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Urban and roadside increments in eBC mass concentrations observed in three major urban conurbations of the UK: London, Birmingham and Glasgow

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Outline

- UK BC Network → Black Carbon Network is managed by NPL and operated by NPL and Imperial College London
- Instrumentation
- Three UK conurbations → London, Birmingham, Glasgow
- Results → eBC and UVPM increments
- Conclusions

Introduction

Why black carbon is important?

- Anthropogenic agent of both climate change and negative health effects
- Much shorter atmospheric lifetime than other climate forcing agents such as CO_2, therefore easier to control
- Policy implications

Definition*

- BC is formally defined as an ideally light-absorbing substance composed of carbon
- Formed through the incomplete combustion

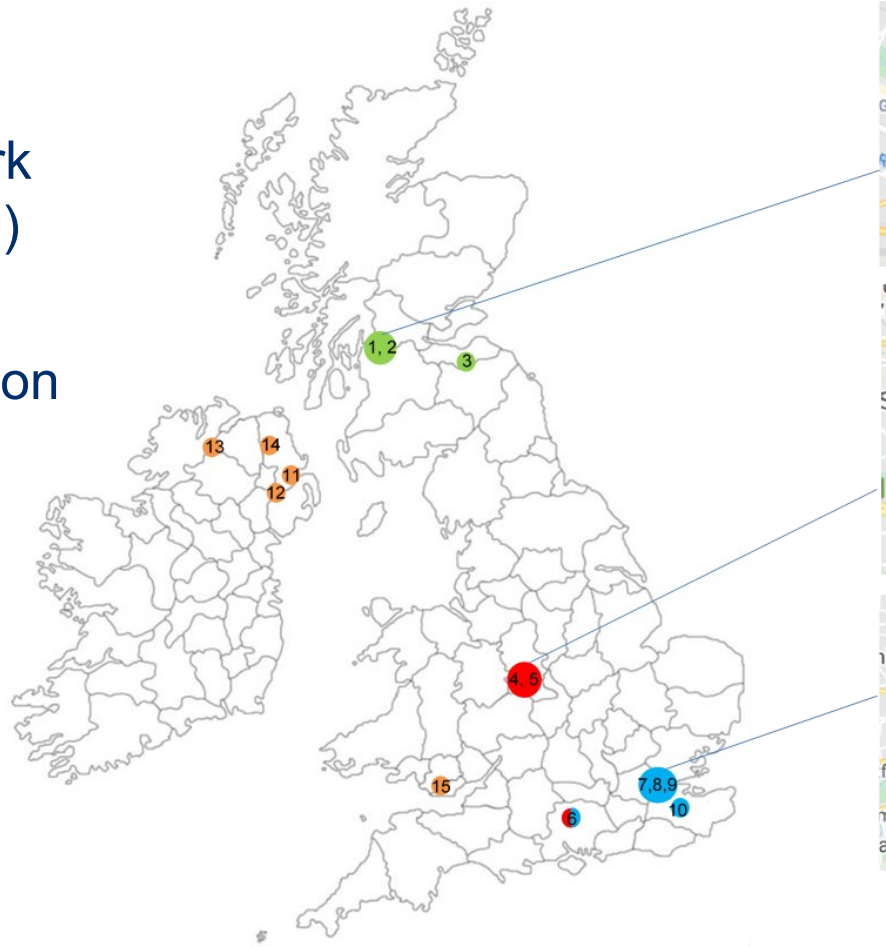
- eBC: equivalent black carbon
  when measured by aethalometers

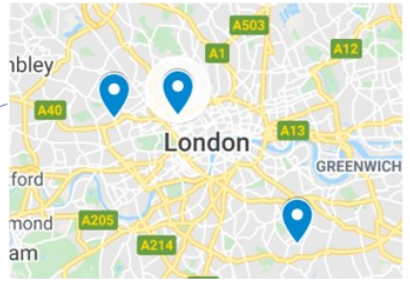
*) Petzold, A. at al. (2013)

UK air quality monitoring networks

- The government has to meet:
  - UK air quality limit and target values; European Union limit values and target values (now in UK law)
- NPL runs (at least part of) a number of these networks:
  - **Black carbon network (BCN)**
  - Heavy metals network
  - Particle numbers and concentrations network
  - Automatic Urban and Rural Network (AURN)

- **BCN sites** using AE33 aethalometers with focus on
  - following emission sources / areas:
  - Glasgow urban area
  - Birmingham urban area
  - London urban area
  - Solid fuel use / domestic emissions areas





Maps: Google

Black Carbon Network

BC Network is managed and operated for Defra* and the Environment Agency by NPL

- Non-regulatory research network
- Currently 14 sites
- Various emission sources
- Uk-air.defra.gov.uk

AETHALOMETERS

PARAMETER	AE22	AE33
No. of wavelengths	2	7
Filter material	Quartz	Teflon
Loading effect compensation	No	Yes
Inlet flow	4 lpm	5 lpm

- Virkkula et al. (2007) loading correction was applied
- 1 h averages
- AE22: Measurements from 2009 - 2019
- Network upgraded with AE33 model in November 2019

*) Defra: Department for Environment Food & Rural Affairs

Three major UK conurbations

Roadside Increment

Urban Traffic – Urban Background

Urban Increment

Urban Background – Rural Background

eBC: data from 880 nm channel

$UVPM = UV_{(370nm)} - eBC_{(880nm)}$

(1) London

London Marylebone Road (TR)
London North Kensington (UB)
Detling (East) & Chilbolton (West)

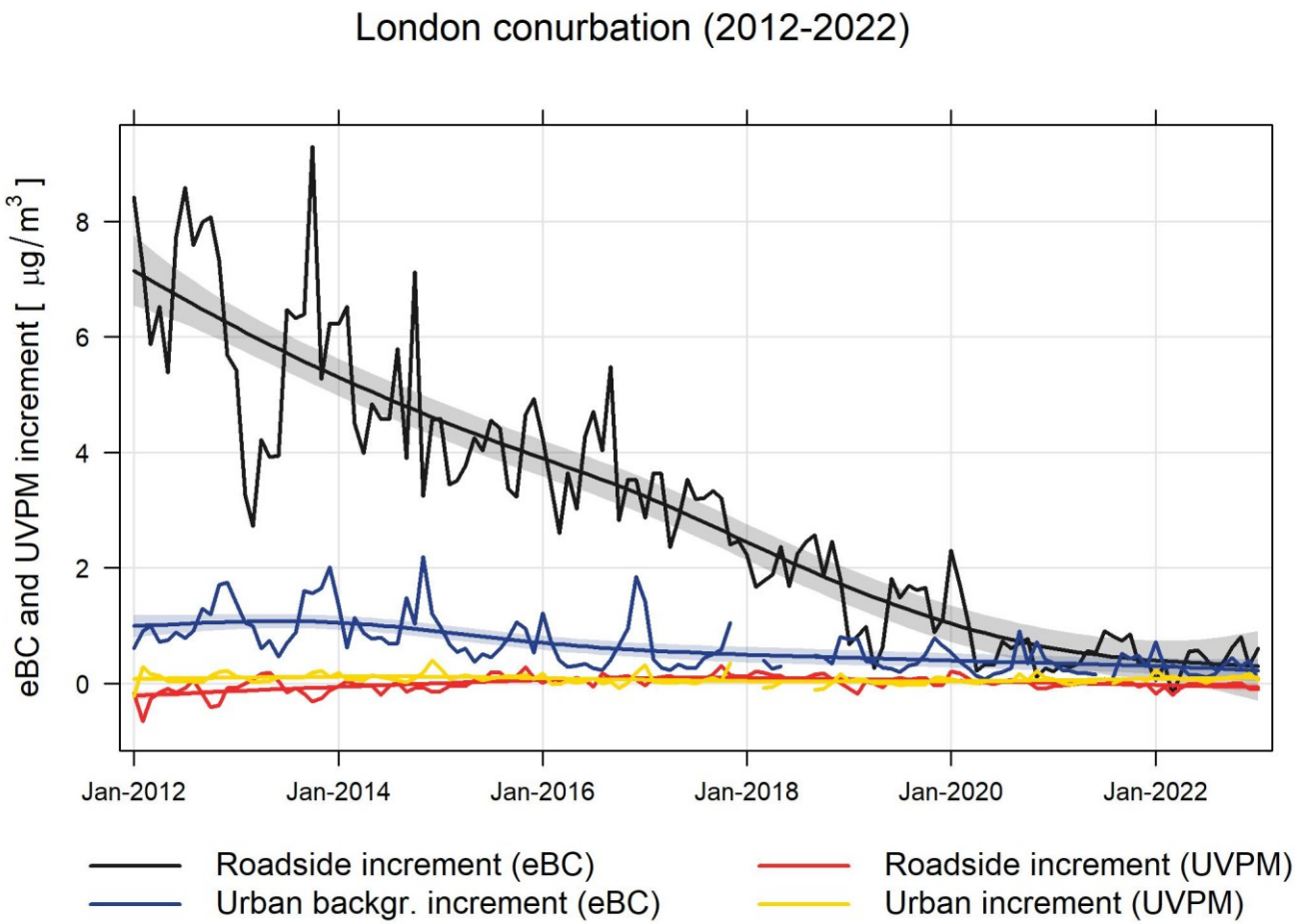
(2) Birmingham

Birmingham A4540 (TR)
Birmingham Ladywood (UB
Chilbolton (South) (RU)

(3) Glasgow

Glasgow High Street (TR)
Glasgow Townhead (UB)
Auchencorth Moss (East) (RU)

Three major UK conurbations



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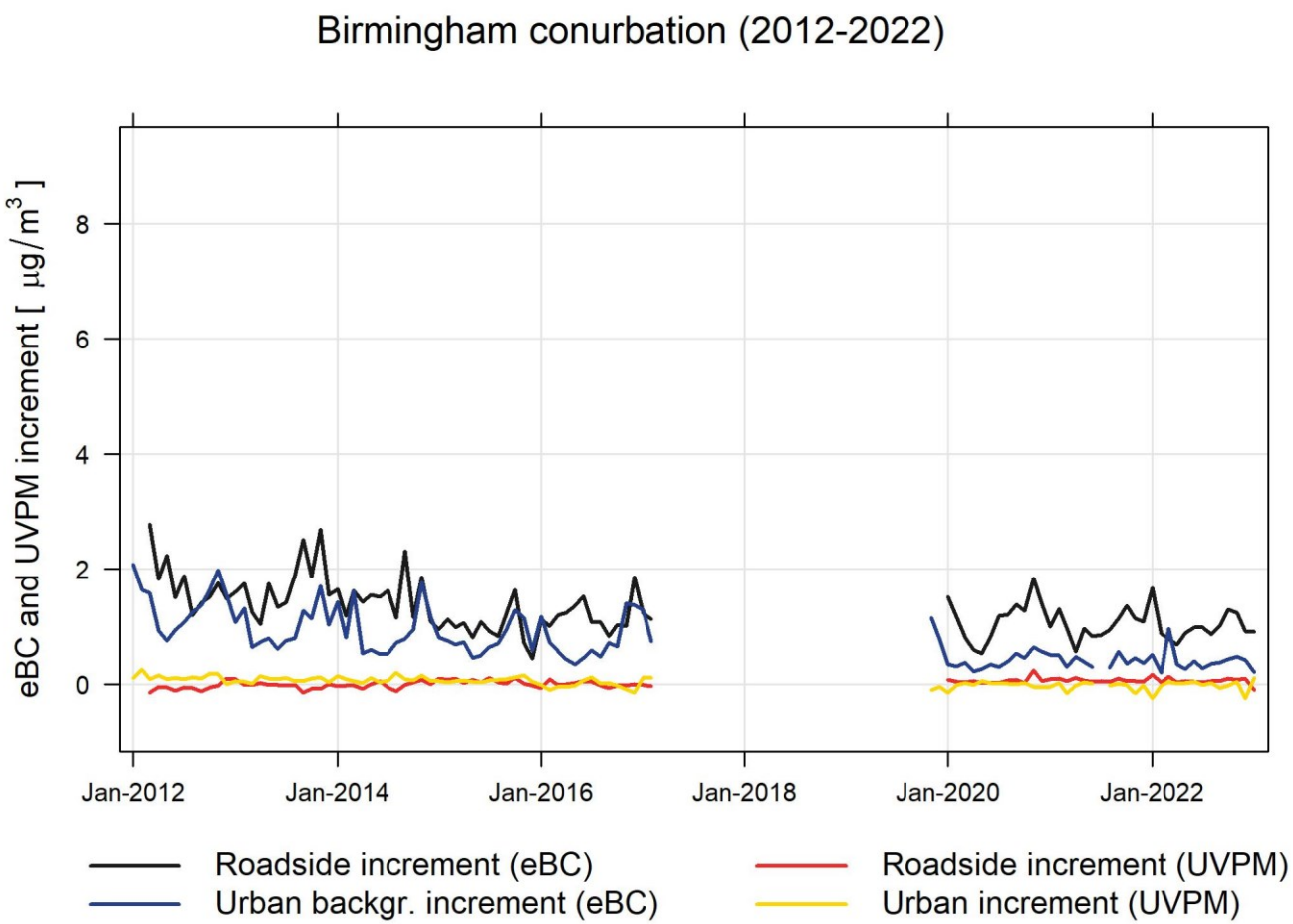

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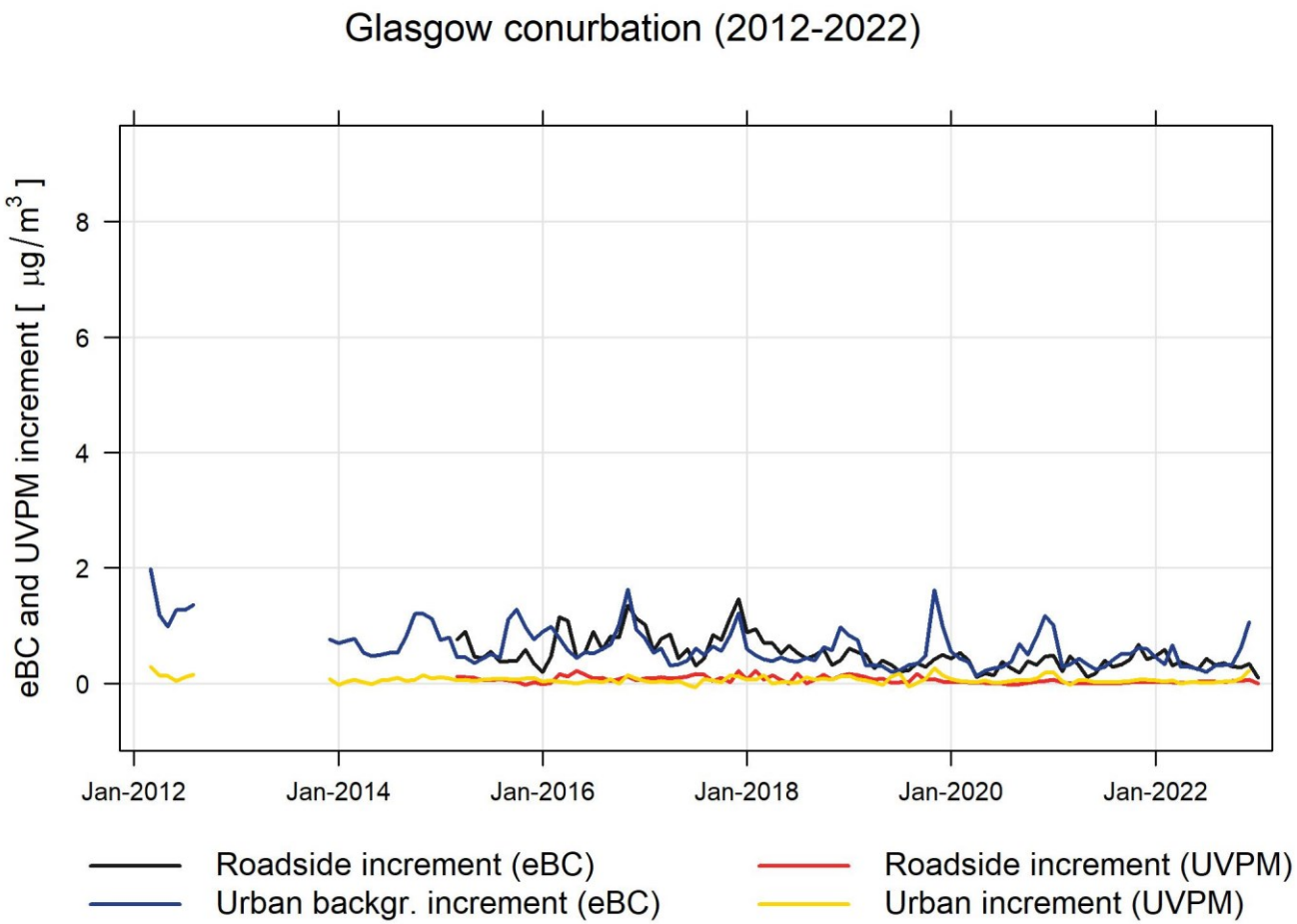

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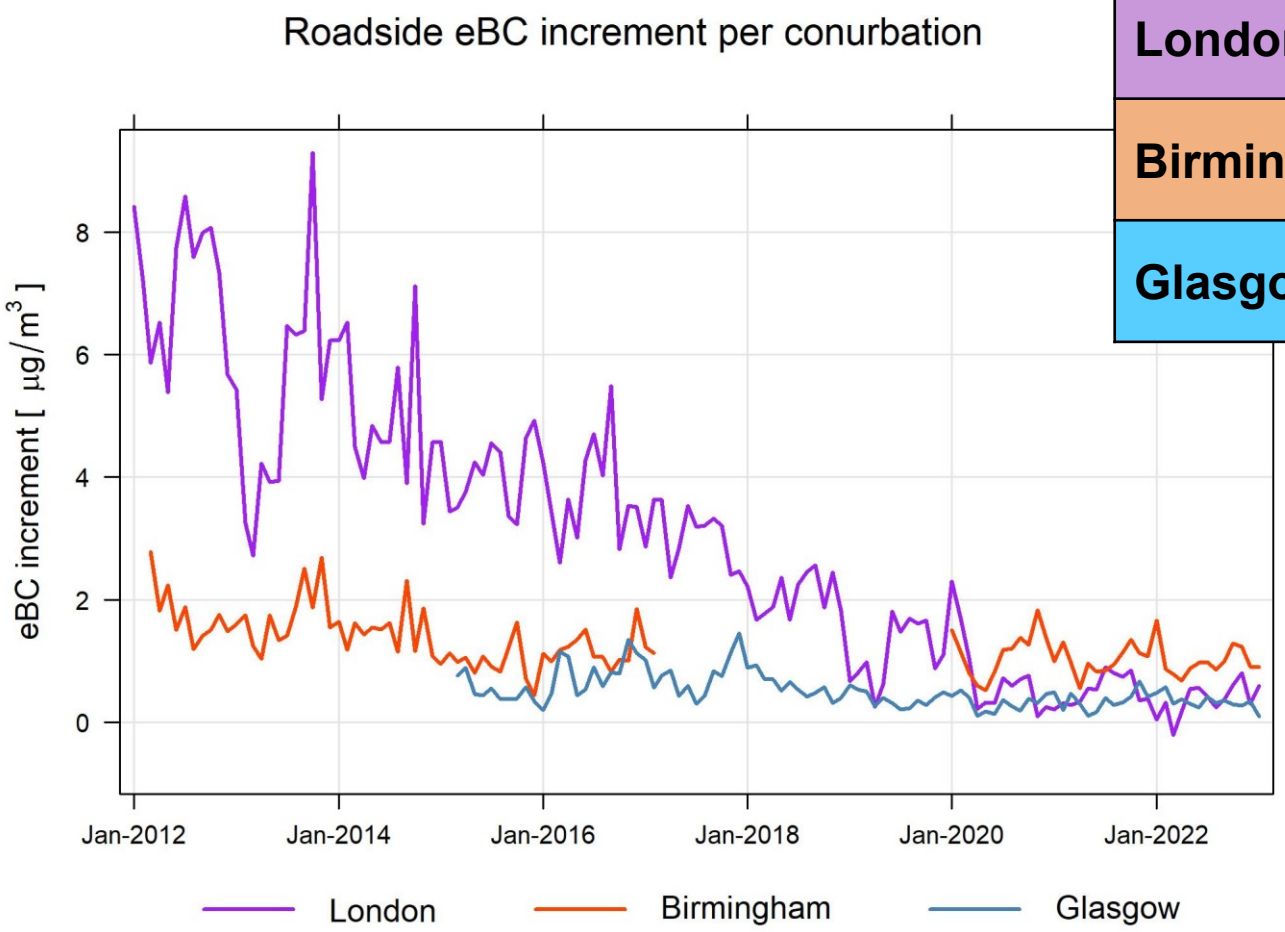
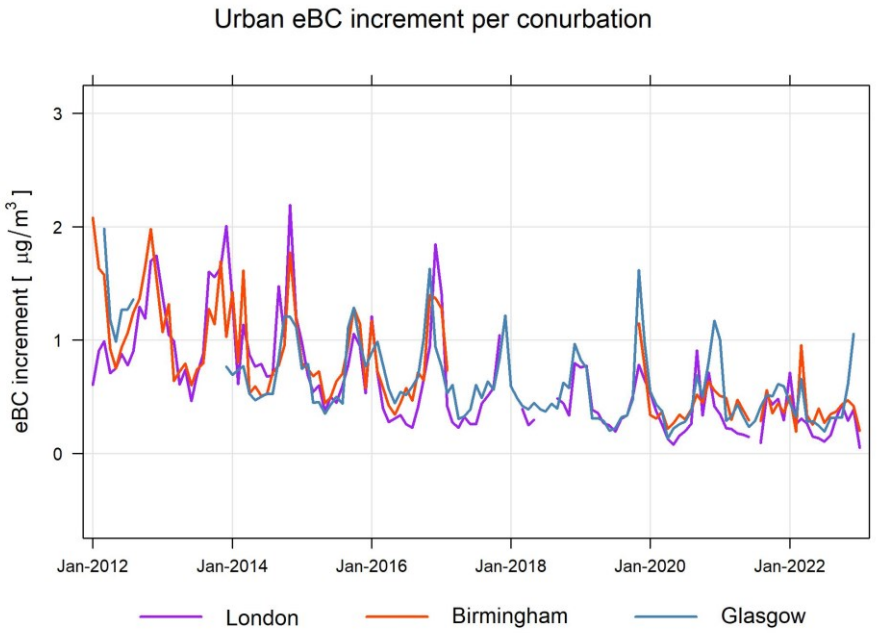
Three major UK conurbations

	Roadside eBC Increment		Urban eBC Increment
London	-0.63 [units/year] $CI_{95\%}$: [-0.70, -0.57]	**-10.0 %/yr**	-8.2 %/yr
Birmingham	-0.06 [units/year] $CI_{95\%}$: [-0.08, -0.04]	-4.4 %/yr	-7.5 %/yr
Glasgow	-0.05 [units/year] $CI_{95\%}$: [-0.08, -0.03]	-8.4 %/yr	-6.0 %/yr





Conclusions

General:

- The most significant decrease in roadside increment in eBC was observed in London.
- The roadside increment in Birmingham has been higher than in London since 2020.
- Urban and Roadside increments in London and Glasgow in recent years have similar values.

Challenges:

- Uncertainties related to measurements of low concentrations.
- Instrumental noise and local pollution sources.
- Location of sites is important to be a “representative” site for the area.

Future work:

A standardised method for eBC measurements is needed.

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NPL

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