Urban Air Quality – an overview

Steve Crawshaw: Bristol City Council
Contents

• Health
• Legal
• Emissions
• Monitoring
• Citizen sensing
• Communications
• Planning and action planning
Health

• London smog (1952)
• Pope et. Al (2002)
  – “Long-term exposure to combustion-related fine particulate air pollution is an important environmental risk factor for cardiopulmonary and lung cancer mortality.”
• PHOF – fraction of mortality attributable to PM air pollution
Health Impact Assessment

- PHE – Estimating Local Mortality Burdens
- COMEAP Interim statement on quantifying association between health impact and nitrogen dioxide
- Updated COMEAP note in technical report of UK NO2 Plan
- BCC Health impacts report
Legal Framework

• From emission based controls
  – IPC \ LAAPC
    • Best practicable means
  – Lead in petrol

• to ambient air quality regulation
  – EU Air Quality Directive
    • Members state
  – Local Air Quality Management
    • Local Authorities
EU Law

• Air Quality Framework Directive (1996)
  – Sets approach for assessment and management
  – Lists pollutants

• Air Quality Daughter Directives (x4)
  – Pollutant – specific

• Cleaner Air For Europe (CAFÉ – 2008)
  – Zones and agglomerations
UK LAQM

  - Duty on LA’s to report and manage air quality
  - AQMA and AQAP to “Act in pursuit” of compliance with air quality objectives for 8 pollutants
- Technical Guidance – LAQM TG.16
  - Sets out detailed approach to monitoring, reporting, data processing
- Policy Guidance – Action planning
Emissions: NOx
Source apportionment of NOx at Defra defined exceedance point
Traffic count point 57291, A4032: 2017

Component

Transboundary
Natural
Agriculture
London Taxi
LGV (Petrol)
Motorcycles
Shipping
Industry
UK background
Transboundary inc shipping
Other urban background
Off road mobile machines
HGV (Artic)
Commercial \ Residential
Buses
Petrol cars
HGV (Rigid)
LGV (Diesel)
Road traffic
Diesel cars

Category
- Local sources
- Regional background
- Urban background

NOx μg m⁻³
Emissions: Particulate Matter

PCM modelled population weighted source apportionment of PM2.5 (2010) (AQEG)
BCC Monitoring: NOx

- **Continuous Monitoring**
- LAQM TG.16 – “reference method” instruments = chemiluminescence
- Teledyne API T200 instruments
- Power, comms (landline \ GPRS \ GSM)
- Roadside monitoring - residential exposure (worst case)
Monitoring PM

- Mass – balance (TEOM)
- Beta – Attenuation (BAM)
- Hourly gravimetric concentrations
- Particle size determined by head
Passive NO2 Monitoring
Diffusion tubes

- 20% TEA in water
- Monthly placement / change
- Somerset Scientific Services
- QA through WASP
- In house changing / placement
- Network reviewed annually
- Can be used for compliance assessment but less accurate than continuous
Data processing: Continuous

- Optical instruments subject to drift
- Fortnightly calibration required
- Calibration factors applied to data rather than adjusting the instrument
- Ratification – monthly and annually
- Data is on SQL server
- Proprietary software to collect and manage data (Envista ARM)
Data processing: Tubes

- DT’s are co-located (triplicate) with continuous analysers and bias adjusted (~0.9) annually
- If data collection <75% they are also annualised
- We also distance adjust concentrations where location not representative of residential exposure
- Purpose built database does this.
Defra Monitoring

Use the interactive map below to explore different UK monitoring networks. The map shows the current sites within the network selected. Information about the selected network is shown below the map.

Map options

Filter by network
- Automatic Urban and Rural
- Automatic Hydrocarbon
- Non-Automatic Hydrocarbon
- PAH
- TOMPs
- Black Carbon
- Heavy Metals
- Particulates
- Stratospheric Ozone and UV
- UKEAP: Precip-Net
- UKEAP: Acid Gas and Aerosol
- UKEAP: Rural NO2
- UKEAP: National Ammonia
- UKEAP: Automatic Mercury

Show UK Regions Overlay

Filter by environment type
Defra Monitoring

- AURN – mainly for compliance with EU directive
- Background (St. Pauls) NOx, PM, O3
- Roadside – 4m from road, no junction within 25m, representative of 100m stretch (Temple Way) NOx PM10
Plots

- **R \ openair**
- Functions for calculating temporal distribution, plotting, subsetting and extracting data.
PM$_{10}$ ($\mu$g m$^{-3}$) at Old Market and St. Paul's: 2012

- **Mean:** 13.9
- **Median:** 14
- **Max:** 208
- **Min:** 0

**Histograms:**
- Left: PM$_{10}$ distribution at Old Market
- Right: PM$_{10}$ distribution at St. Paul's

**Graphs:**
- X-axis: Date (Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec)
- Y-axis: PM$_{10}$ concentration ($\mu$g m$^{-3}$)
Time Variation of NO\textsubscript{x} in Bristol: 2016

- **Brislington**
- **Fishponds**
- **Parson St**
- **St Paul's**
- **Wells Road**

**NO\textsubscript{x}**

- **Monday**
- **Tuesday**
- **Wednesday**
- **Thursday**
- **Friday**
- **Saturday**
- **Sunday**

**hour**

**mean and 95% confidence interval in mean**

**hour**

**month**

**weekday**
Communication

- Monitoring data
- Defra reporting
- Open Data
  - https://opendata.bristol.gov.uk/pages/trialno2map/
- How effective is behaviour change?
What is the Daily Air Quality Index?

PM\textsubscript{2.5} Particles

Based on the daily mean concentration for historical data, latest 24 hour running mean for the current day.

<table>
<thead>
<tr>
<th>Index Band</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>µgm\textsuperscript{-3}</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Very High</td>
</tr>
<tr>
<td>0-11</td>
<td>12-23</td>
<td>24-35</td>
<td>&gt;36-41</td>
<td>&gt;42-47</td>
<td>&gt;48-53</td>
<td>54-58</td>
<td>59-64</td>
<td>65-70</td>
<td>71 or more</td>
<td></td>
</tr>
</tbody>
</table>

Up to 5 day forecasts are available, use the links below to step through each day.

- Today (27th February 2018)
- Wednesday (28th February 2018)
- Thursday (1st March 2018)
- Friday (2nd March 2018)
- Saturday (3rd March 2018)

Bristol 2017 – 11 days with Moderate (4/5)
Bristol 2018 – 4 Moderate 1 High so far
- **Index of pollution levels and recommended actions and health advice.** Forecast data and monitored (Urban Background St Pauls)

<table>
<thead>
<tr>
<th>Air Pollution Banding</th>
<th>Value</th>
<th>Accompanying health messages for at-risk individuals*</th>
<th>Accompanying health messages for the general population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>1-3</td>
<td><strong>Enjoy</strong> your usual outdoor activities.</td>
<td><strong>Enjoy</strong> your usual outdoor activities.</td>
</tr>
<tr>
<td>Moderate</td>
<td>4-6</td>
<td>Adults and children with lung problems, and adults with heart problems, who experience symptoms, should <strong>consider reducing</strong> strenuous physical activity, particularly outdoors.</td>
<td><strong>Enjoy</strong> your usual outdoor activities.</td>
</tr>
<tr>
<td>High</td>
<td>7-9</td>
<td>Adults and children with lung problems, and adults with heart problems, should <strong>reduce</strong> strenuous physical exertion, particularly outdoors, and particularly if they experience symptoms. People with asthma may find they need to use their reliever inhaler more often. Older people should also <strong>reduce</strong> physical exertion.</td>
<td>Anyone experiencing discomfort such as sore eyes, cough or sore throat should <strong>consider reducing</strong> activity, particularly outdoors.</td>
</tr>
<tr>
<td>Very High</td>
<td>10</td>
<td>Adults and children with lung problems, adults with heart problems, and older people, should <strong>avoid</strong> strenuous physical activity. People with asthma may find they need to use their reliever inhaler more often.</td>
<td><strong>Reduce</strong> physical exertion, particularly outdoors, especially if you experience symptoms such as cough or sore throat.</td>
</tr>
</tbody>
</table>
Should BCC Issue Warnings?

Pollution episode data is publicly available but maybe not known/accessible to all and those who might want it?

**Potential Positive Impacts:**

- Raise awareness of air pollution and short term impacts of pollution episodes on health
- Allow people to take direct action to reduce exposure on moderate + pollution days in line with COMEAP health advice
- Schools and medical professionals made aware to increase preparedness?
- Provide a trigger for BCC to implement short term pollution reduction measures to reduce local contribution and help raise awareness of sources of pollution
Should Bristol City Council Issue Warnings?

Potential negative impacts of warnings

• How – General/targeted to those who sign up/are sensitive? Resource implications?
• South Wales study showed increased admissions due to warnings. Evidence of effectiveness is limited
• Assumption that air pollution is fine at other times – But legal exceedences in Bristol due to annual average roadside pollution and health impacts of long term exposure
• If warnings are limited to exposure reduction advice open to criticism as in London. Sensitive individuals recommended to change behaviour but those adding to the pollution by driving, wood burning, construction activity etc. not advised to modify behaviour (Victim Pays, not Polluter Pays)
Citizen Sensing

- Low – cost air quality sensors are becoming more available
- Often alphasense sensors repackaged
- Problems with reliability and accuracy
- Often compounded by cross sensitivity (pollutants \ humidity)

AQEG Advice
- Pre – engaged people often become less engaged
- Communications challenge for BCC – need a protocol
Air Quality Action Plans

• LAQM – compliance aim
• Quantify and cost measures
• Drive for NO2 compliance is main feature
• But also PM
• And longer term objective.
  – Exposure reduction?
  – WHO limits?
Transport planning

- Modal shift\suppressed demand
- Fiscally restrain demand for polluting journeys (CAZ)
- Take road space away from cars?
- Generate revenue to fund sustainable transport – RUC\WPL
- No coherent funding regime
- Limited regulatory power
Planning policy

• Core strategy LDF
• Standalone Air Quality Policy
• Developer contributions on damage cost basis?
Development Management

- Applications reviewed for AQ impact
- Air Quality Assessments
- EPUK Air Quality and Planning guidance (non statutory)
- Significance criteria
- Object to > negligible
- But how to account for CAZ?