

Urban Air Quality – an overview

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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

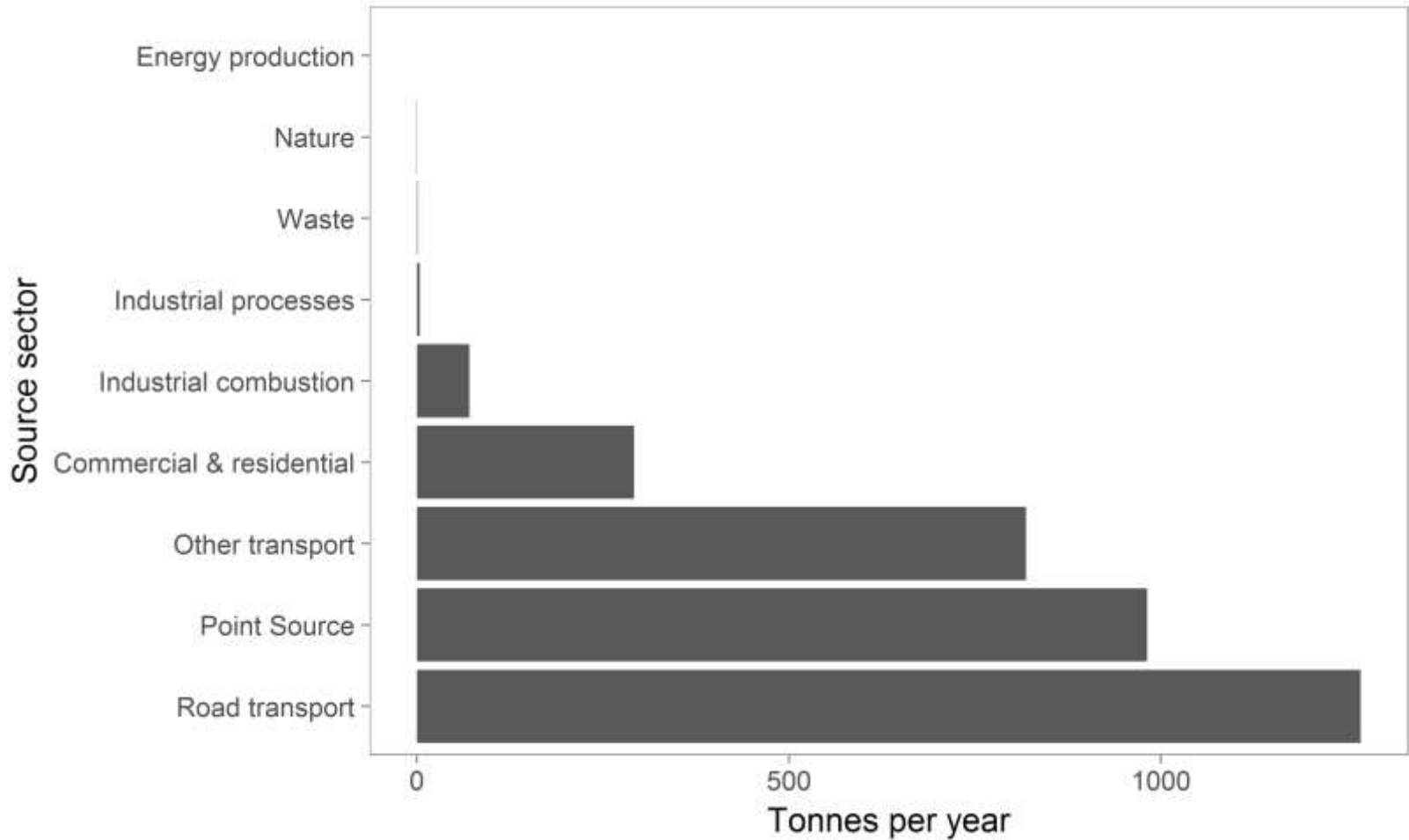
UK LAQM

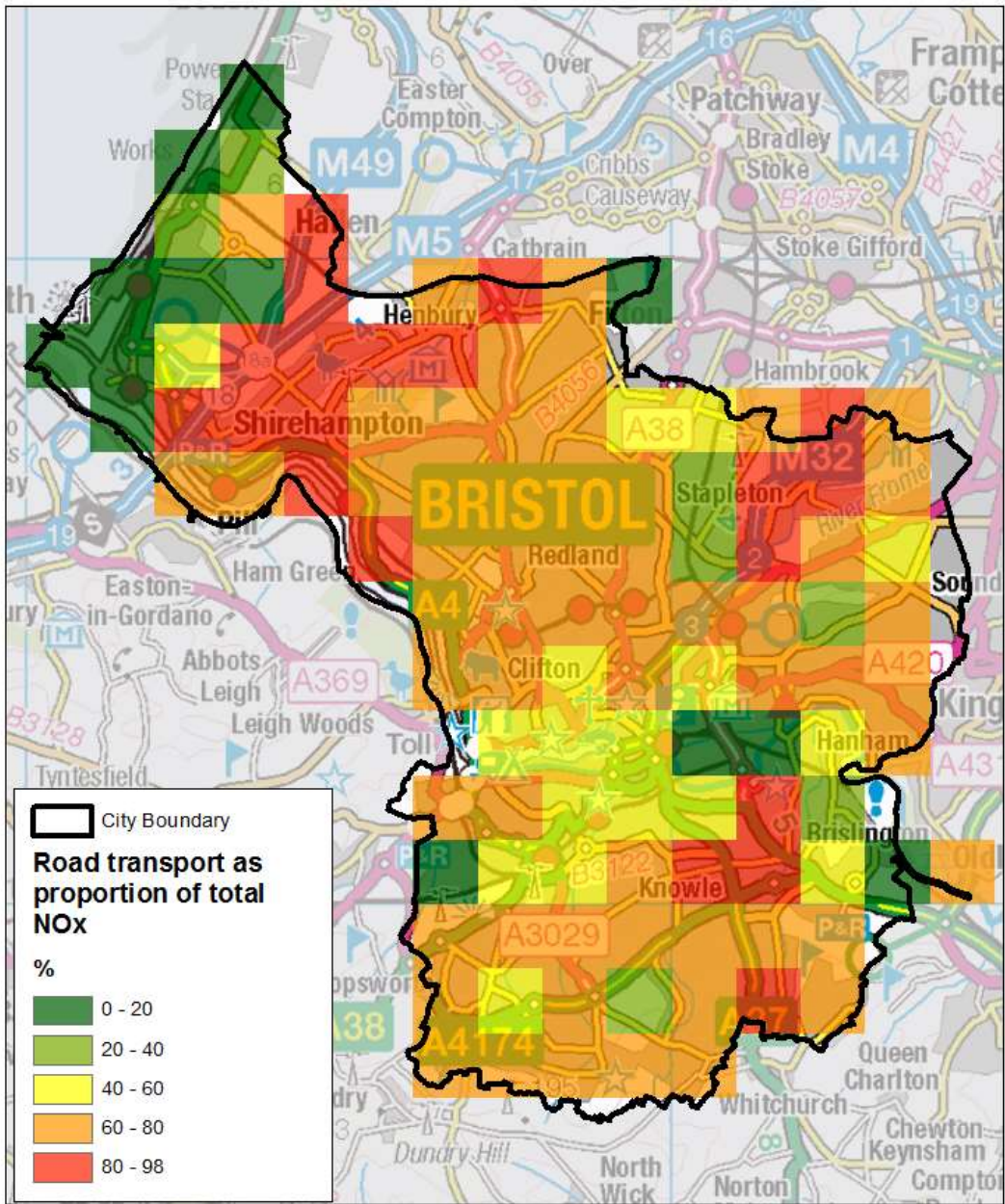
- Environment Act (1995)
 - **Duty on LA's to report and manage air quality**
 - **AQMA and AQAP to "Act in pursuit" of compliance with air quality objectives for 8 pollutants**
 - Technical Guidance – LAQM TG.16
 - Sets out detailed approach to monitoring, reporting, data processing
 - Policy Guidance – Action planning

Emissions: NOx

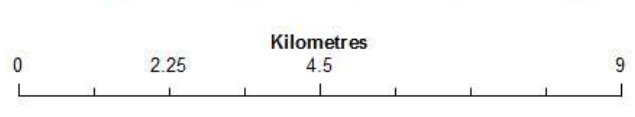
Emissions of NOx by sector in Bristol: 2014

Sectors defined in CORINAIR: Data from NAEI



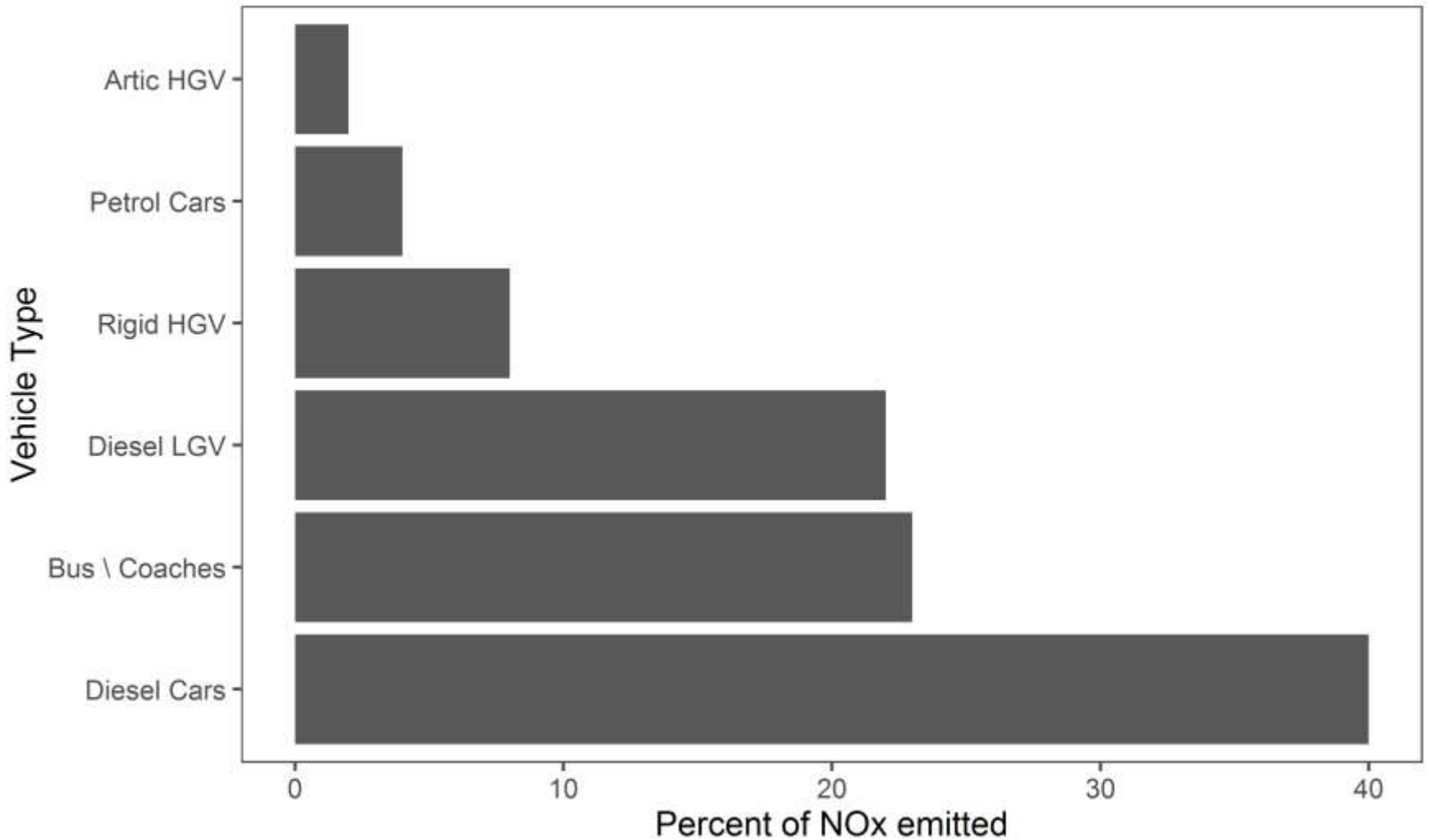


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Bristol City Council
100023406: 2017



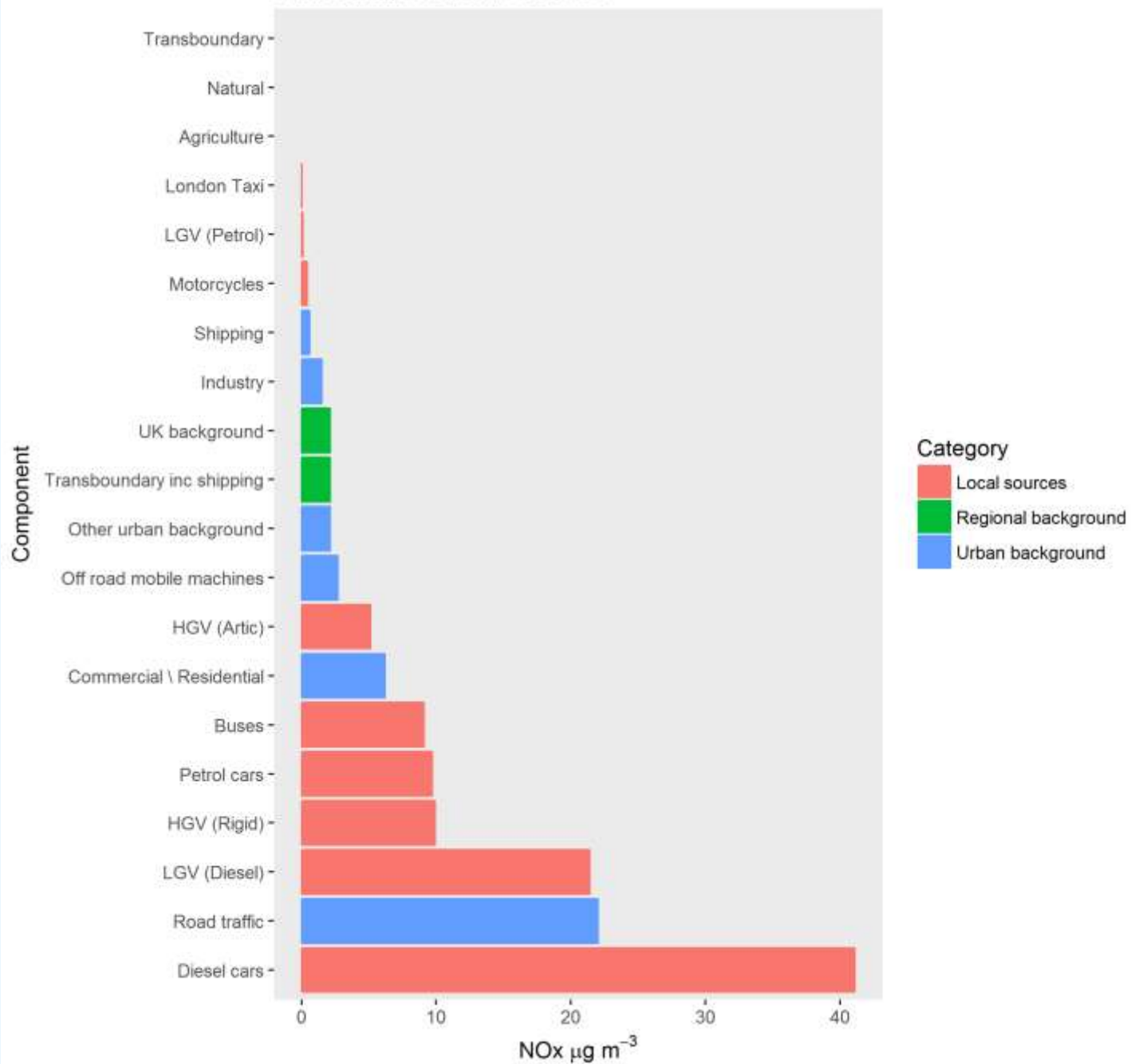
NOx emissions by vehicle type

Central Bristol: Transport sources



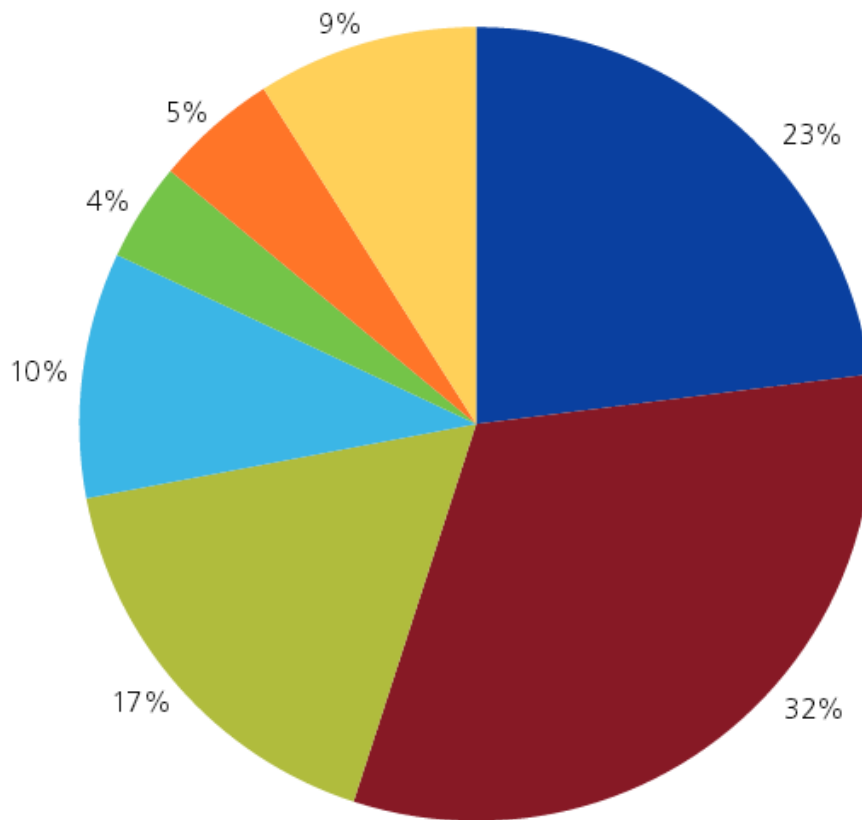
Source apportionment of NOx at Defra defined exceedance point

Traffic count point 57291, A4032: 2017



Emissions: Particulate Matter

PCM (updated since AQEG Report)



PCM modelled population weighted source apportionment of PM_{2.5} (2010) (AQEG)

- Primary
- Secondary inorganic aerosol
- Secondary organic aerosol
- Mineral dust/soil
- Traffic non-exhaust
- Sea salt
- Other

BCC Monitoring: NO_x

- 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

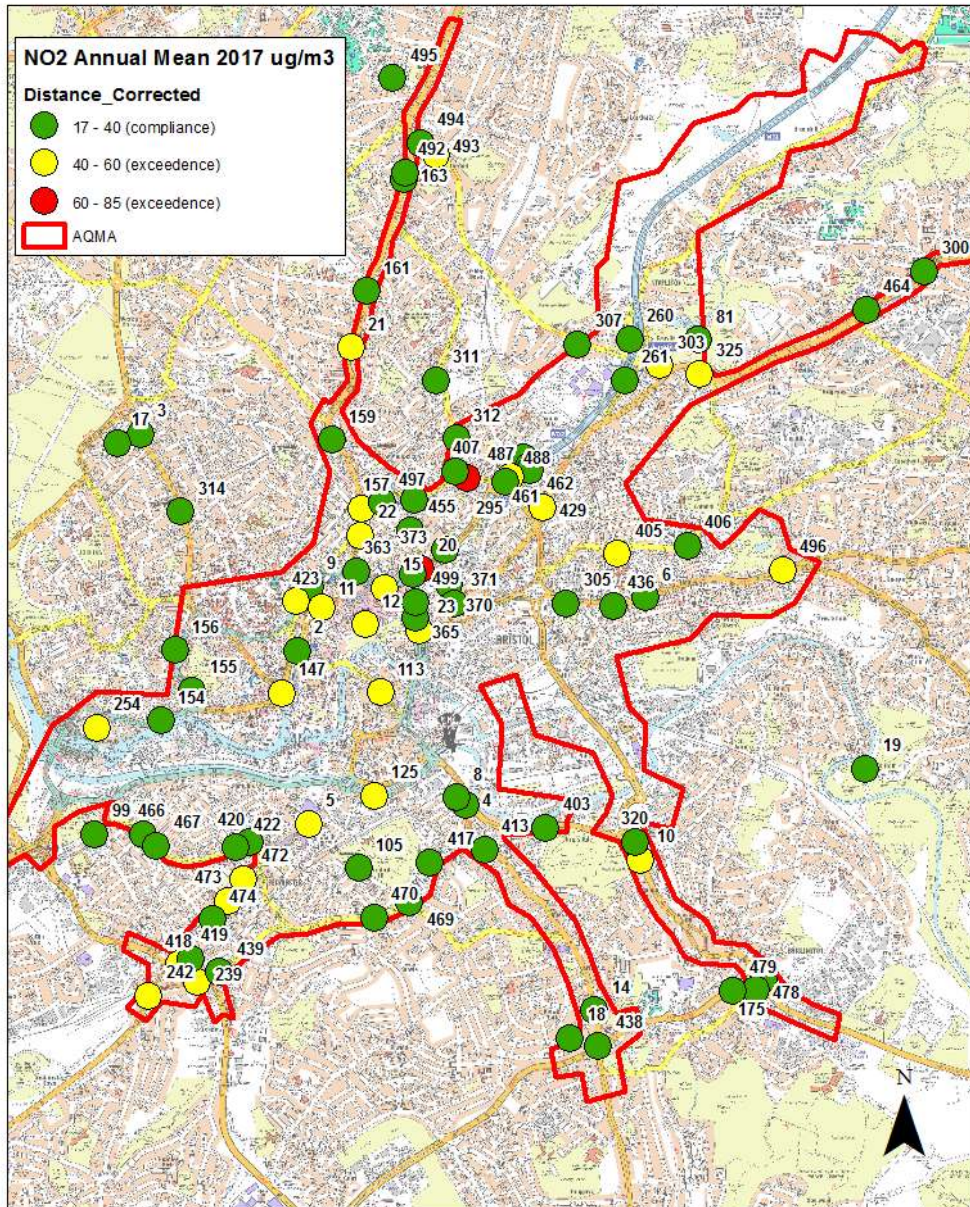


Passive NO₂ Monitoring

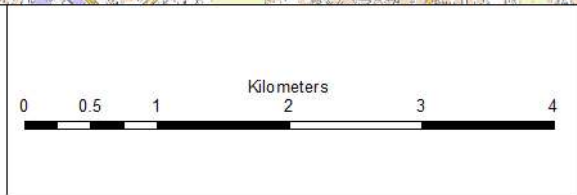


Diffusion tubes

- 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



OS data © Crown copyright & database rights 2015 Ordnance Survey 100023406



Data processing: Continuous

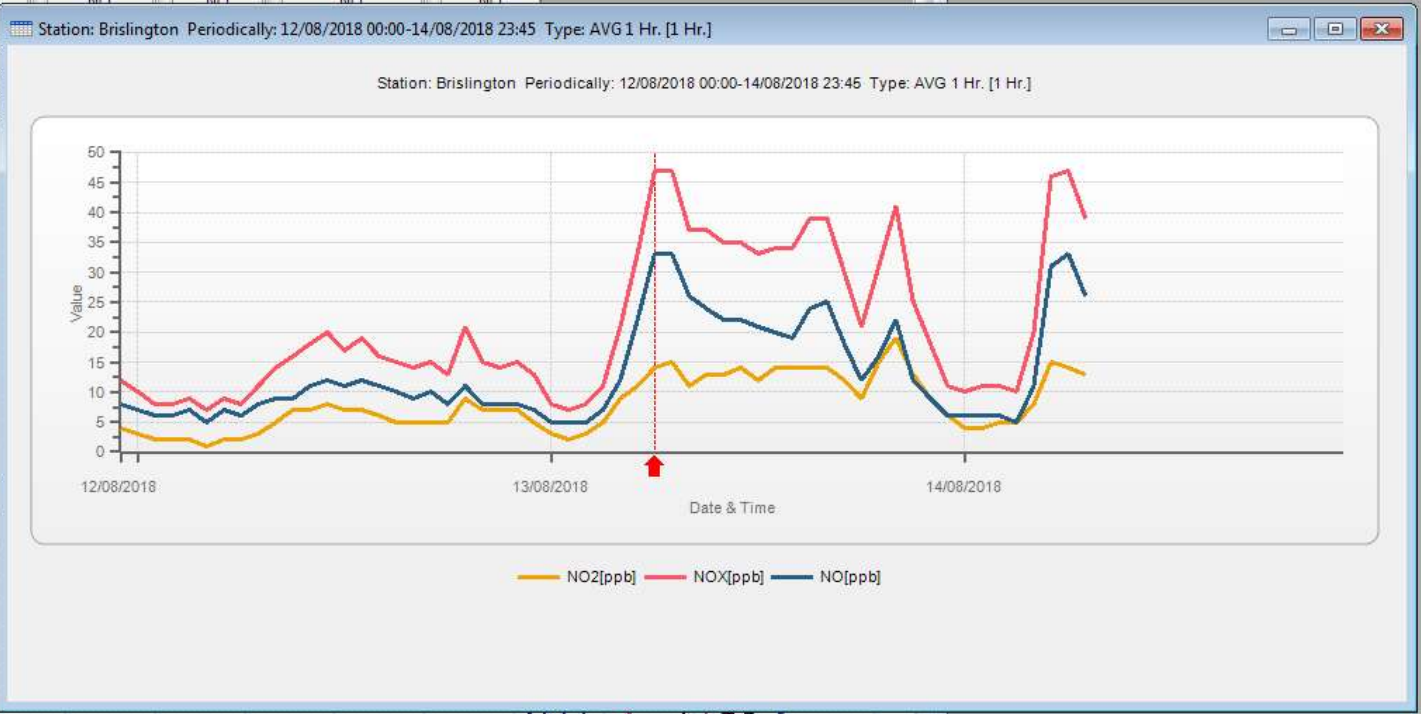
- Optical instruments subject to drift
- Fortnightly calibration required
- Calibration factors applied to data rather than adjusting the instrument
- Ratification – monthly and annually
- Data is on SQL server
- Proprietary software to collect and manage data (Envista ARM)

Station Multi Group Matrix Summary Histogram Index 2Y/XY Wind Events Parallel Percentile Annual Component Interval Graph Monitor Multi Monitor Daily Monthly Yearly Data Alerts State Calibration Validation Raw Vs Edited

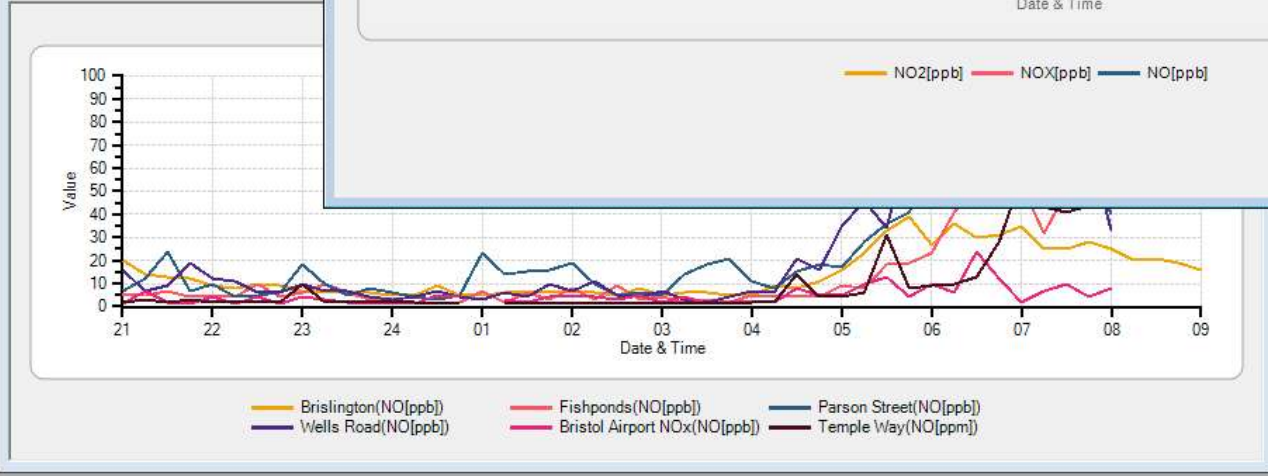
Textual and Charts Matrix Analysis CEM Combination Edit History

Dynamic Multi Station - NOx Sites 12 Hours

Date & Time	Brislington	Fishponds	Parson Street	Wells Road	Bristol Airport NOx	Temple Way
	NO	NO	NO	NO	NO	NO
	ppb	ppb				
14/08/2018 09:00	16	NoData				
14/08/2018 08:45	19	NoData				
14/08/2018 08:30	21	NoData				
14/08/2018 08:15	20	NoData				
14/08/2018 08:00	25	49				
14/08/2018 07:45	28	48				
14/08/2018 07:30	25	50				
14/08/2018 07:15	25	32				
14/08/2018 07:00	35	53				
14/08/2018 06:45	31	55				
14/08/2018 06:30	30	51				
14/08/2018 06:15	36	41				
14/08/2018 06:00	27	23				
14/08/2018 05:45	39	19				
14/08/2018 05:30	33	18				
14/08/2018 05:15	23	8				
14/08/2018 05:00	16	9				



Invalid Alarm Inst



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
 - 📍 Markers show latest pollution index
- Automatic Hydrocarbon
- Non-Automatic Hydrocarbon
- PAH
- TOMP's
- 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

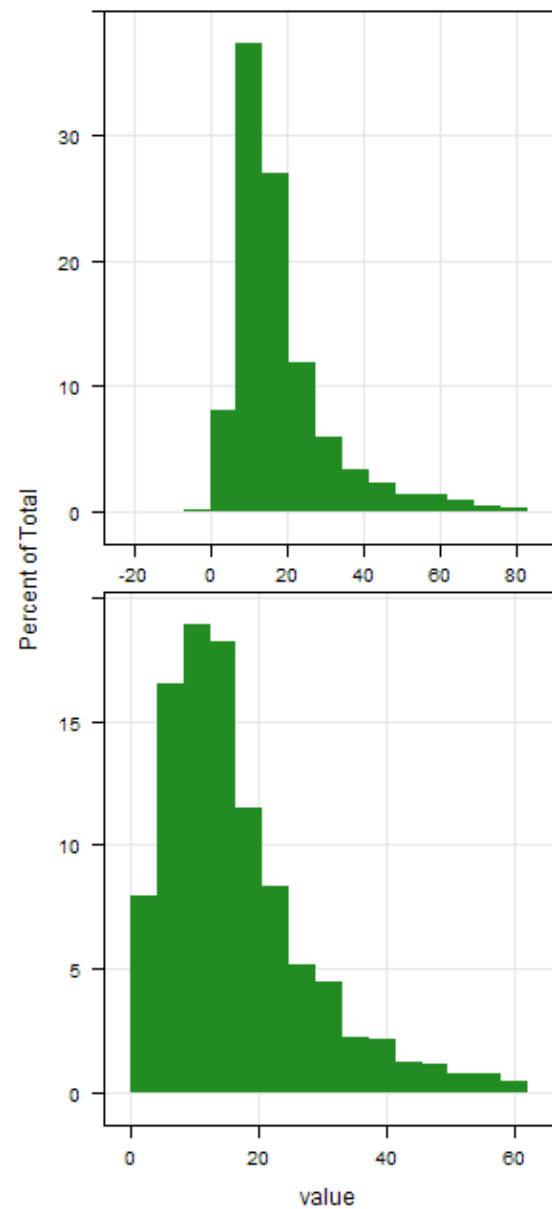
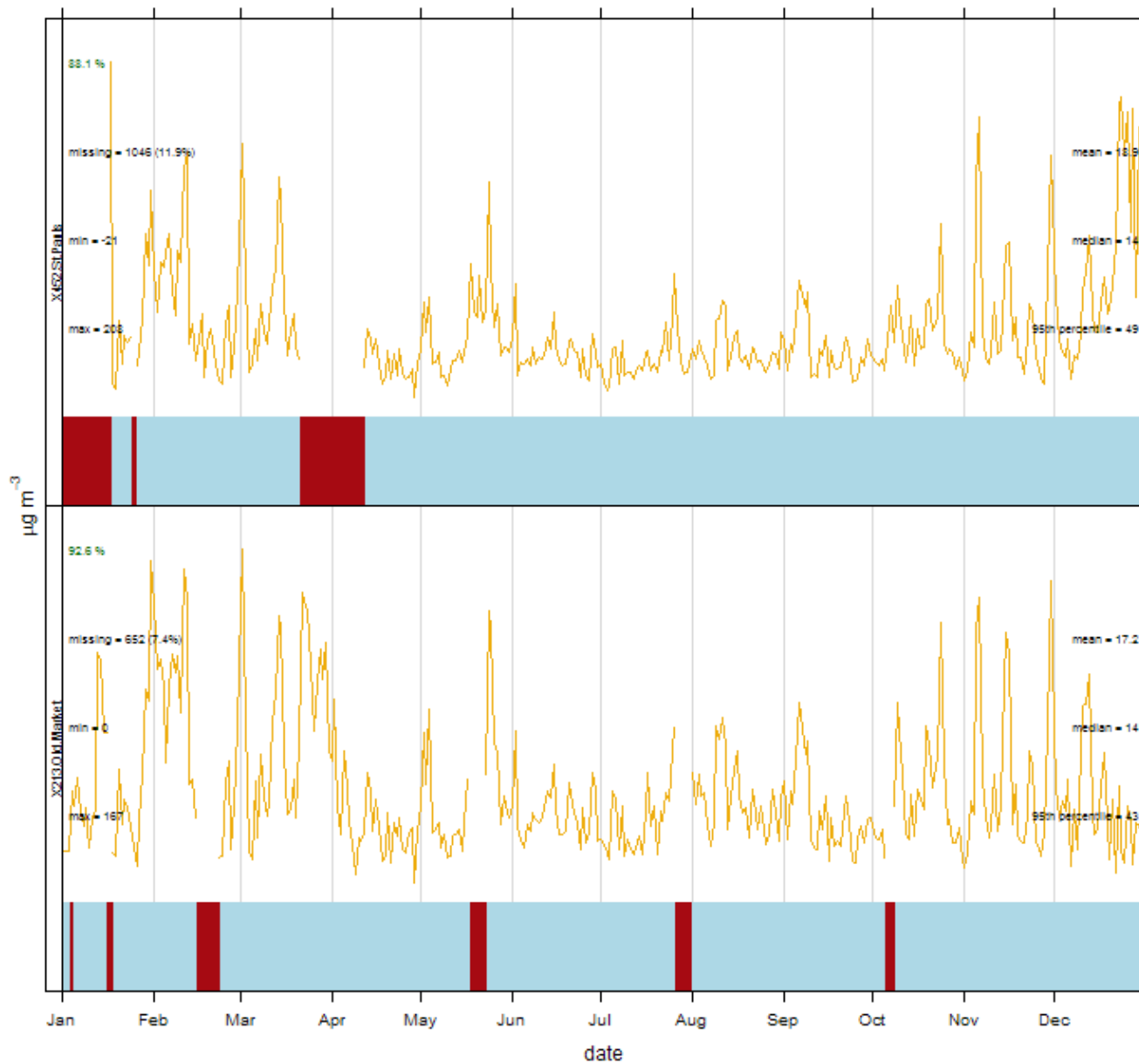
Defra Monitoring

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

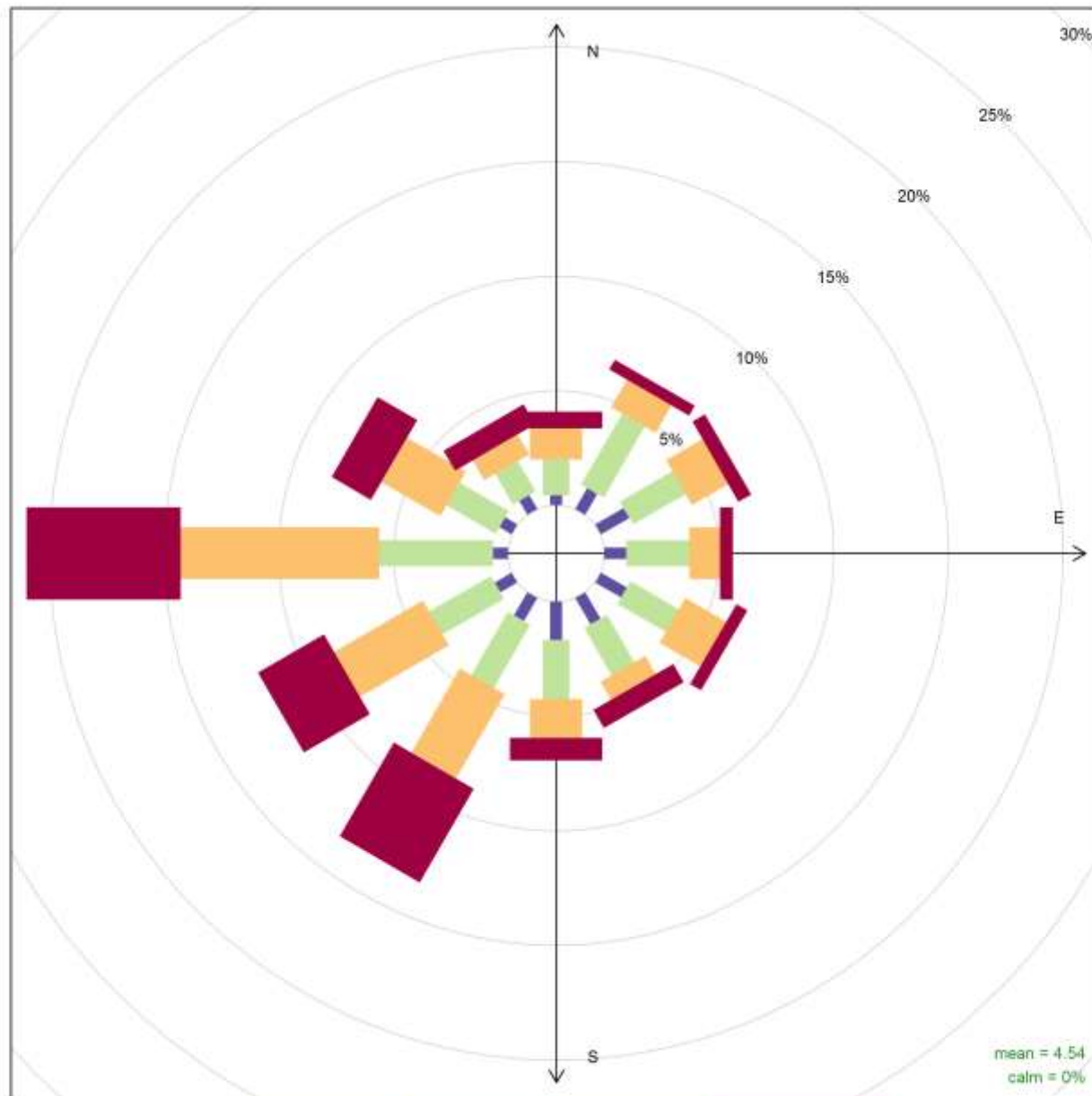
Plots

- R \ [openair](#)
- Functions for calculating temporal distribution, plotting, subsetting and extracting data.

PM₁₀ ($\mu\text{g m}^{-3}$) at Old Market and St. Paul's: 2012

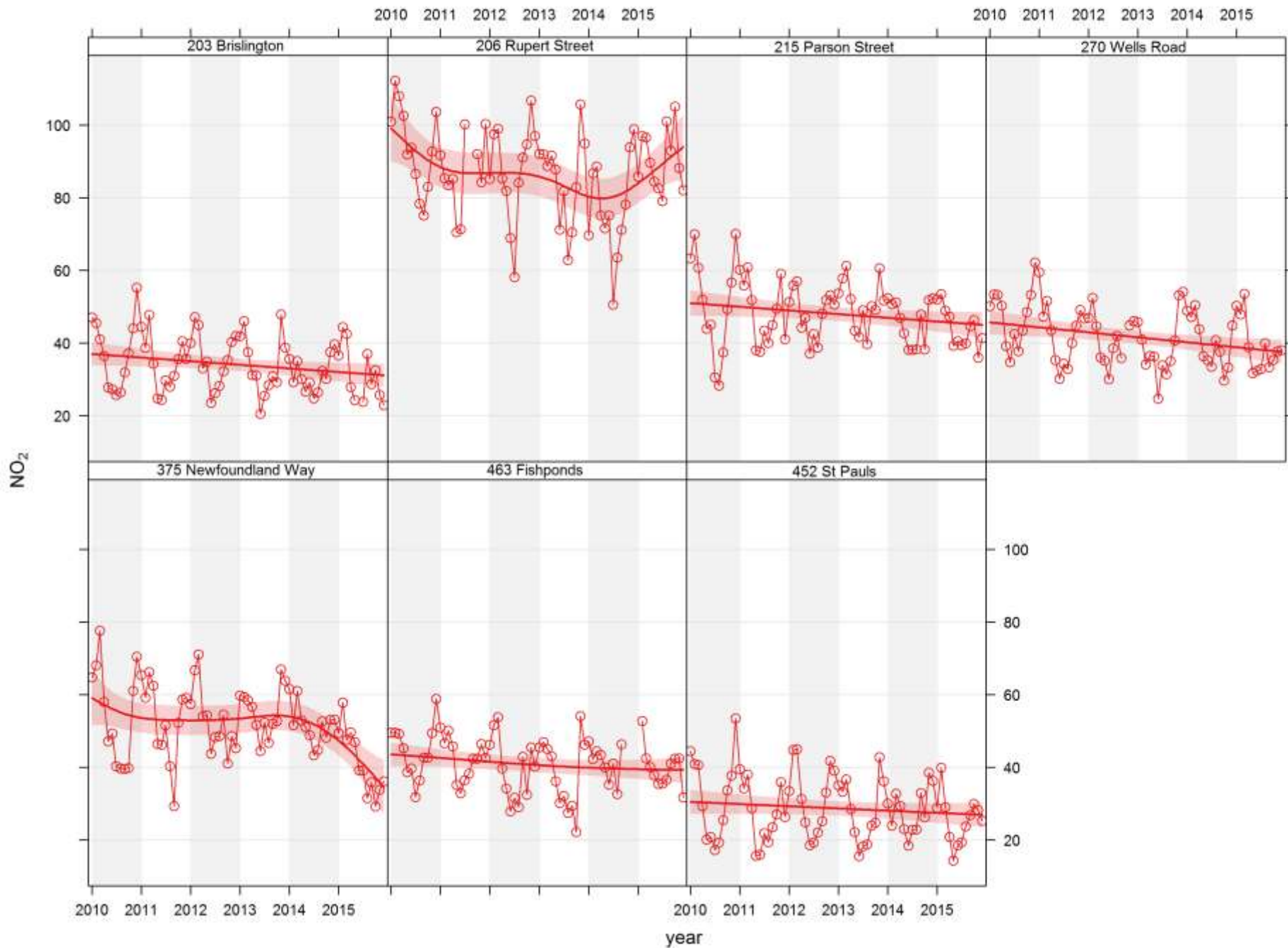


Wind rose for Bristol (St. Pauls) 2012

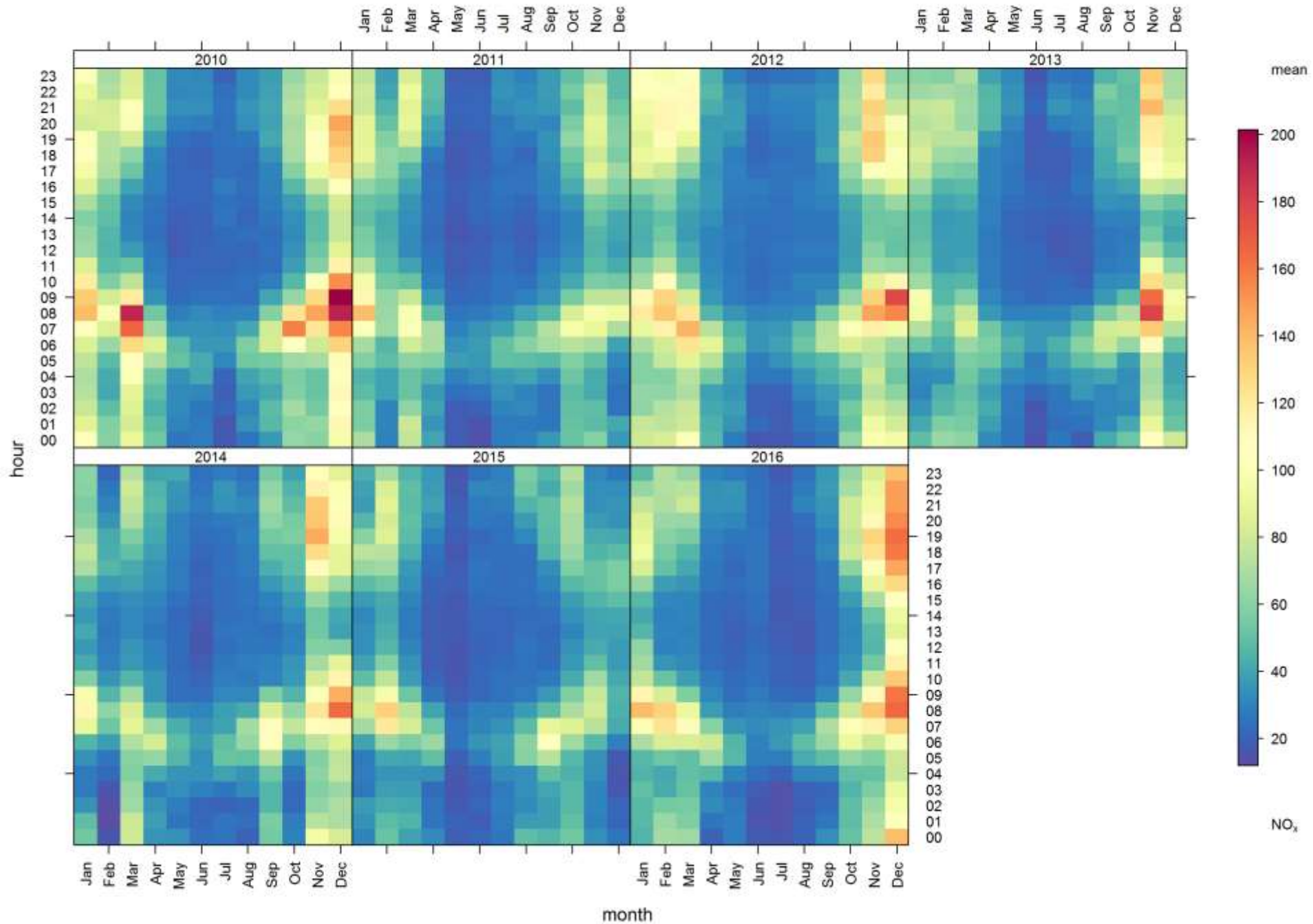


Frequency of counts by wind direction (%)

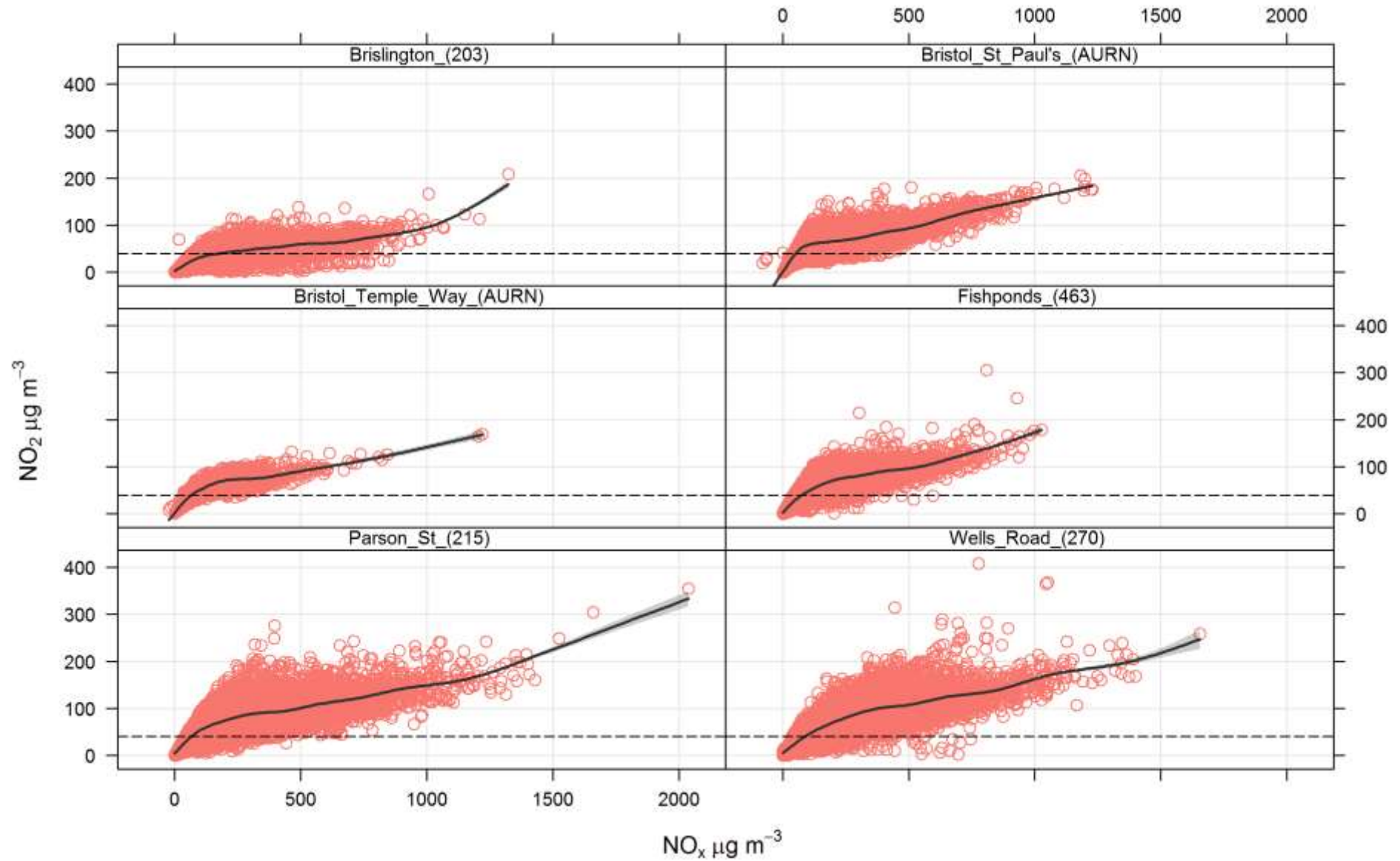
NO₂ trends at air quality monitoring sites in Bristol: 1998 - 2015



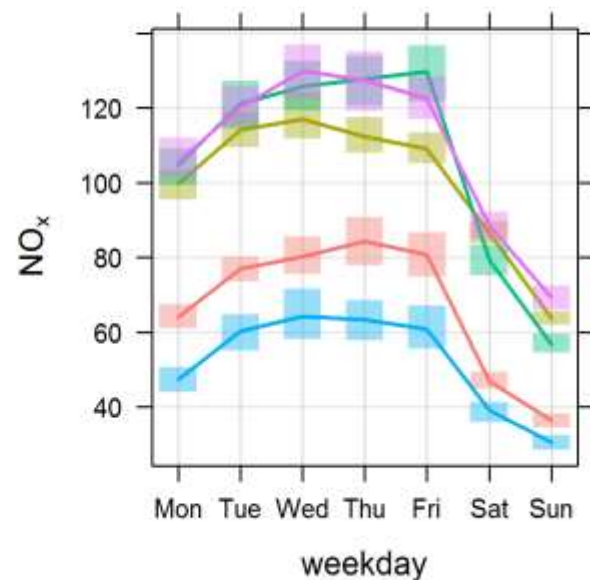
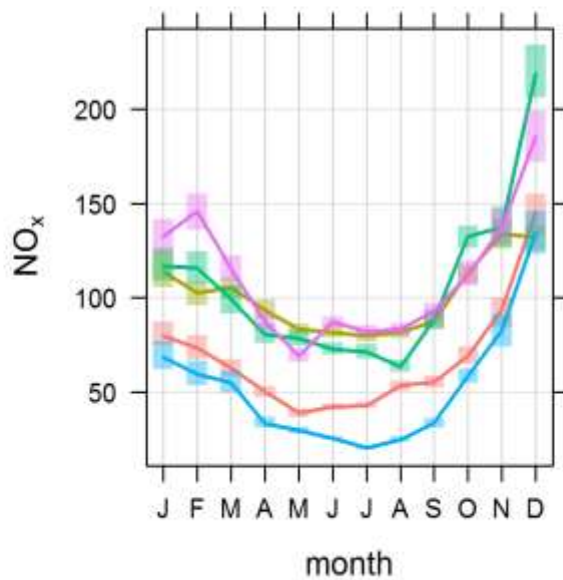
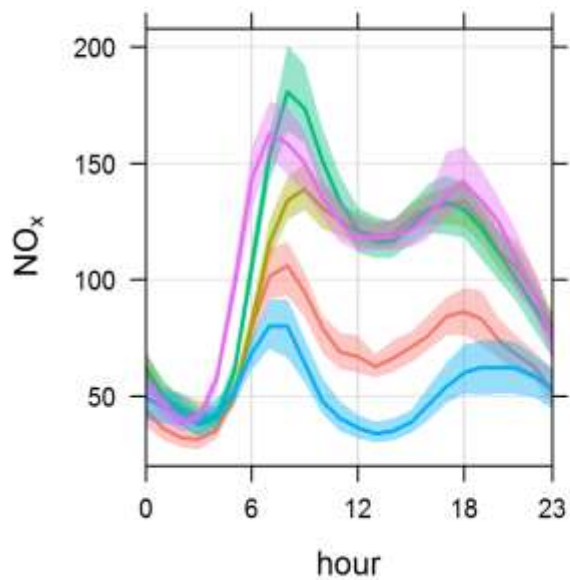
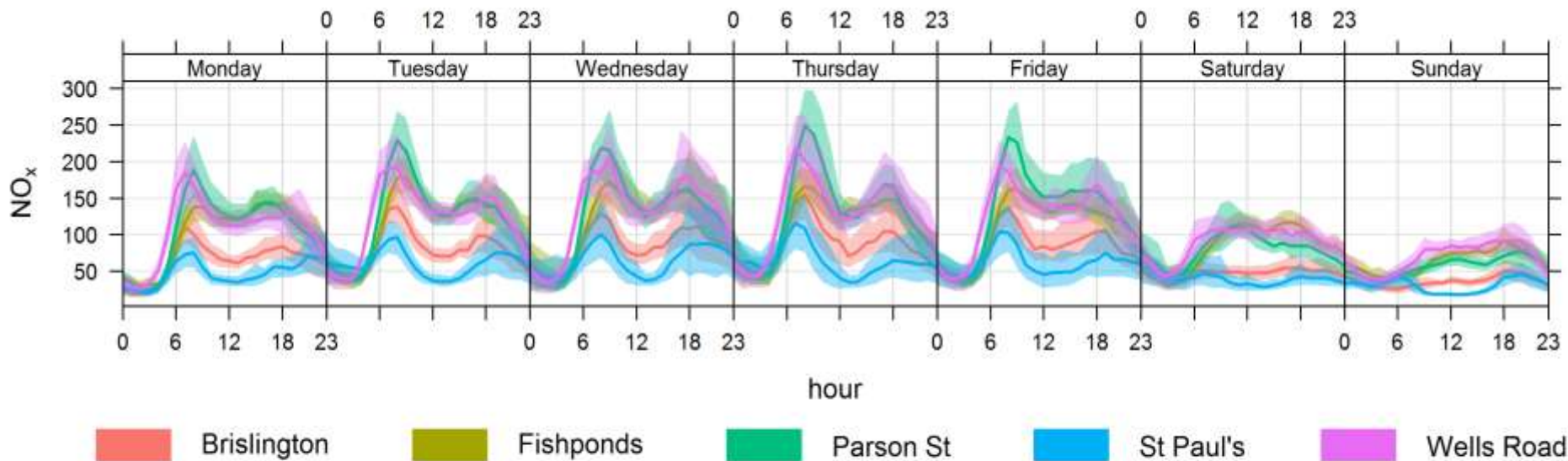
NO_x trend level at Bristol St. Pauls: 2010 - 2016



Scatterplot of NO_x vs NO₂ at Bristol sites



Time Variation of NO_x in Bristol: 2016



mean and 95% confidence interval in mean

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?

Ozone

Nitrogen Dioxide

Sulphur Dioxide

PM2.5 Particles

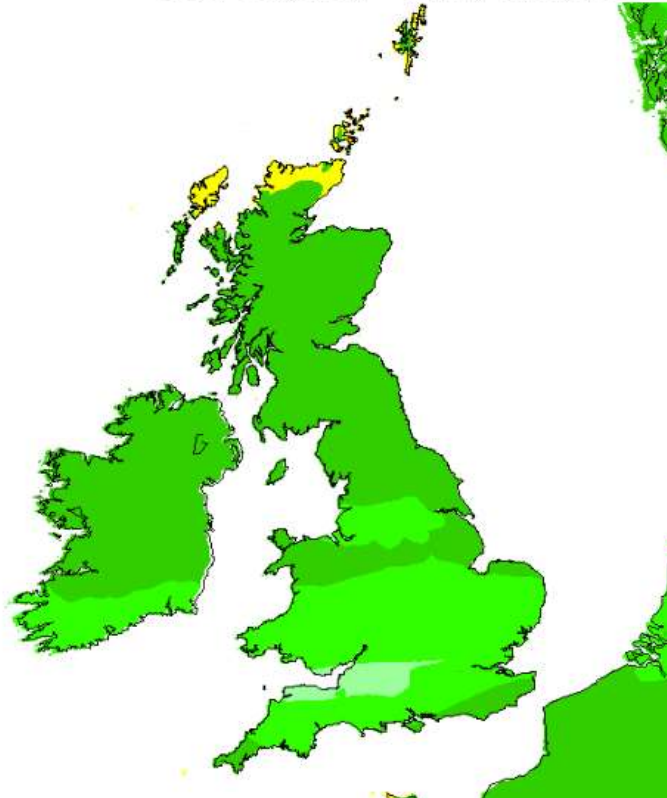
PM10 Particles

PM_{2.5} Particles

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

Index Band	1	2	3	4	5	6	7	8	9	10
	Low	Low	Low	Moderate	Moderate	Moderate	High	High	High	Very High
μgm^{-3}	0-11	12-23	24-35	>36-41	>42-47	>48-53	54-58	59-64	65-70	71 or more

Daily Air Quality Index – Saturday 03/03/2018



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

« Prev

Next »

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

Recommended by COMPEAP

- Index of pollution levels and recommended actions and health advice. Forecast data and monitored (Urban Background St Pauls)

Recommended Actions and Health Advice

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

Should BCC Issue Warnings?

Pollution episode data is publically 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

AQT 420 - Trial



Menu

Admin

Users

Report

Log

Logged in as Sustainability Team [Feedback](#) [Logout](#)

Server Time: 20/08/2018 09:10:01



Bristol City Council (...90533)

Bristol City Council



01/08/2018 09:09 - 20/08/2018 09:09

- Inputs
- AQT420
 - NO2 [ppb]
 - SO2 [ppb]
 - CO [ppb]
 - O3 [ppb]
 - PM2.5 [$\mu\text{g}/\text{m}^3$]
 - PM10 [$\mu\text{g}/\text{m}^3$]
 - Air temperature [°]
 - Air humidity [%RH]
 - Air pressure [mbar]
 - Measurement validity [0 = not valid 1]
 - Device health [%]

Start Date: 01/08/2018 09:09

End Date: 20/08/2018 09:09

[Last Day](#) | [Last Week](#) | [Last 4 Weeks](#)

Generate Graph

Toggle Legend



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?

