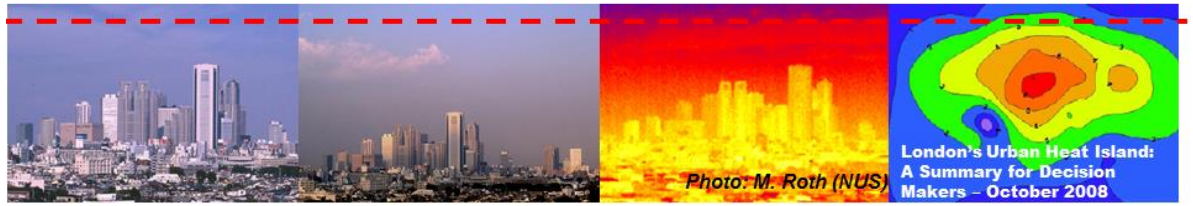


Heat Risk in London- Translational Research/Modelling/Report & Guidance

London Climate Change Partnership (LCCP)

December 2018

Snigdha Jain
City Analytics, WSP

The Urban Environment

There are many ways in which an urban environment differs from a rural one. Some of the parameters are listed below (The Chartered Institution of Building Services Engineers , 2015) :

• The fabric of the built environment has a greater heat capacity than its rural counterpart, absorbing incoming solar radiation during the day and releasing it at night as sensible heat flux;

• Buildings, pavements and roads usually have darker surfaces with lower albedo and higher heat capacity compared to rural landscapes, thereby increasing their ability to absorb heat;

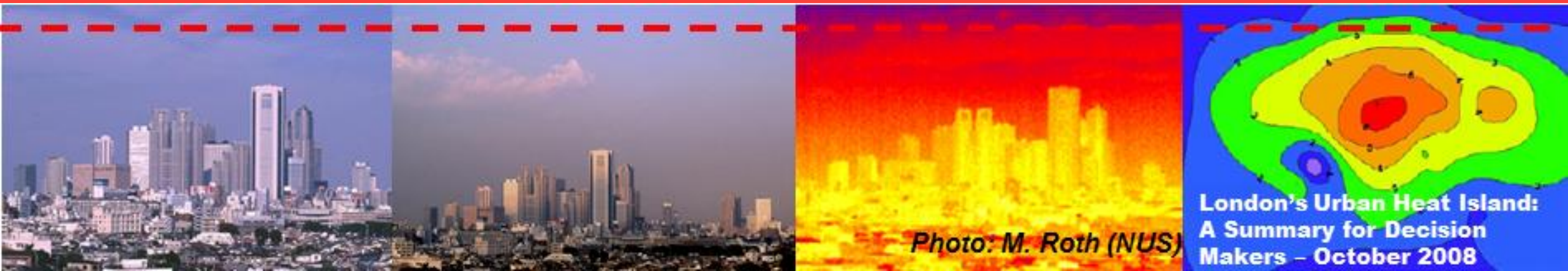
• The geometry of street canyons and increased building density helps trap incoming radiation, whilst reducing the rate of long-wave radiant cooling at night;

• The orientation and density of structures within cities also reduces wind speeds, resulting in a decrease in the amount of convective heat transport away from the urban environment;

• The density of buildings and the resulting street canyons can be defined by an aspect ratio. Street canyons have lower sky-view factors (i.e. the proportion of sky visible in a 180° field of view) due to their high aspect ratios. They store more heat, enabling them to maintain higher surface temperatures for longer periods of time;

• A reduction in vegetation and vegetated surfaces reduces the amount of evapotranspiration; and

• Anthropogenic heat and moisture emissions are produced by transport and buildings.



Urban Heat Island

Heat Risk Mapping

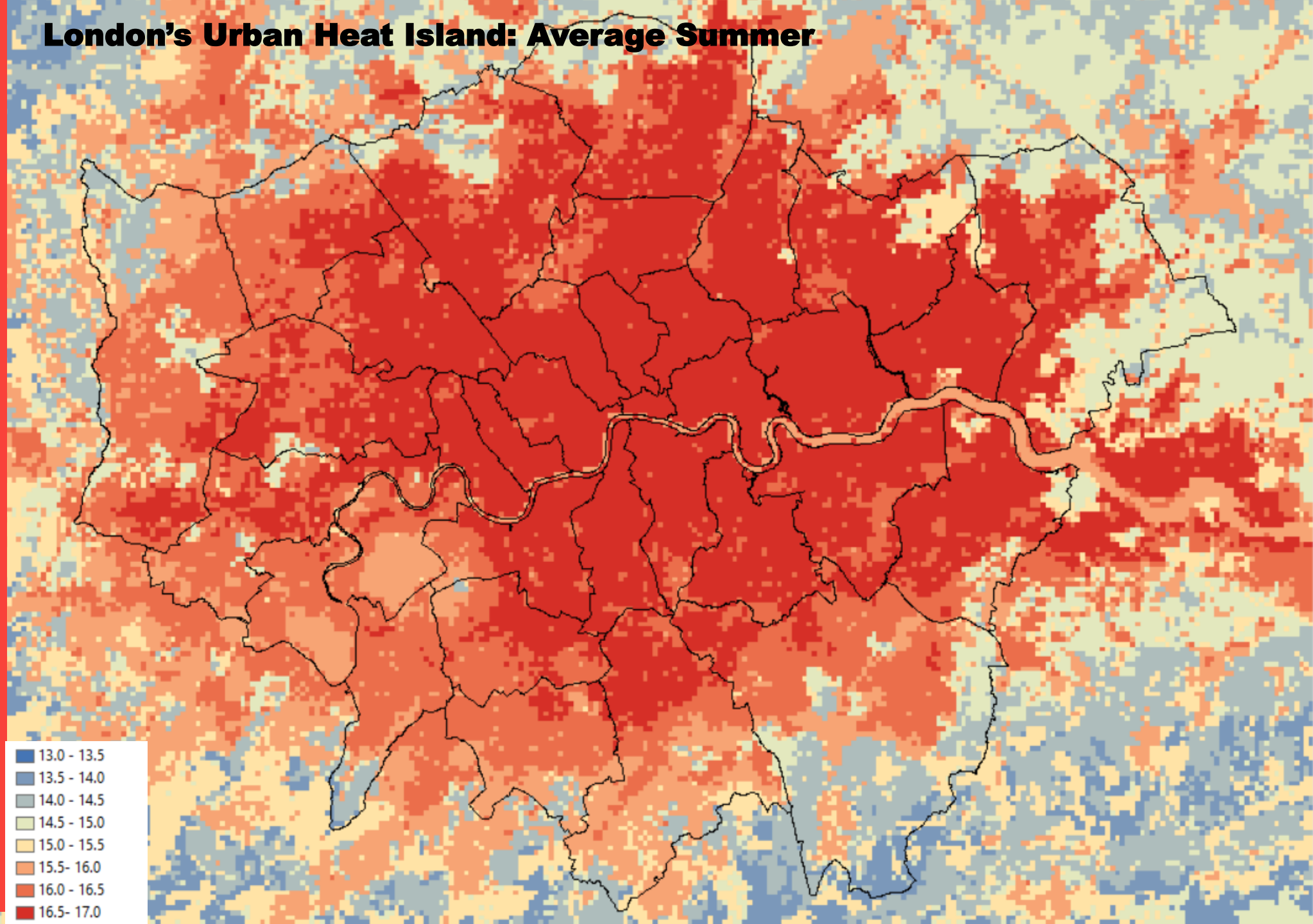
This map shows the results of an 'UrbClim' simulation

Mean temperature at midnight during the summer of 2011.

On average, the night-time temperature is approximately 4˚C higher in the city centre.

During some hot nights, even larger effects are observed.

Source: London Datastore, https://data.london.gov.uk/dataset/london-s-urban-heat-island---average-summer



Why?

Overheating/ Comfort

The concerns

Climate change will increase peak temperatures

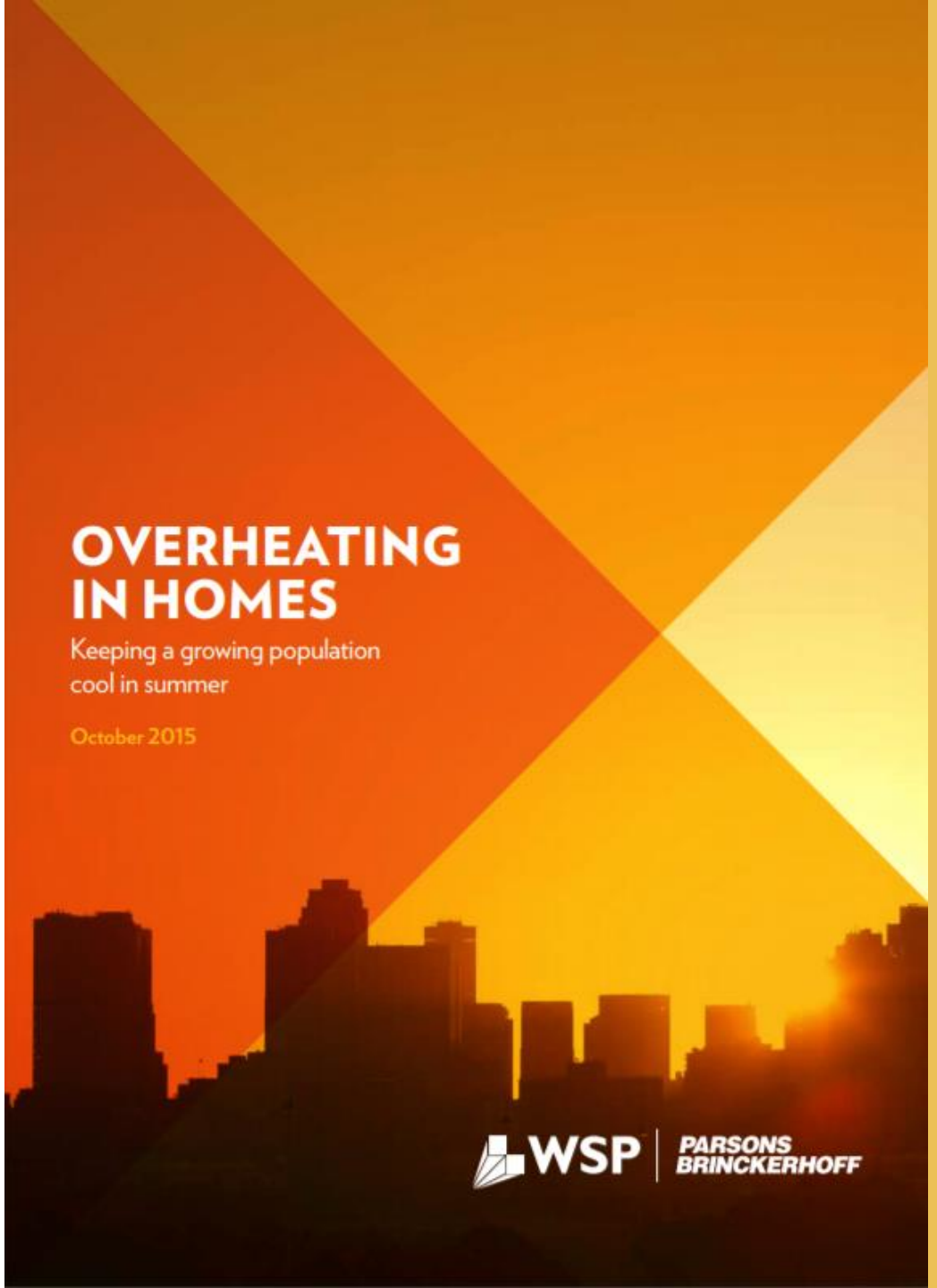
We're building more flats

Tighter building regulations

Older populations are more susceptible to heat

A bad night's sleep affects health and productivity

Very hot temperatures can kill



OVERHEATING IN LONDON

#overheating
Tweet Us @WSP_PB_UK

83% of Londoners suffered from uncomfortably hot homes this summer at least once

Only **13%** never suffered from overheating this summer

54% of Londoners say overheating would influence their decision when buying a home

8% of Londoners affected have taken action and installed air conditioning

31% of those who suffered from overheating felt unwell or tired

52% of those who felt uncomfortably hot this summer were woken up in the night

WSP | PARSONS BRINCKERHOFF

FINDINGS FROM A SURVEY OF 1,005 LONDONERS

The survey was conducted by ComRes as part of WSP | Parsons Brinckerhoff's wider research paper into overheating in homes, which will be launched 22 October.

2,000 deaths are caused by overheating each year, according to government figures.

The UK's temperature will potentially increase 2.5°C by 2050.

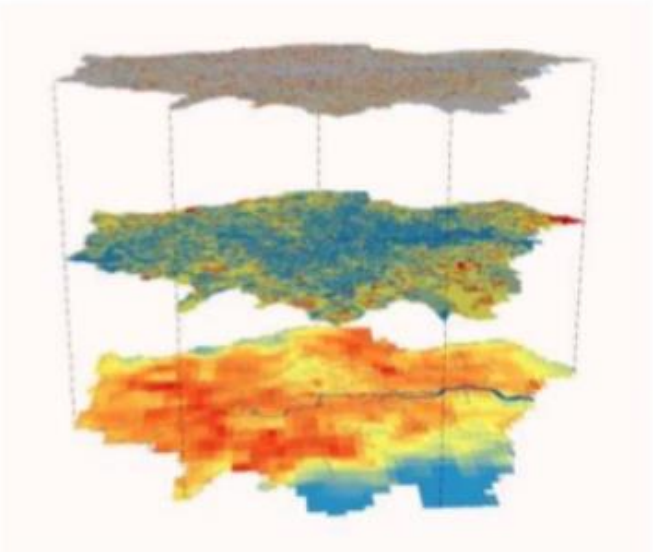
Health Risks

The Europe-wide heatwave in 2003 led to approximately 2,000 excess deaths in the UK and 70,000 across the continent as reported in the Triple Jeopardy Mapping Leaflet (UCL).

The study indicated an overall increased in the Relative Risk (RR) of mortality during hot weather. (Taylor, et al., 2015) In London, this was found to be above a mean daily maximum temperature threshold of 24.8˚C and represented a 3.8% increase in RR per ˚C.

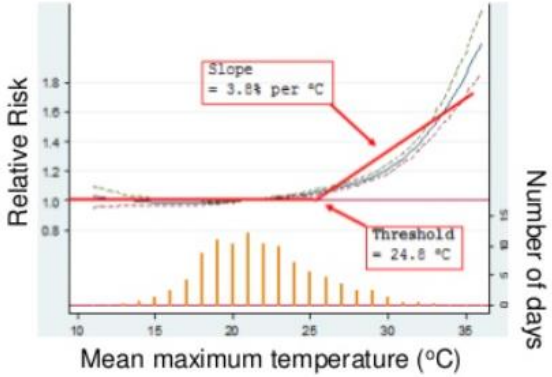
Combined 'triple jeopardy'

The objective of this work is to estimate the overall mortality risk in London, accounting for the 'Triple Jeopardy' of:



1. Building characteristics (EnergyPlus building physics model)
2. Population age (Census 2011)
3. Urban heat island (LUCID LondUM)

Temperature-mortality curve



Studies indicate an overall increase in the Relative Risk (RR) of mortality during hot weather[8-14].

In London, this occurs above a mean daily maximum temperature threshold of 24.8°C, and represents a 3.8% increase in RR per °C[8].

Amended to give age-specific slopes using data from Gasparrini et al[9].

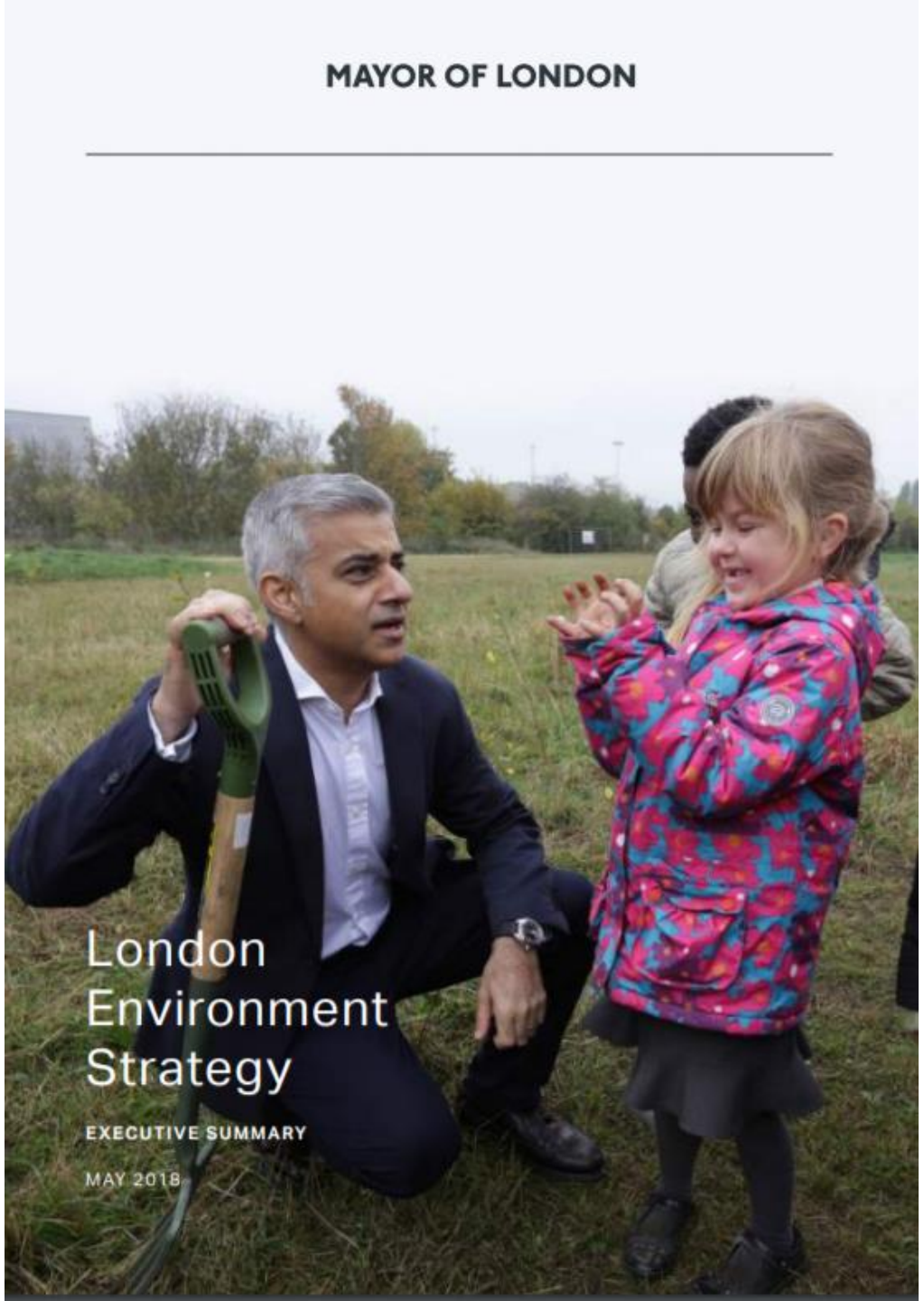
Infrastructure Risks

The current Environmental Strategy (Greater London Authority, 2018) identifies the following risks to infrastructure as a result of rising temperatures:

- 24˚C – London Underground puts in place overheating plans including public health communications and measures to prevent tracks from buckling;

- 33˚C – softening of tarmac, asphalt and bitumen road surface generally begins to occur;

- 36˚C – power sources begin overheating, extreme precautions may need to be introduced to prevent rail lines buckling, such as speed restrictions.



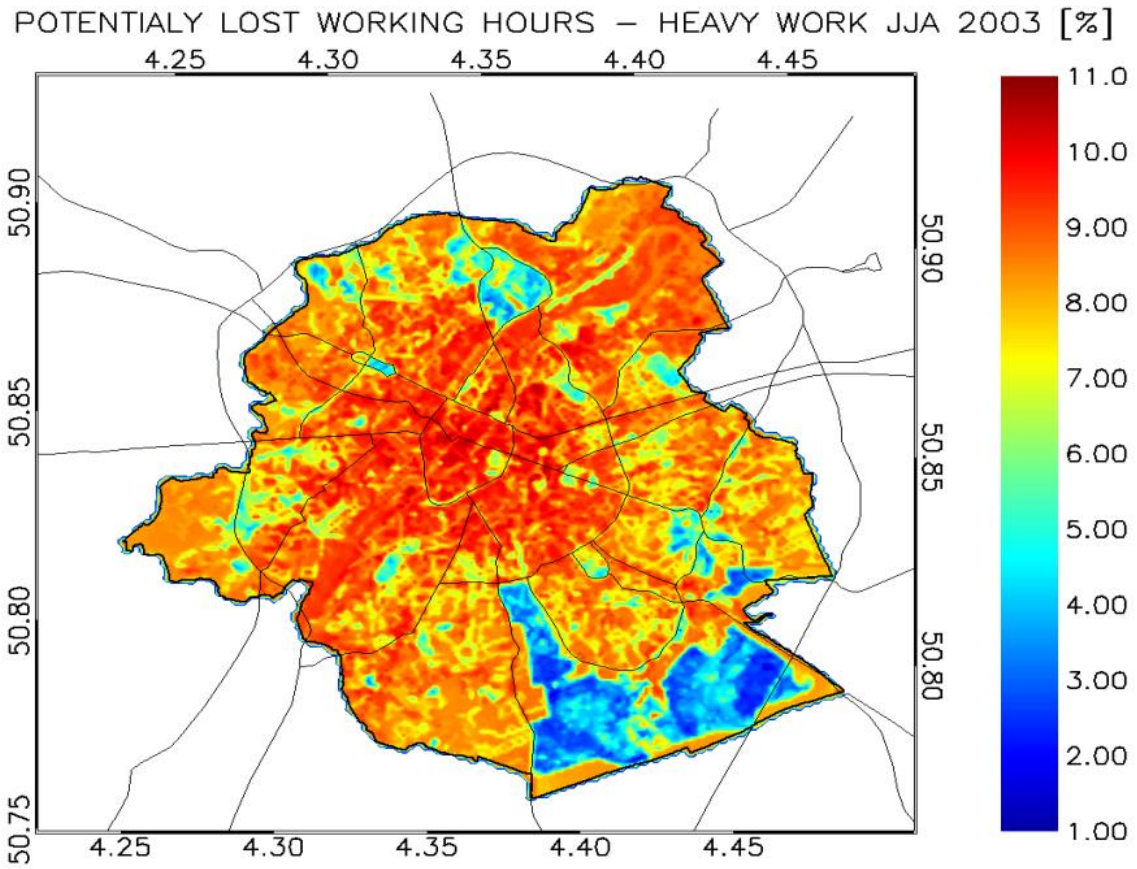
Productivity Loss

We estimate that in a warm year in the far future (2081-2100), the total losses to the urban economy could range between 0.4% of Gross Value Added (GVA) (€1.9 billion) for London.

Climate change, heat stress and labour productivity: A cost methodology for city economies

Hélia Costa, Graham Floater, Hans Hooyberghs, Stijn Verbeke and Koen De Ridder

July 2016
Centre for Climate Change Economics and Policy
Working Paper No. 278
Grantham Research Institute on Climate Change and the Environment
Working Paper No. 248



Interaction with other environmental priorities

It’s too Noisy!

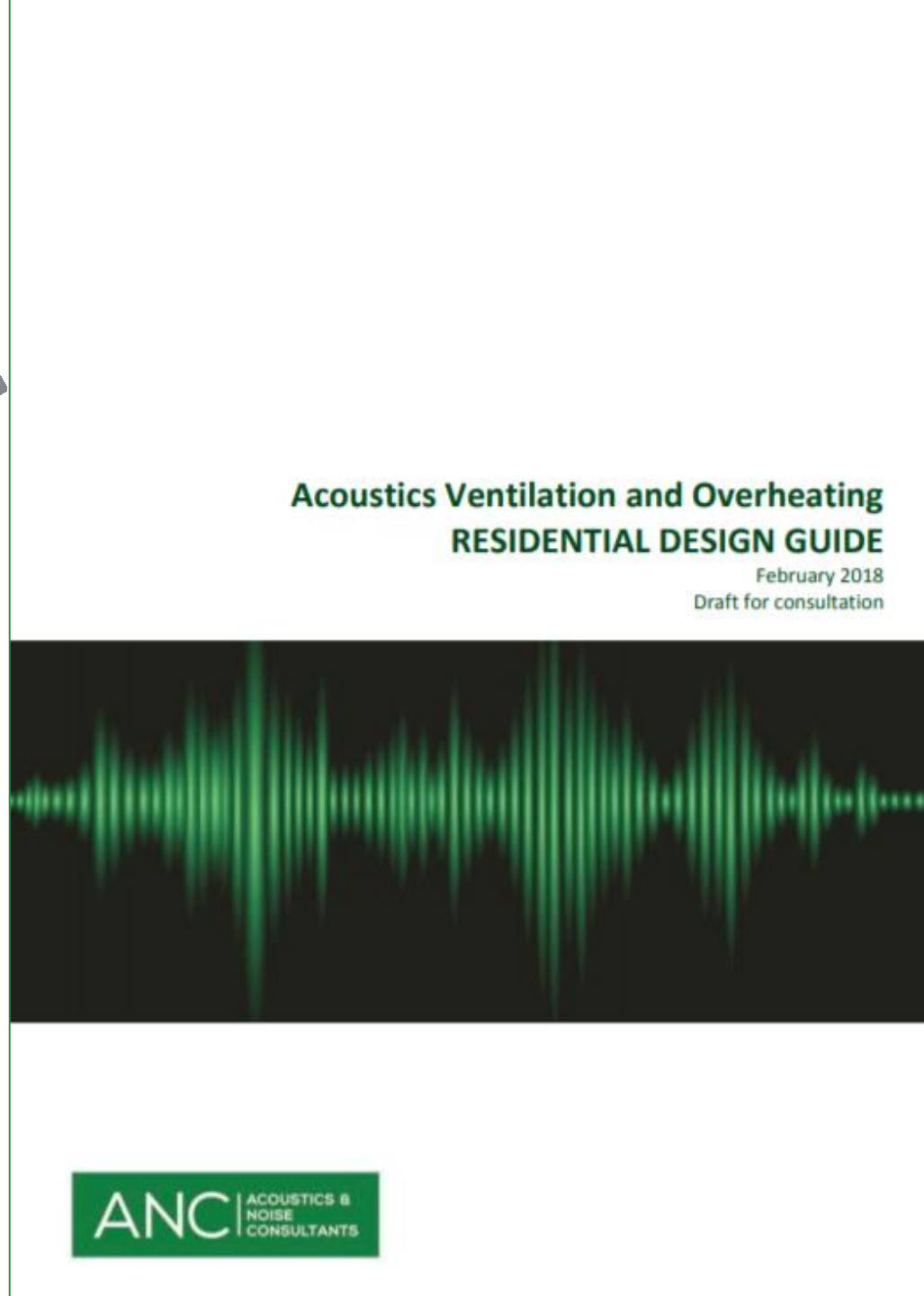
National Noise Incidence Survey (2000)

54% of the UK Population exposed to daytime noise above WHO guidelines for community annoyance (55 dB $L_{Aeq,16hr}$)

67% of the UK Population exposed to night-time noise above the guidelines that allow people to sleep with windows open (45 dB $L_{Aeq,8hr}$)

“IT GOT SO HOT LAST YEAR THAT THEY HAD TO HAVE THE WINDOWS OPEN WHICH MEANS THAT WHEN THE TRAINS START AT 4AM, YOUR SLEEP IS DISRUPTED WHEN YOU HAVE TO GET UP TO CLOSE THE WINDOW”

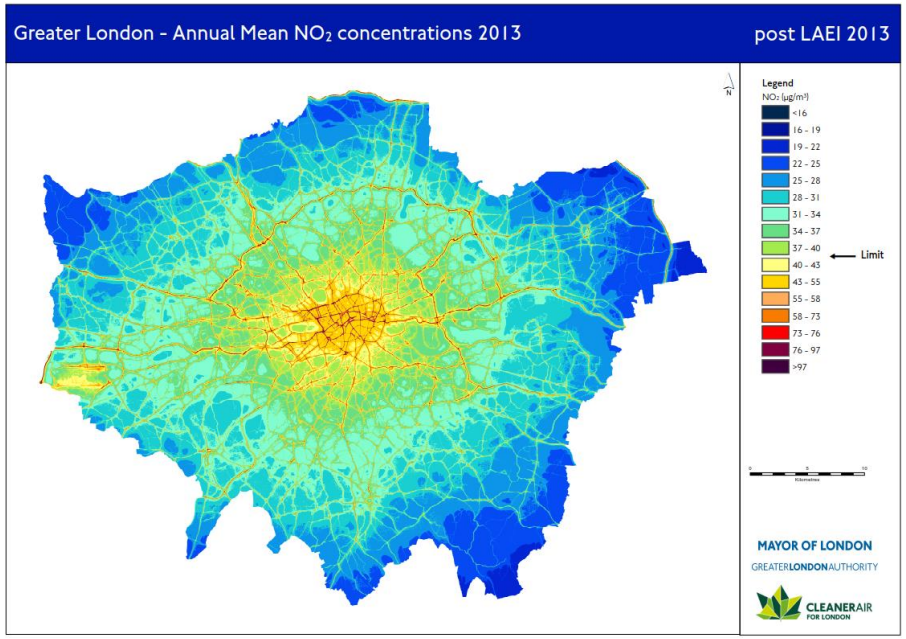
“WE LEAVE THE WINDOWS OPEN UNTIL WE GO TO BED AS THE HIGH LEVEL OF NOISE POLLUTION MEANS WE CAN’T LEAVE THEM OPEN”

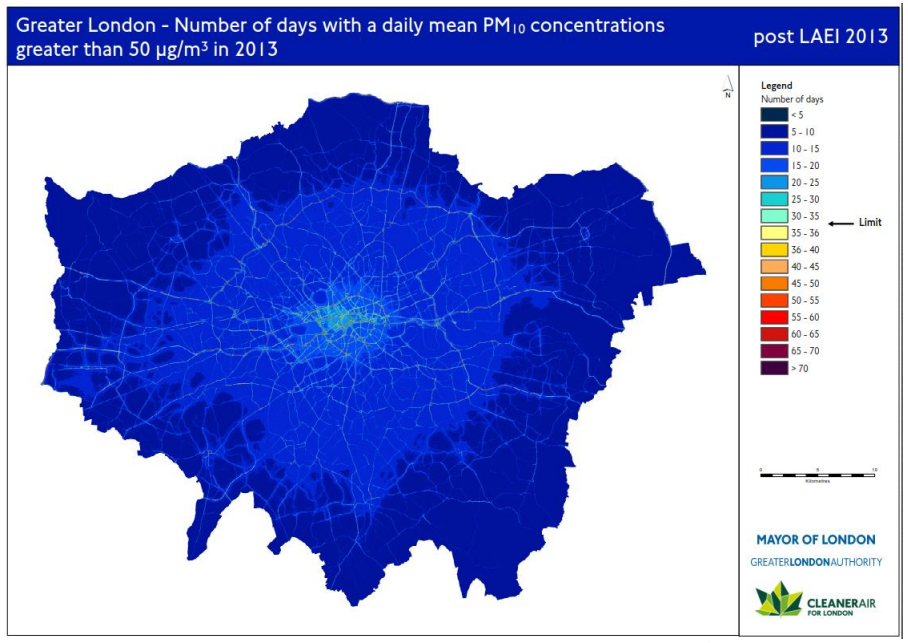


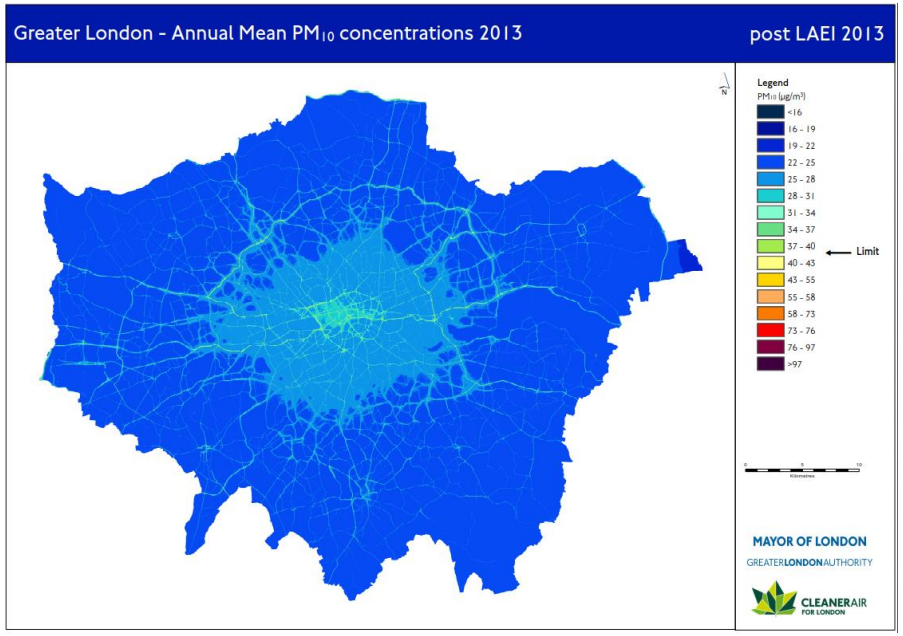
Air Pollution

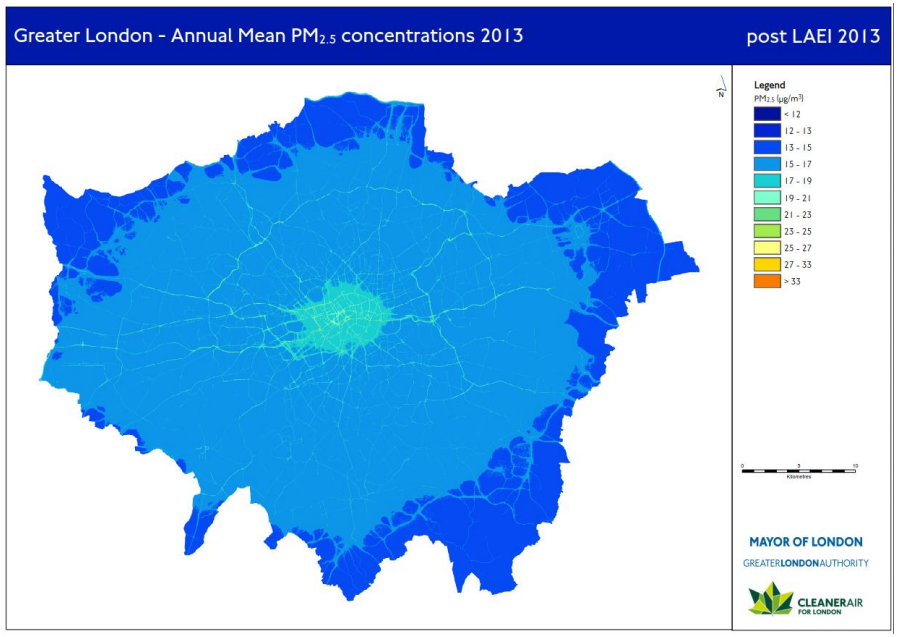
2016 report titled 'Every Breath we take: the lifelong impact of air pollution'

40,000 deaths in the UK each year can be attributed to exposure to outdoor air pollutants. The financial cost is considerable – estimated at approximately £20 billion
every year (around 16% of the total NHS budget).









A Systems Thinking Approach

WSP: Holistic Mapping

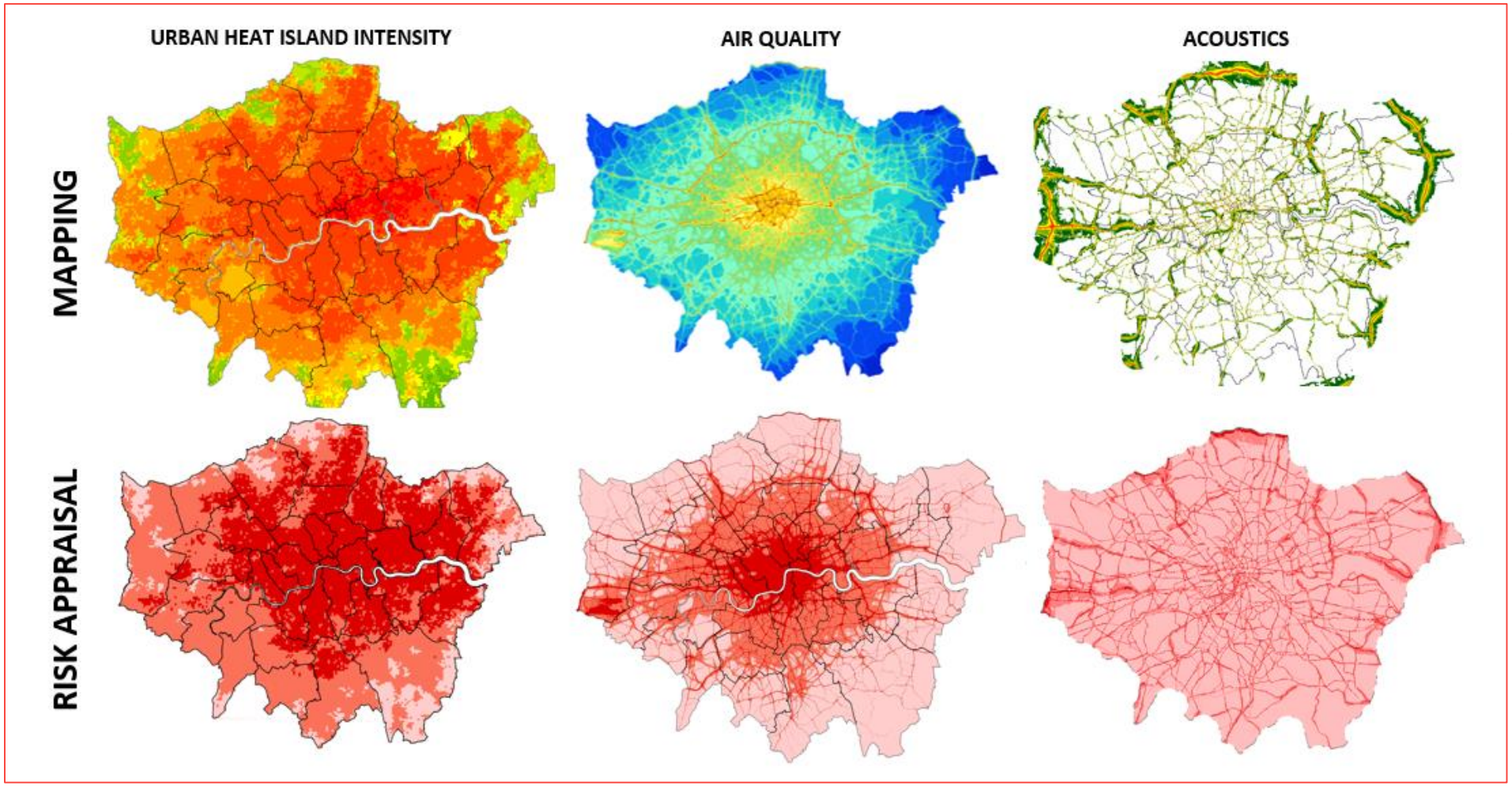
Mapping of environmental variables (Urban Heat Island, Air Quality and Noise Exposure)

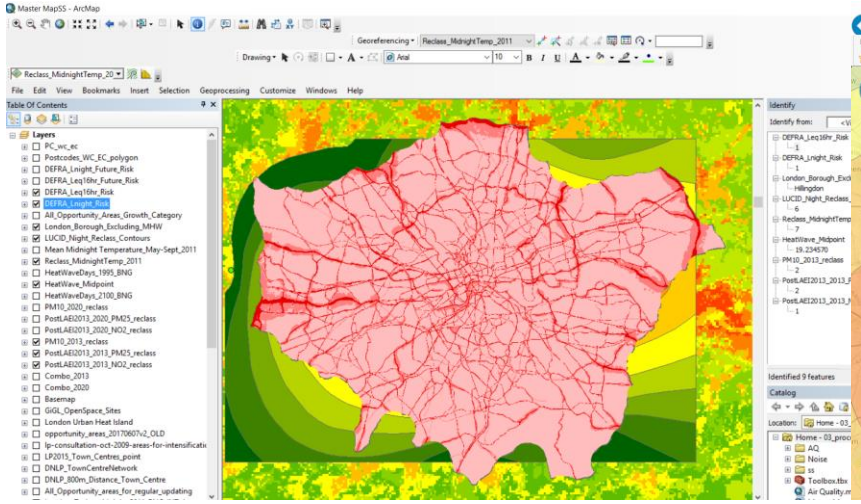
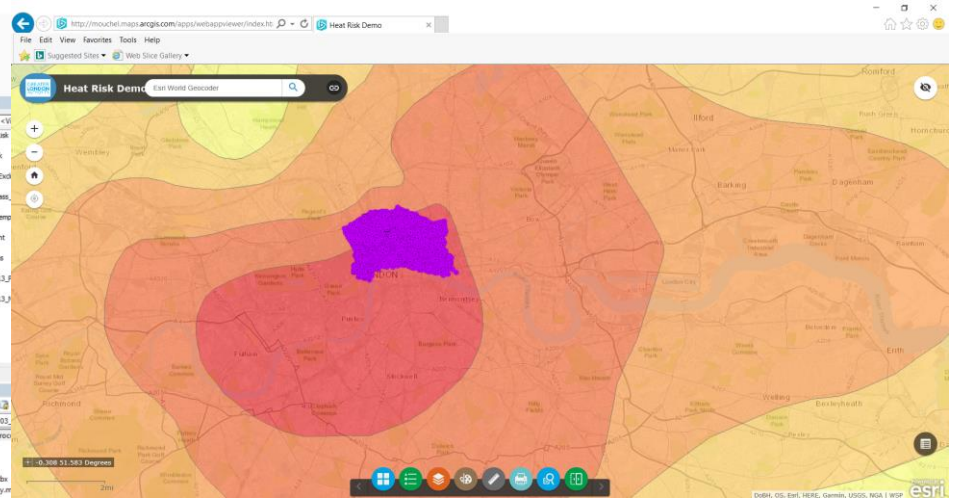
Assigning each variable a sensitivity/score

Layering the city's future spatial growth

Consideration of future trends

Urban Risk Appraisal



Project Achievements

- **Vast array of data sources into a single tool**
- **First to consider the interactions of Heat, Air Quality and Noise**
- **Tangible outputs in the form of a web based tool that has real applications to be used 'live'**
- **A checklist that can be used to feed into SPDs after consultation**
- **Lot of applications and global interest ~ C40 Cities / Horizon 2020.**