



# Street-scale resolution air quality modelling for the West Midlands

**A novel approach of task farming was applied to optimise model execution time**

**Street scale air quality maps for the West Midlands have been generated**

**Air quality maps have been served as one of the key inputs for Air Quality Lifecourse Assessment Tool (AQ-LAT) and Climate Risk and Vulnerability Assessment (CRVA) mapping**

**Output used to support WM first AQ Framework**



**Effective collaboration and co-development – of air quality modelling tool and scenarios**



**Knowledge Exchange – with local and regional authorities**



**Public Engagement - The Air We Breathe exhibition + Science Futures at Glastonbury**



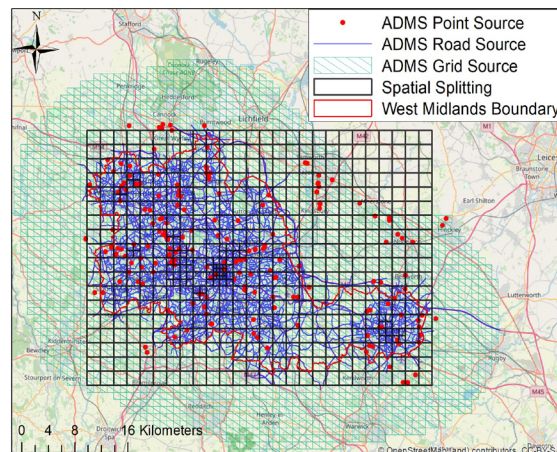
**Policy + Legislation – WM AQ Framework application + Chief Medical Officer's Annual Report 2022**

Air pollution has become the biggest environmental risk for public health. It is important to better understand the sources and processes of air pollutants. High-resolution air quality models combining emissions, chemical processes, dispersion and dynamical treatments are necessary to develop effective policies for clean air in urban environments. A street-scale air quality model, ADMS-Urban, was configured for a case study of the West Midlands, UK. Air quality modelling is an important tool for the investigation of air quality and for the assessment of the impact of specific intervention scenarios on air quality within the region.

## Background - why does this work matter?

Air pollution has become the biggest environmental risk for public health both globally and locally. World Health Organisation (WHO) estimated premature deaths attributed to ambient air pollution as about 4.2 million per year. The mortality burden associated with ambient air pollution is about 28–36,000 per year in the UK. The availability of air quality information is of vital importance to improve the understanding of the associated health effects, and to develop effective and equitable air pollution control policies. High resolution air quality models combining emissions, chemical processes, dispersion and dynamical treatments are necessary to develop effective policies for clean air in urban environments, but can have high computational demand. Multiple model runs can be required in order to assess different policy or emissions scenarios, and to perform sensitivity analyses, so improving model run times is a key requirement for enabling the analysis of a broad range of scenarios.

## Method – what did we do?



The WM-Air ADMS-Urban air quality model configuration for the West Midlands has been developed in collaboration with Cambridge Environmental Research Consultants (CERC). Model predictions for air quality have been evaluated against measurement data from Local Authorities within the West Midlands and Defra's Automatic Urban and Rural Network (AURN). Overall,

the model performed well and run times are manageable using the task farming approach.

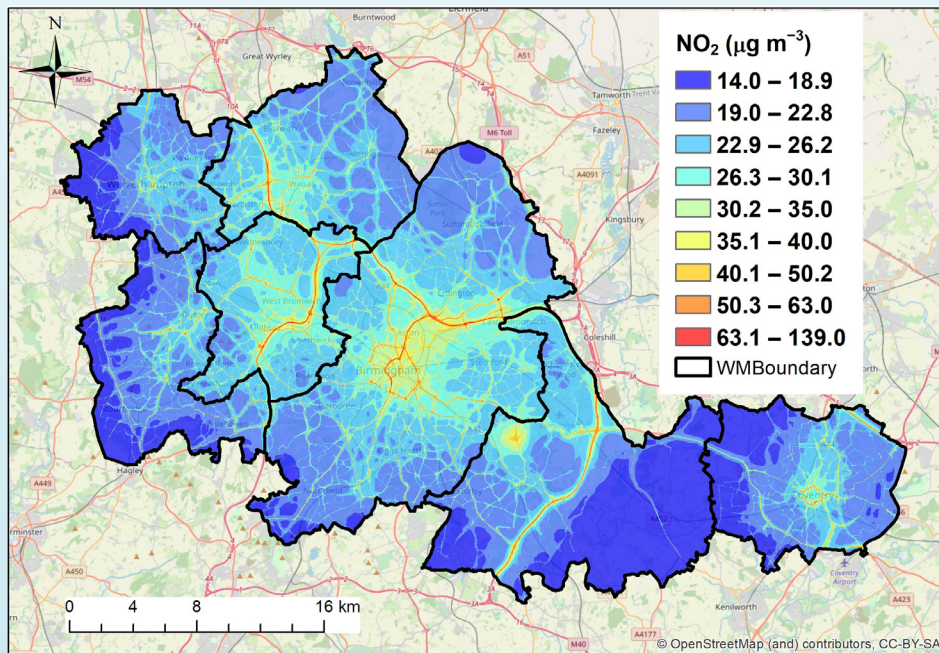
The post-processing flexibility enables the creation of air quality maps for annual/subset averages and other statistical output (e.g., percentiles). High resolution air quality maps (at 10 m × 10 m resolution) have been generated from the model. For the purposes of health-related research, including assessment of personal exposure and exploration of relationships between air pollution levels and socio-demographic characteristics typically available on different spatial scales, the 10 m × 10 m horizontal resolution annual air quality maps have been further aggregated into other polygon layers, e.g., Lower Layer Super Output Areas and ward levels.

### What tools/outputs were developed?

- [Air quality modelling method paper](#).
- [Air quality scenarios papers for Net Zero and traffic reduction](#)
- [Special Issue of Urban Air Quality Modelling in Atmosphere, Guest Editor \(April 2024, a collection of 11 papers viewed by 15633\)](#)
- [Birmingham Environment for Academic Research blog](#).

### Outcomes, Impacts and Benefits delivered

The WM air quality modelling tool has provided high resolution air quality maps for the West Midlands and has been applied to a range of case studies/ intervention scenarios.



### The AIR WE BREATHE exhibition

WM-Air modelling tool was applied to visualise invisible air pollution across the West Midlands. An animation was generated to show the changing levels of nitrogen dioxide across the West Midlands during an average 24 hours.

### Science Futures at Glastonbury Festival

'Sounding Out Pollution: Can you hear what's in the air?' has contributed to Science Futures at Glastonbury Festival and is also available in the [YouTube channel](#).

### WM AQ Framework application

Air quality maps for the West Midlands have been included in the Air Quality Context of the WM AQ Framework.

### Chief Medical Officer's Annual Report 2022: Air Pollution

Air quality maps for Birmingham have been included Chapter 6 of the report, 'City examples – work to reduce air pollution' and was highlighted in the Executive summary (Dec 2022).

**"There is significant inequality of exposure to poor air quality in the region (identified in the WM-Air modelling) and this will be important to address in our air quality work."**

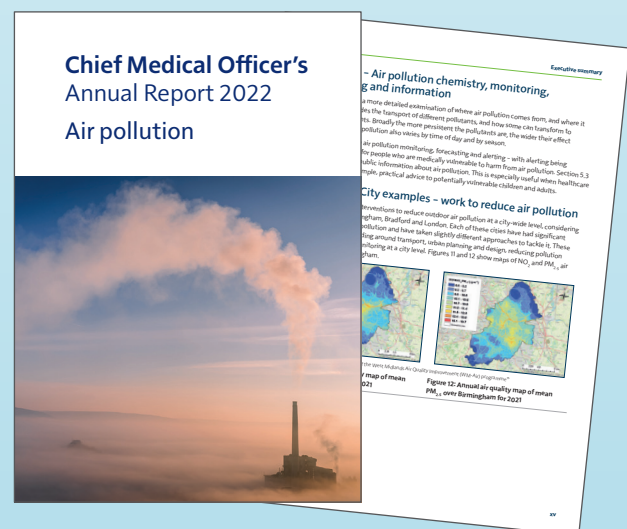
**Jackie Homan, Head of Environment, West Midlands Combined Authority**



**Contribution to WMCA AQ framework: 2024 UoB Impact Award for 'Outstanding Impact on the Environment'**

**Contribution to CRVA: SEE Redefining Sustainability Conference 2024; Dubai: Received Special Recognition Award; CIHT Research Award 2024: Shortlisted for Regional (West Midlands) and National Awards. Commended at National Awards**

**Invited talk on air quality scenario modelling at TfWM Air Quality, Congestion and Environmental Impact Member Engagement Group Meeting (Jan 2024)**



**“Provision of modelled data sets for the West Midlands air quality data platform: Without these datasets we would be unable to present the regional picture of air pollution to the public in such an understandable and accessible way.”**

**Elle Winning, Air Quality Lead,  
West Midlands  
Combined Authority**

### **About WM-Air: Clean Air Science for the West Midlands**

WM-Air (“Clean Air Science for the West Midlands”) is a NERC-funded initiative, led by the University of Birmingham, working in collaboration with over 20 cross sector partners, to apply environmental science research expertise to improve air quality in the West Midlands, delivering health, economic and environmental benefits.

[wm-air.org.uk](http://wm-air.org.uk)



**Natural  
Environment  
Research Council**

### **Looking to the Future/Legacy**

There would be a lot of opportunities for future scenarios modelling, such as future air quality supporting TfWM local transport plan, bus electrification and Net Zero strategies.

WM-Net Zero is applying the air quality modelling tool specifically for Net Zero policies in transport, housing and energy sectors.

CLEETS – CLEETS will provide the evidence base for decision making for transport decarbonization using three regions (including West Midlands using air quality modelling tool) as case studies.

WM-Adapt – As part of UKRI funding available for Adaptation Projects, a bid was submitted to in July 2024 to extend regional work from WM-Air and WM-Net Zero to a climate change adaptation capacity.

### **Underpinning Science**

- Zhong, J., Stocker, J., Cai, X., Harrison, R. H., & Bloss, W. J., 2024. Street-scale air quality modelling over the West Midlands, United Kingdom: Effect of idealised traffic reduction scenarios. *Urban Climate*, 55, 101961.
- Zhong, J., Hodgson J. R., Bloss, W. J., & Shi, Z. 2023. Impacts of net zero policies on air quality in a metropolitan area of the United Kingdom: Towards world health organization air quality guidelines. *Environmental Research*, 116704.
- Zhong, J., Hood, C., Johnson, K, Stocker, J, Handley, H, Wolstencroft, M, Mazzeo, A, Cai, X & Bloss, W J, 2023, Modelling street-scale resolution air quality for the West Midlands (UK) using the ADMS-Urban RML system. In: Mensink, C., Jorba, O. (eds) *Air Pollution Modeling and its Application XXVIII*. ITM 2021. Springer Proceedings in Complexity. Springer, Cham.
- Zhong, J, & Hodgson, J, 2022 Co-benefits of decarbonisation policies on future ambient air quality and health, *Policy Solutions to the Clean Air Challenge*, 10.25500/epapers.bham.00004048.
- Mazzeo, A, Zhong, J, Hood, C, Smith, S, Stocker, J, Cai, X, Bloss, W J 2022. Modelling the Impact of National vs. Local Emission Reduction on PM2.5 in the West Midlands, UK Using WRF-CMAQ. *Atmosphere*, 13, 377.
- Bloss, W J, Action, J, & Zhong, J 2021, Clean Air: Bringing local synergies to the global climate challenge. *Addressing the climate challenge*.
- Zhong, J, Hood, C, Johnson, K, Stocker, J, Handley, H, Wolstencroft, M, Mazzeo, A, Cai, X & Bloss, W J 2021. Using task farming to optimize a street-scale resolution air quality model of the West Midlands (UK). *Atmosphere*, 12(8), 983.

### **Partners**



**CERC**



**Transport for  
West Midlands**



**Walsall Council**



**West Midlands  
Combined Authority**

**More info  
and URLs:**

