

UNIVERSITY OF
BIRMINGHAM



Developing a Climate Risk and Vulnerability Assessment for Birmingham

Dr Sarah Greenham (UoB)

Stephen Jones (BCC)

Dr Emma Ferranti (UoB)

18th October 2023

WM-AIR
CLEAN AIR SCIENCE FOR
THE WEST MIDLANDS



Presentation overview

Climate Risk and Vulnerability Assessment

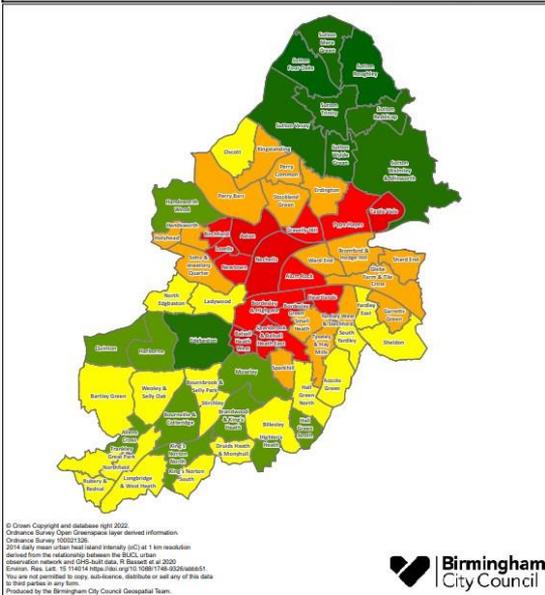
1. Background: Bringing together research and work programmes
2. CRVA aims and objectives
3. Approach: Creating and building a CRVA map for Birmingham
4. Application: What are BCC using it for?
5. Next steps: Regional upscaling, further application and outputs

Bringing together research and work programmes



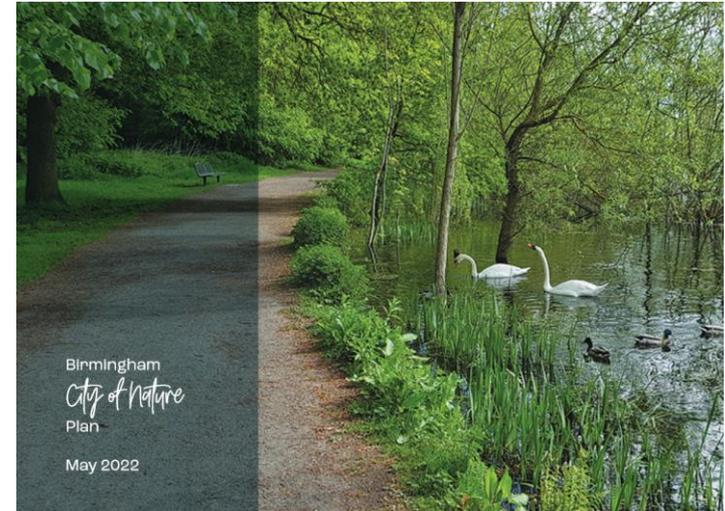
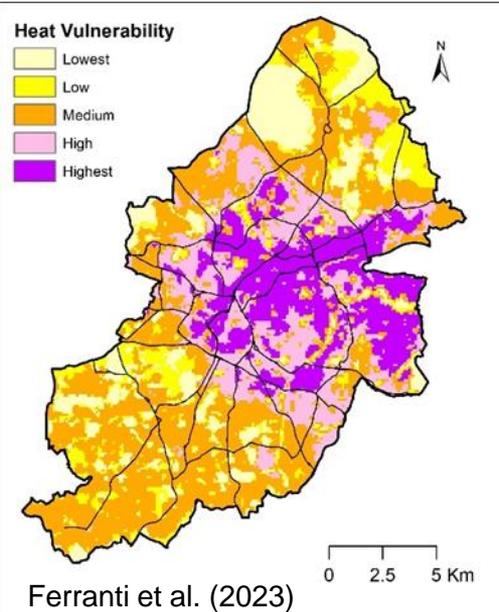
Combined Index by Ward - Mean Value

0.12 - Sutton Roughley	0.28 - Brandwood & King's Heath	0.32 - Frankley Great Park	0.37 - Garretts Green
0.12 - Sutton Four Oaks	0.28 - King's Norton North	0.32 - Acocks Green	0.38 - Shard End
0.15 - Sutton Vesey	0.29 - Harfield	0.32 - North Edgbaston	0.38 - Handsworth
0.16 - Sutton Wylke Green	0.29 - Ryaby & Rednal	0.32 - Landwood	0.38 - West End
0.16 - Sutton Mere Green	0.30 - Bournbrook & Selly Park	0.34 - Erdington	0.39 - Sparkbrook & Batsall Heath East
0.18 - Sutton Trinity	0.30 - Hal Green North	0.34 - Holyhead	0.39 - Alum Rock
0.21 - Edgbaston	0.30 - King's Norton South	0.34 - Yardley West & Shefford	0.39 - Birchfield
0.22 - Sutton Walsley & Minworth	0.30 - Yardley East	0.34 - Small Heath	0.39 - Heartlands
0.22 - Sutton Heddicap	0.30 - Walsley & Selly Oak	0.35 - Tyseley & Hay Mills	0.39 - Bordesley Green
0.24 - Hal Green South	0.30 - Longbridge & West Heath	0.35 - Sparkhill	0.39 - Pyle Hayes
0.26 - Harborne	0.30 - Ciccoit	0.36 - Perry Barr	0.40 - Bordesley & Highgate
0.26 - Bourville & Cotteridge	0.31 - Barley Green	0.36 - Scho & Jewellery Quarter	0.40 - Lozelle
0.26 - Moseley	0.31 - Sheldon	0.36 - Perry Common	0.41 - Canley Hill
0.26 - Handsworth Wood	0.31 - Billesley	0.36 - Bromford & Hodge Hill	0.41 - Newtown
0.27 - Chelton	0.31 - Selly Oak	0.37 - Stockland Green	0.42 - Aston
0.28 - Highgate's Heath	0.32 - South Yardley	0.37 - Kingstanding	0.42 - Nechells
0.28 - Alders Cross	0.32 - Druids Heath & Moryhull	0.37 - Glebe Farm & Tile Cross	0.43 - Castle Vale
			0.43 - Batsall Heath West



Article Incorporating Heat Vulnerability into Local Authority Decision Making: An Open Access Approach

Emma Ferranti ^{1,*}, Samuel Cook ¹, Sarah Victoria Greenham ^{2,*}, Nick Grayson ³, Julie Fletcher ⁴ and Kat Salter ²



CRVA aim and objectives

Aim: To develop a prototype toolkit that enables practitioners to evaluate the effects of climate change on new or existing developments

Objectives:

Submitting as part of the CDP on transparency and bold climate action

Co-develop with BCC to meet council needs e.g., design codes, policies and strategies

Using public data; taking an open-access approach for anyone to replicate

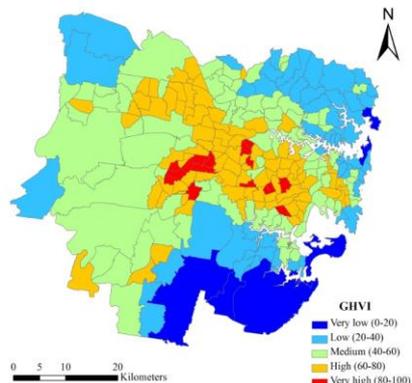
Disseminating methodology and results with a transparent and open approach

Uptake continuity in the council via handover of updating CRVA map to BCC

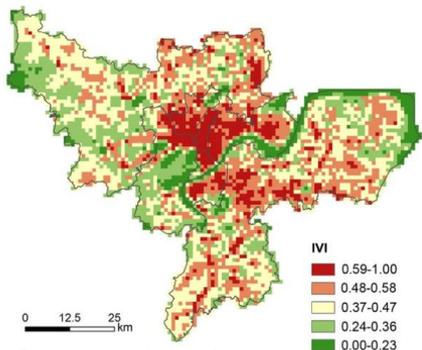
Air Quality will form a central part of the city climate risk assessment process, to serve as a national exemplar



CRVA approach



Zhang et al. (2018)



Sun et al. (2022)

CRVA examples

(Anticlockwise from top-left)

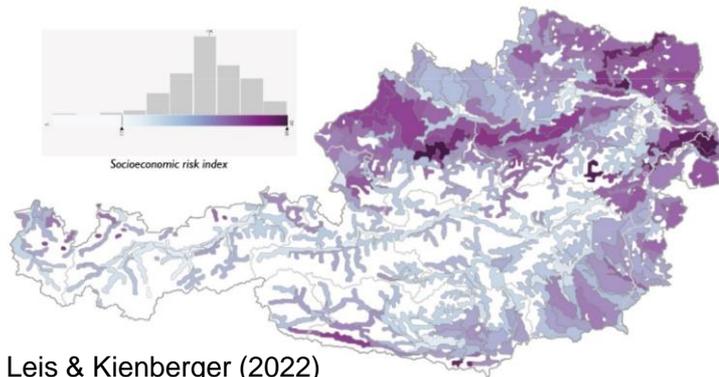
Sydney (Australia)

Hangzhou (China)

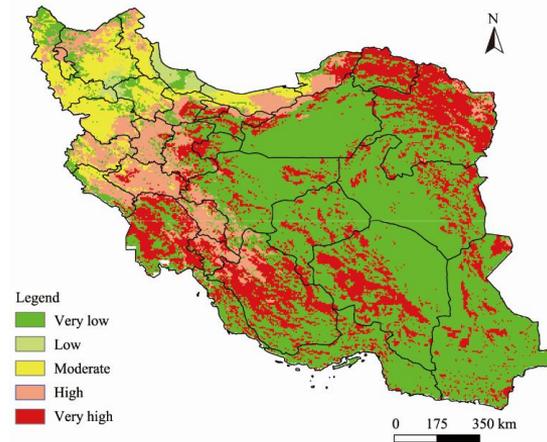
Austria

London (UK)

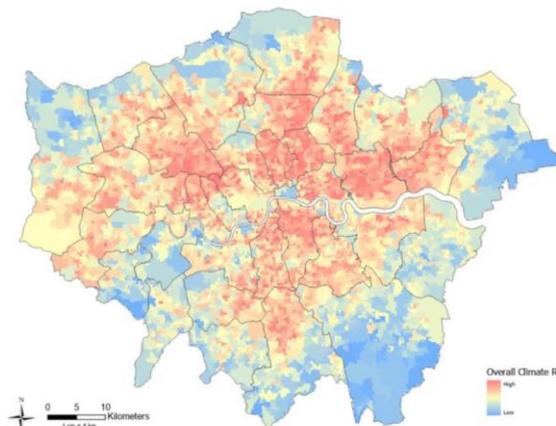
Iran



Leis & Kienberger (2022)



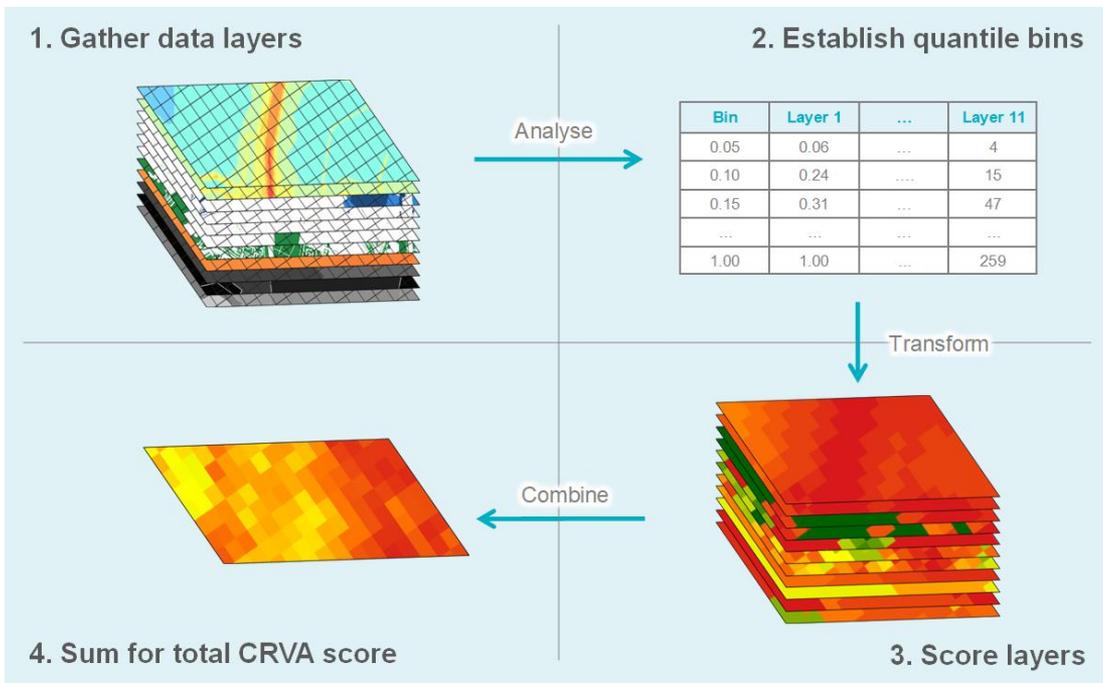
Heydari Alamdarloo et al. (2020)



Bloomberg & GLA (2022)

CRVA approach

Choosing the fillings, making the burger 🍔



UNIVERSITY OF
BIRMINGHAM



Birmingham
City Council

Greenham, D., Jones, S., Ferrant, E., Zhong, L., Acton, W., Mackenzie, A., Grayson, M., 2023. Mapping climate risk and vulnerability with publicly available data. A guidance document produced by the WM-Air project, University of Birmingham. Funding provided by NEFC Innovation grant NE500348/1. Ferrant acknowledges EPSRC Fellowship EP/R007365/1. <https://www.birmingham.ac.uk/research/innovation/innovation-grants>

MAPPING CLIMATE RISK AND VULNERABILITY WITH PUBLICLY AVAILABLE DATA

Several factors affect climate risk. What these are and the extent of their influence varies from place to place. Therefore, climate action is needed on all fronts: "everything, everywhere, all at once."¹

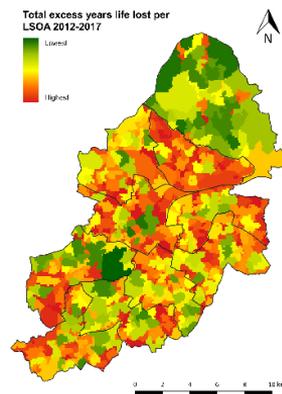
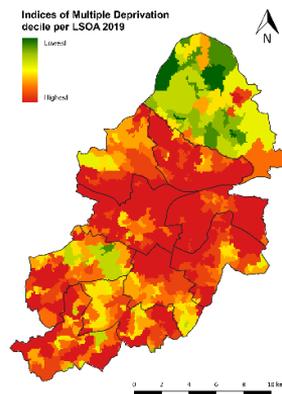
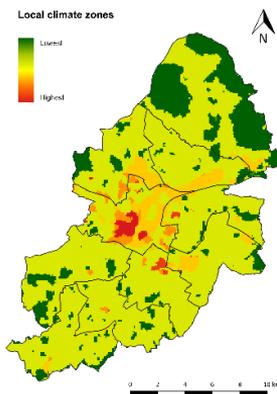
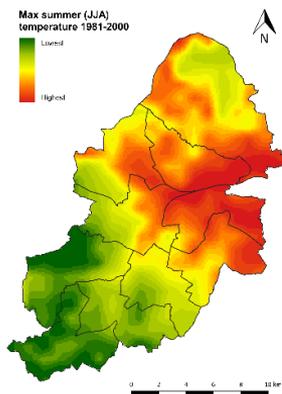
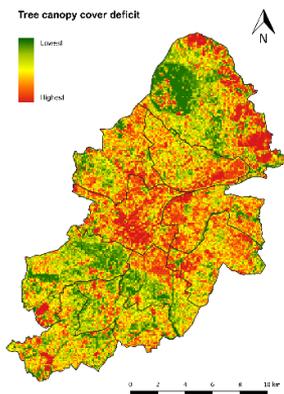
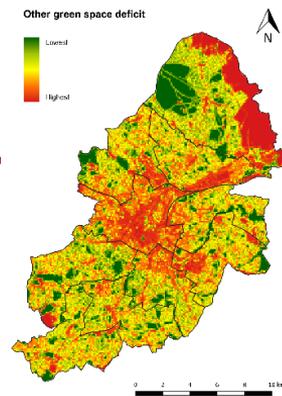
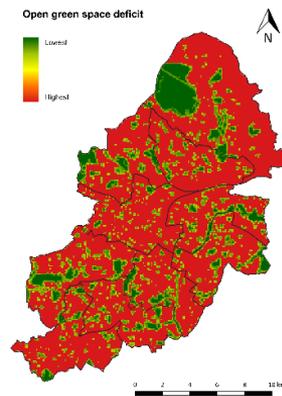
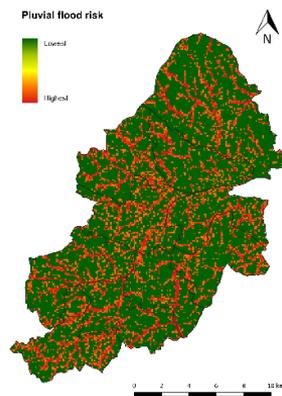
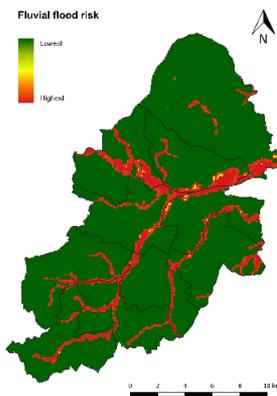
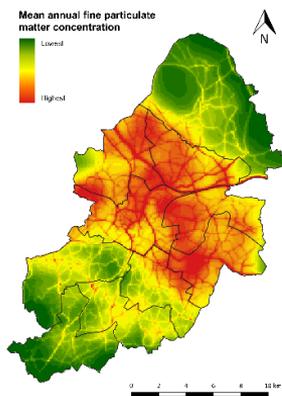
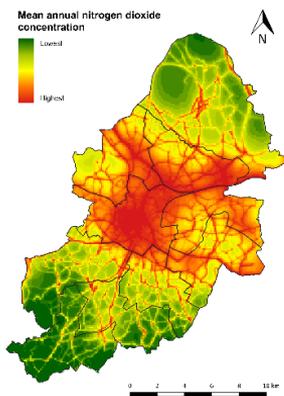
A guidance document from the WM-Air project

Version 1.1 October 2023



Scan me for burger recipe 🍔

CRVA approach



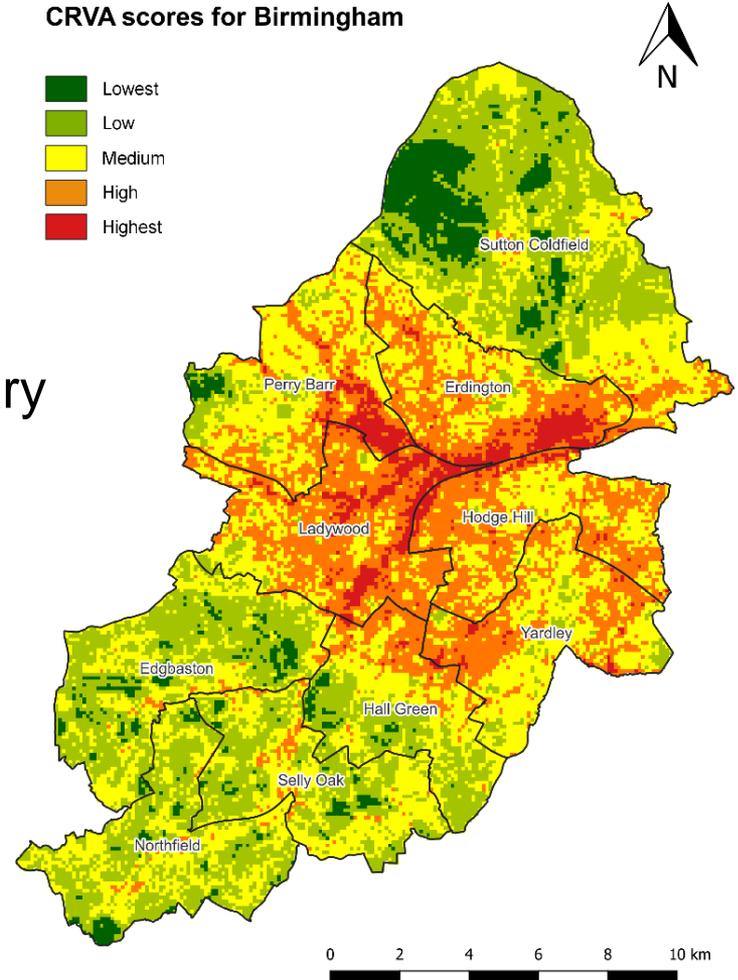
CRVA map

Notes:

100m resolution

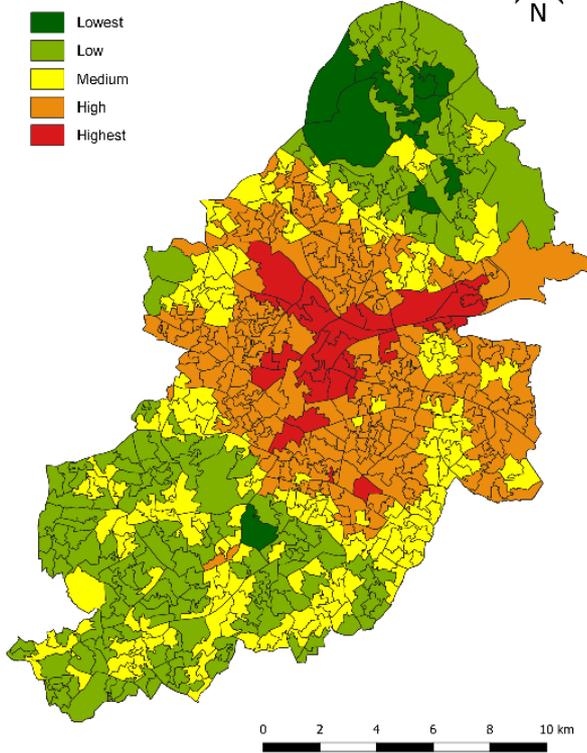
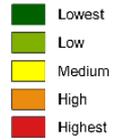
Relative scores within Birmingham boundary

Sum of layers are weighted equally

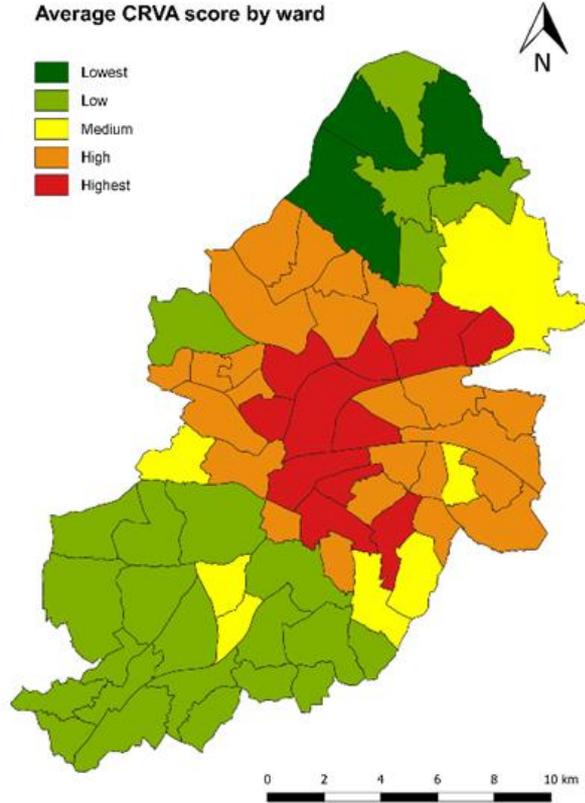


CRVA map

Average CRVA score by LSOA



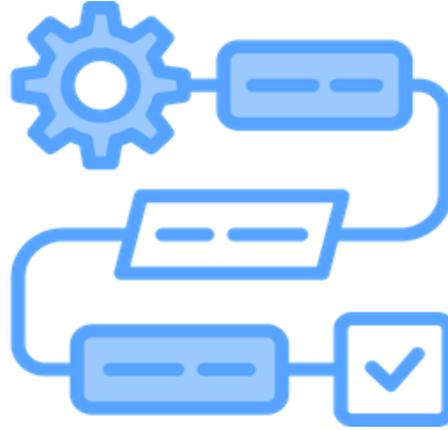
Average CRVA score by ward



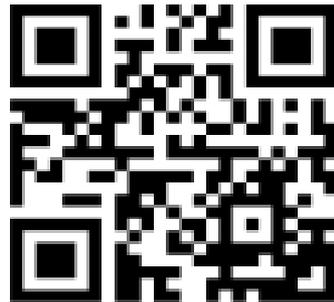
Birmingham City Council: What Did We Do ?



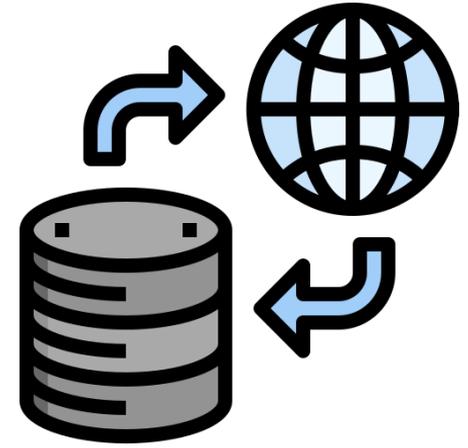
Collaborated in the creation of the CRVA methodology



Development of automated workflow



←
Scan to view the map!



Created 2 data products (Ward & LSOA)
Hosting the map

The map

Background:

On 11 June 2019 the council declared a climate emergency. In this declaration, the council recognised that the impacts of climate change, such as increased extreme weather events such as flooding, droughts and heatwaves will affect Birmingham residents. With this, the council is also committed to preparing Birmingham for the effects of climate change to make sure our city and residents are resilient to future climate risks. This resulted in Birmingham's Environmental Justice Map, which is helping with the planning and delivery of the City of Nature Plan, reducing the risks of climate change for the most vulnerable and working towards building a more resilient and greener city.

To help the council develop the city while also adapting to climate change, a climate risk and vulnerability assessment (CRVA) is needed to help identify where the needs of Birmingham are greatest. The council has developed a CRVA map, which builds on the success of the Environmental Justice Map.

Methodology:

The CRVA map scores areas of Birmingham based on compiling the presence and extent of 11 different factors that may influence the effect of climate change. These factors are:

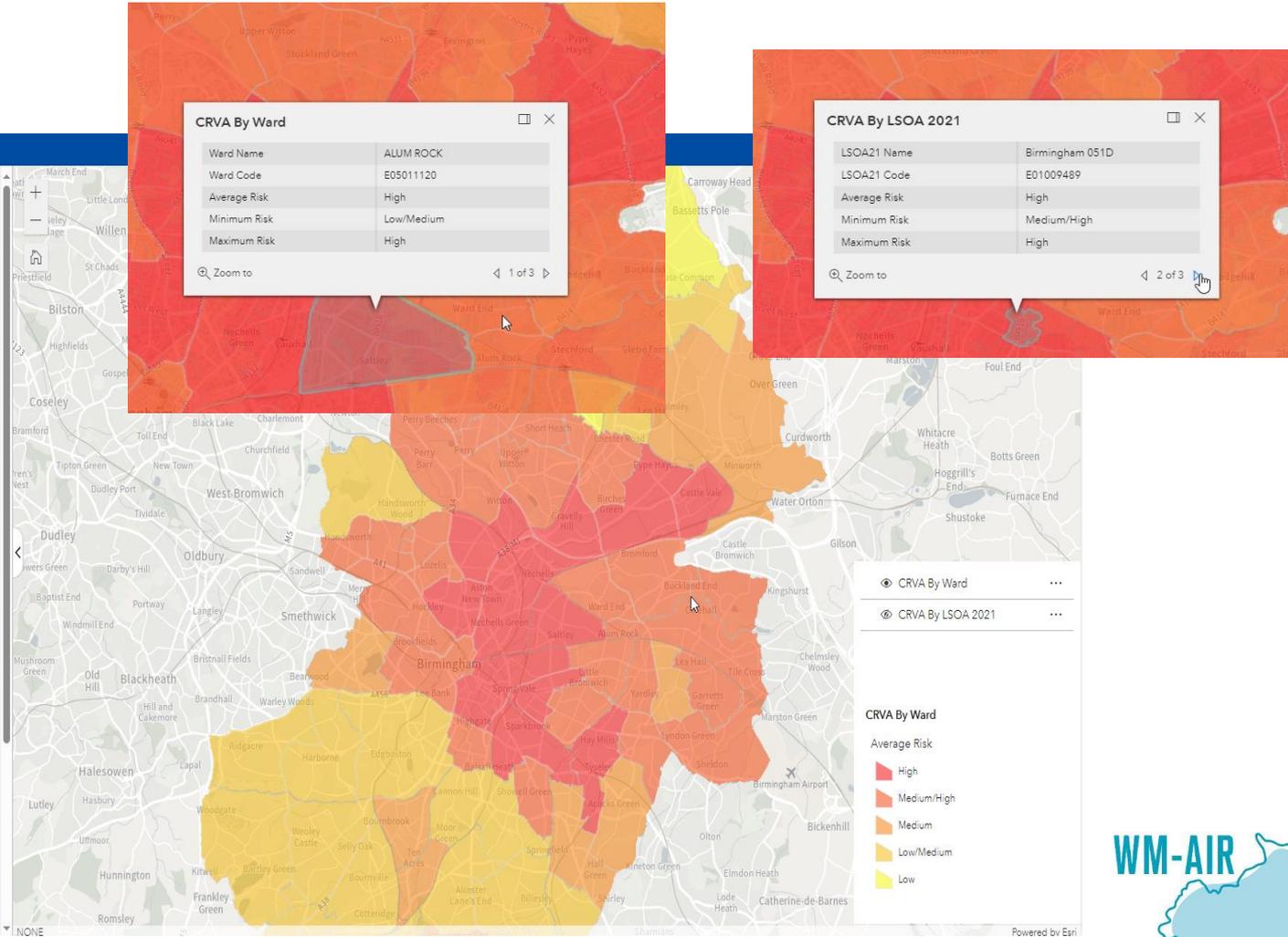
- Concentration of nitrogen dioxide (an air pollutant)
- Concentration of fine particulate matter (an air pollutant)
- Fluvial (river) flood risk
- Pluvial (surface) flood risk
- Surface temperature
- Local climate zone classification
- Deficit in open green space
- Deficit in other green space
- Deficit in tree canopy cover
- Excess years life lost
- Indices of Multiple Deprivation

Most of these datasets are open source and can be viewed using geographic information system (GIS) mapping software, such as ArcMap or QGIS.

To create the CRVA map, the map of Birmingham was divided into a 100m² grid and a score from 0 to 1 was generated per grid square for each factor. The higher the score in a layer, the more at risk or vulnerable that area is to the factor. The scores for all the layers were then summed to create the final CRVA score for the grid across Birmingham, where the higher the score, the more at risk and vulnerable that area is to the compound effects of climate change, now and in future.

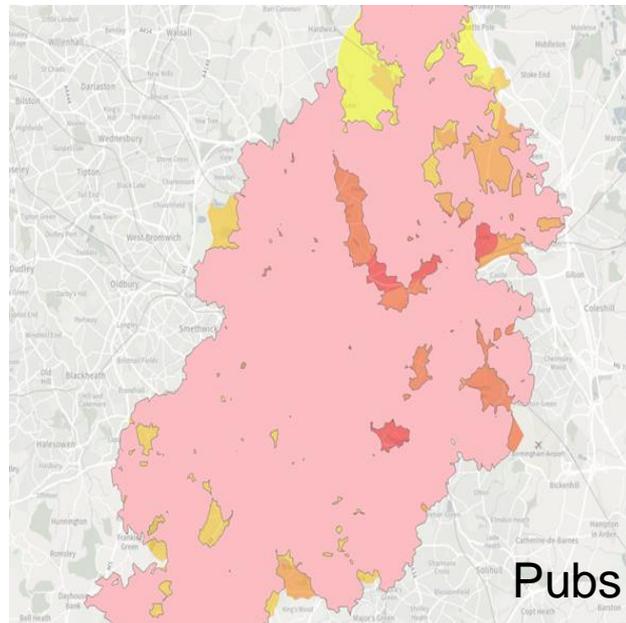
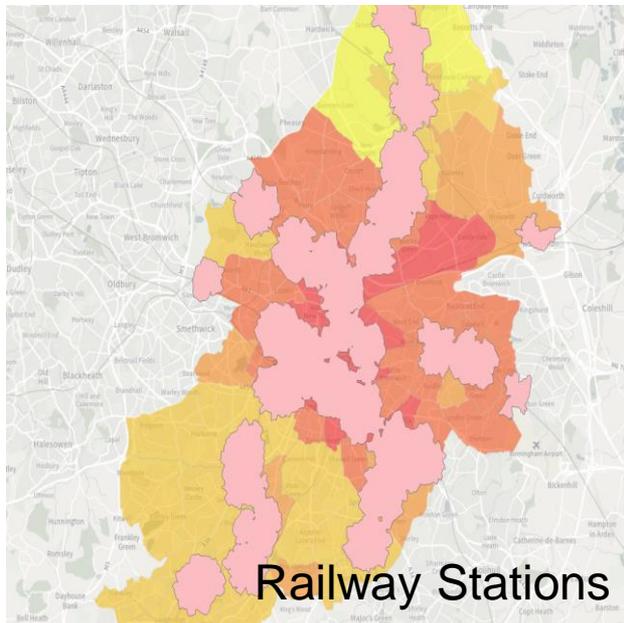
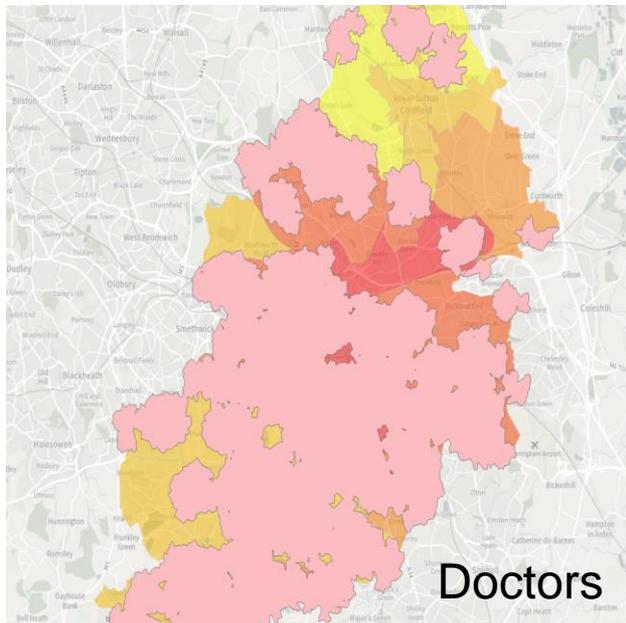
For the list of data sources and a more in-depth description of the methodology see [here](#)

How is the risk defined?

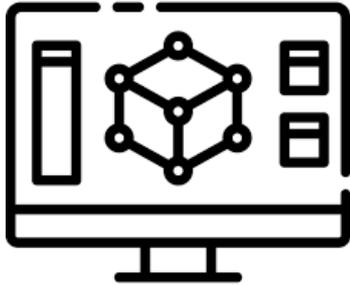


We can do this today

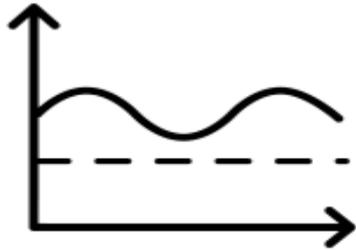
Using 670k virtual points – generating 7.5-minute walking service areas
Merged service areas to give overall city-wide access



What's next for BCC



Re-run
analysis...
(5-yearly)



... to measure
and show
change

Public-facing tool for
Citizens to test
“what-ifs?”



API for
developers to
submit and
verify plans

Scenario
tool for
BCC
planners

What's next for the CRVA?

Regional upscaling (WM-CRVA)

West Midlands Combined Authority: spatial dimensions of climate vulnerability, citizen engagement, addressing transport infrastructure risks (NERC funding; 8 months)

Further application

Climate-Resilient Development Pathways in Metropolitan Regions of Europe (CARMINE): Birmingham as one of eight European case study areas (EU funding; 4 years)

Upcoming outputs

Peer-review research article on CRVA in Birmingham (in draft)

CRVA use in BCC Liveable Neighbourhoods pilot

BCC development of CRVA tools



Further information: WM-Air UDGI/BCC team

GIS, data and methodology

Dr Sarah Greenham, UoB Clean Air Impact Fellow in Urban Design and Green Infrastructure: s.greenham@bham.ac.uk

Dr Emma Ferranti, UoB Associate Professor in Civil Engineering: e.ferranti@bham.ac.uk

Simon Needle, BCC Strategic lead – Urban Forestry & Nature: simon.needle@birmingham.gov.uk

Stephen Jones, BCC Lead Data Engineer – Geospatial: stephen.l.jones@birmingham.gov.uk

Air quality, atmospheric science and applications

Dr Joe Acton, UoB Clean Air Impact Fellow in Applications: w.j.f.acton@bham.ac.uk

Implications for green infrastructure and policy

Prof Rob Mackenzie, UoB Professor of Atmospheric Science and Director of BIFoR: a.r.mackenzie@bham.ac.uk



Natural
Environment
Research Council



Engineering and
Physical Sciences
Research Council

West Midlands Air Quality Improvement
Programme NERC Innovation grant NE/S003487/1

E. Ferranti Fellowship "Bringing the Mediterranean
to Birmingham" EPSRC grant EP/R007365/1



Birmingham
City Council

