
  - 2011: 1.12 ng.m$^{-3}$
  - 2012: 1.03 ng.m$^{-3}$
- Strabane
  - 2011: 0.86 ng.m$^{-3}$
  - 2012: 0.58 ng.m$^{-3}$

Black Carbon site
- Ballymena
  - 2011: 1.12 ng.m$^{-3}$
  - 2012: 1.03 ng.m$^{-3}$
- Belfast
- Dunmurry
  - 2011: 0.86 ng.m$^{-3}$
  - 2012: 0.58 ng.m$^{-3}$

EU target value: 1 ng.m$^{-3}$

Met data
Dunmurry: aethalometer UV and BaP in 2012
Northern Ireland PAH and Black Carbon sites

- **PAH site**
  - **Derry**
    - 2011: 0.95 ng.m\(^{-3}\)
    - 2012: 0.88 ng.m\(^{-3}\)
  - **Ballymena**
    - 2011: 1.12 ng.m\(^{-3}\)
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  - **Strabane**
  - **Belfast**
  - **Dunmurry**
    - 2011: 0.86 ng.m\(^{-3}\)
    - 2012: 0.58 ng.m\(^{-3}\)

- **Black Carbon site**

**EU target value:**
1 ng.m\(^{-3}\)

- **Met data**
Aethalometer data at Ballymena Nov/Dec 2012
Trends: BC at Marylebone Road

-0.13 [-0.48, 0.37] units/year
Long term trends: Black Smoke and Black Carbon

Black Smoke method

aethalometer

Time

µg.m⁻³

CARDIFF 12
DUNMURRY 3
NORWICH
STRABANE 2
Some final remarks, and points for discussion

Black Carbon instruments are very sensitive, rapid and reliable, and have relatively low costs;

They give a good indication of combustion emissions, and of solid fuel emissions, but not a well-defined chemical component of PM;

Black Carbon concentrations show a far greater range than the usual PM metrics PM$_{10}$ and PM$_{2.5}$, and so allow clearer interpretation;

Is there a wider role for Black Carbon as a proxy to clarify local primary PM sources and evaluate mitigation measures?

Is there an alternative measure that could do a similar job?
Thank you

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