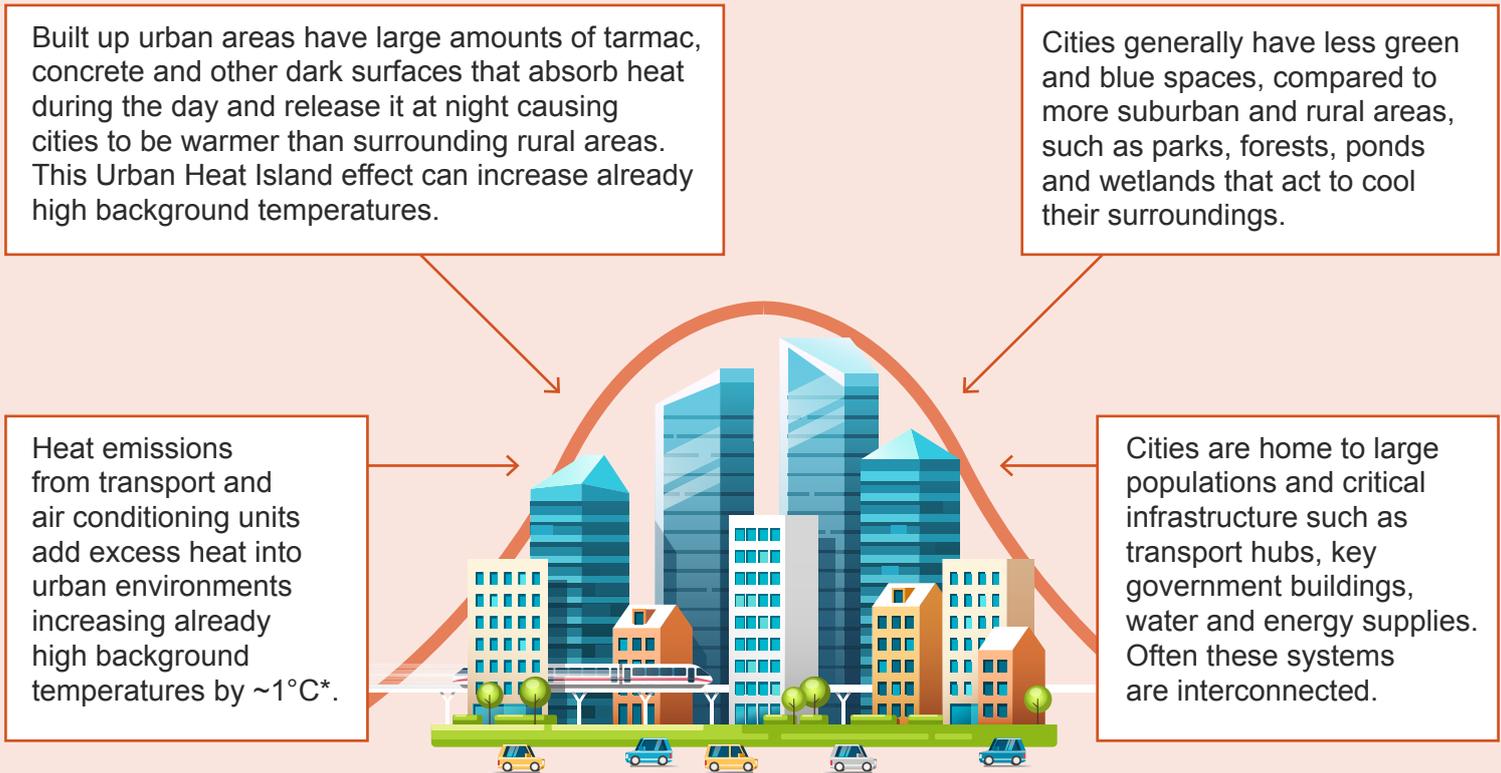


# Belfast Heat Pack

Cities can be impacted by a range of weather and climate hazards including extreme heat, heavy rainfall and sea level rise. The Heat Pack provides information on how extreme heat events in your city may change this century due to climate change, the impacts, and how to build resilience to extreme heat.

## WHY ARE CITIES PARTICULARLY VULNERABLE TO HEAT?



## WHAT ARE THE IMPACTS OF EXTREME HEAT?



Increased heat related illnesses and mortality, particularly among the most vulnerable.



Overheating of buildings and thermal discomfort of inhabitants.



Increased pressure on city services, including green spaces, energy for cooling, water demand and health and social care services.



Disruption to transport from overheating of signalling equipment, buckling of railway lines or damage to road surfaces.



Air quality issues can become worse as air stagnates causing increased health risks.



Reduced staff productivity from negative effects on employee health and wellbeing.

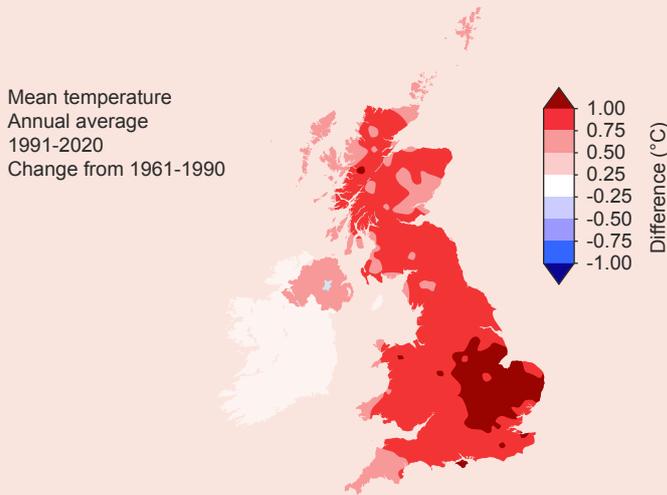
\*Oke et al (2017), Urban Climates. Available at: <https://doi.org/10.1017/9781139016476> & Bohnenstengel, S. et al (2014) Available at: <https://doi.org/10.1002/qj.2144>

# HOW IS TEMPERATURE CHANGING ACROSS THE UK?

## CURRENT TRENDS\*

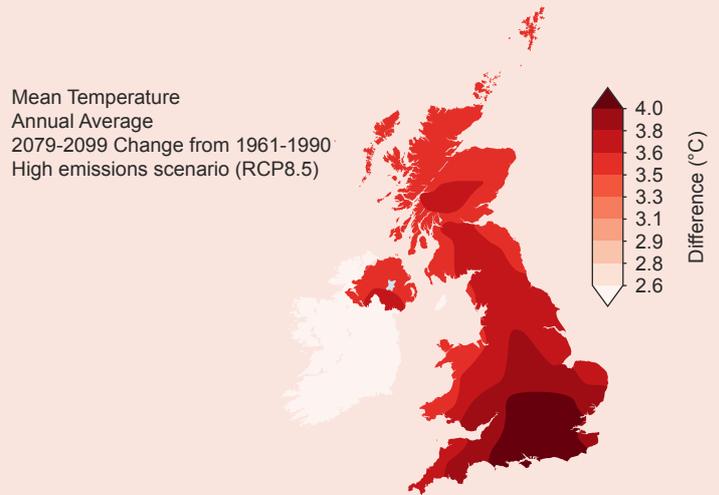
### ANNUAL AVERAGE TEMPERATURE

Since the 1961-1990 period annual average temperatures have increased by 1°C in some parts of the UK.



## FUTURE TRENDS\*\*

In a low emissions scenario†, the annual average temperature of the UK is expected to increase between 0.7-2.5°C\* by the 2080s. In a high emissions scenario, this change could be between 2.2-5.5°C\*. The rate of change will vary across the UK.



### AVERAGE SUMMER TEMPERATURE

Average summer temperatures have also increased:



Hot spells\*\*\* are largely confined to the south-east UK in the present-day and occur on average once every 5 years.

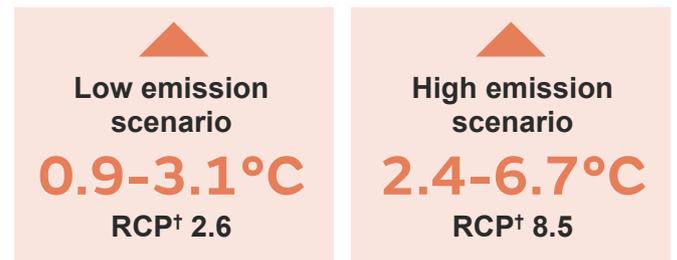


\* Compared to 1961-1990 period.

\*\*Results from UKCP 25km probabilistic projections and compared to 1961-1990 period. The first value in the range represents the 10th percentile (90% chance of being higher than this result) and 90th percentile (10% chance of being higher than this result).

\*\*\*Maximum day time temperatures >30°C for two or more consecutive days

By the 2080s average summer temperatures are projected to increase by:



Under a high emissions scenario, the frequency of hot spells\*\*\* increases to 4 occurrences per year and become more widespread.



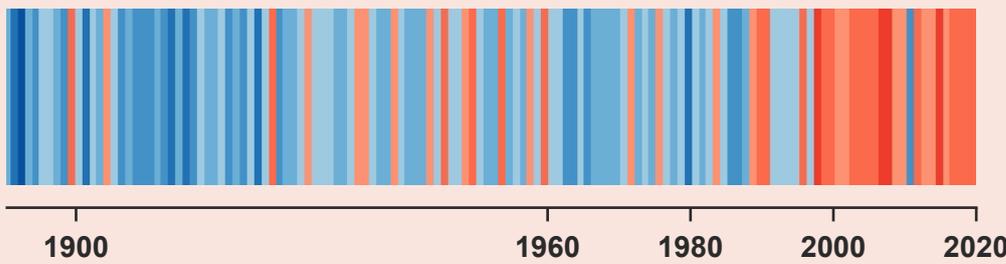
†Emissions scenarios refer to the Representative Concentration Pathways (RCPs) used in climate models to describe possible futures based on assumptions about green house gas emissions. In RCP2.6 global emissions are strongly mitigated and reduced. Global temperature rise is kept below 2°C. In RCP8.5 global emissions grow unmitigated and global temperature rise exceeds 4°C.

## HOW IS TEMPERATURE CHANGING IN BELFAST?

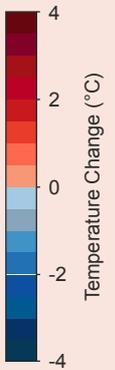
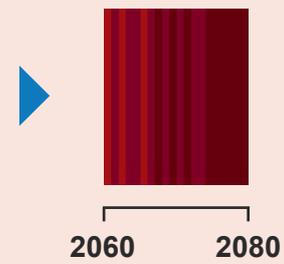
Observations show that average temperatures in Belfast have increased since the middle of the 20th century. This trend is in line with the rest of UK. Most of this warming has occurred in the last two decades and is projected to continue throughout this century as shown by the warming stripes:

### Annual average temperature change in Belfast compared to 1981-2000

Observed since 1884:



Modelled (high emission scenario):



Concept from Prof. Ed Hawkins #ShowYourStripes

## FREQUENCY OF EXTREME HEAT EVENTS

Below are examples of the heat events in Belfast that have occurred in the last 5 years and their impacts:



### Spring 2017

Warmest on record for NI. The mean temperature from March to May was 1.3°C warmer than the seasonal average\*.



### Summer 2018

Heatwave conditions caused delays and cancellations to NI rail network services and triggered a hose pipe ban\*. June was the warmest on record.

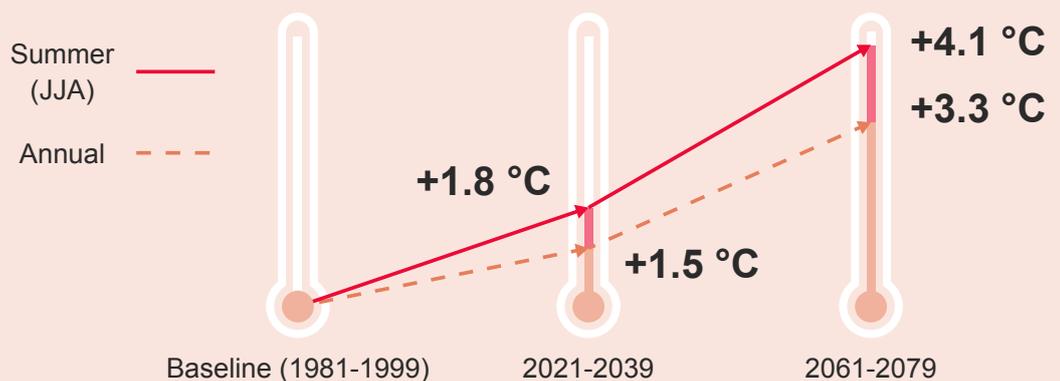


### July 2021

The Met Office issued its first ever amber extreme heat warning for NI when temperatures exceeded 30°C for 3 consecutive days and a record of 31.3°C recorded in Castleterg.

## FUTURE CHANGE IN BELFAST'S TEMPERATURE

The thermometers show the projected\*\* change in average annual and summer temperatures for Belfast over the 21st century, which are in line with projected trends for the UK on page 2.



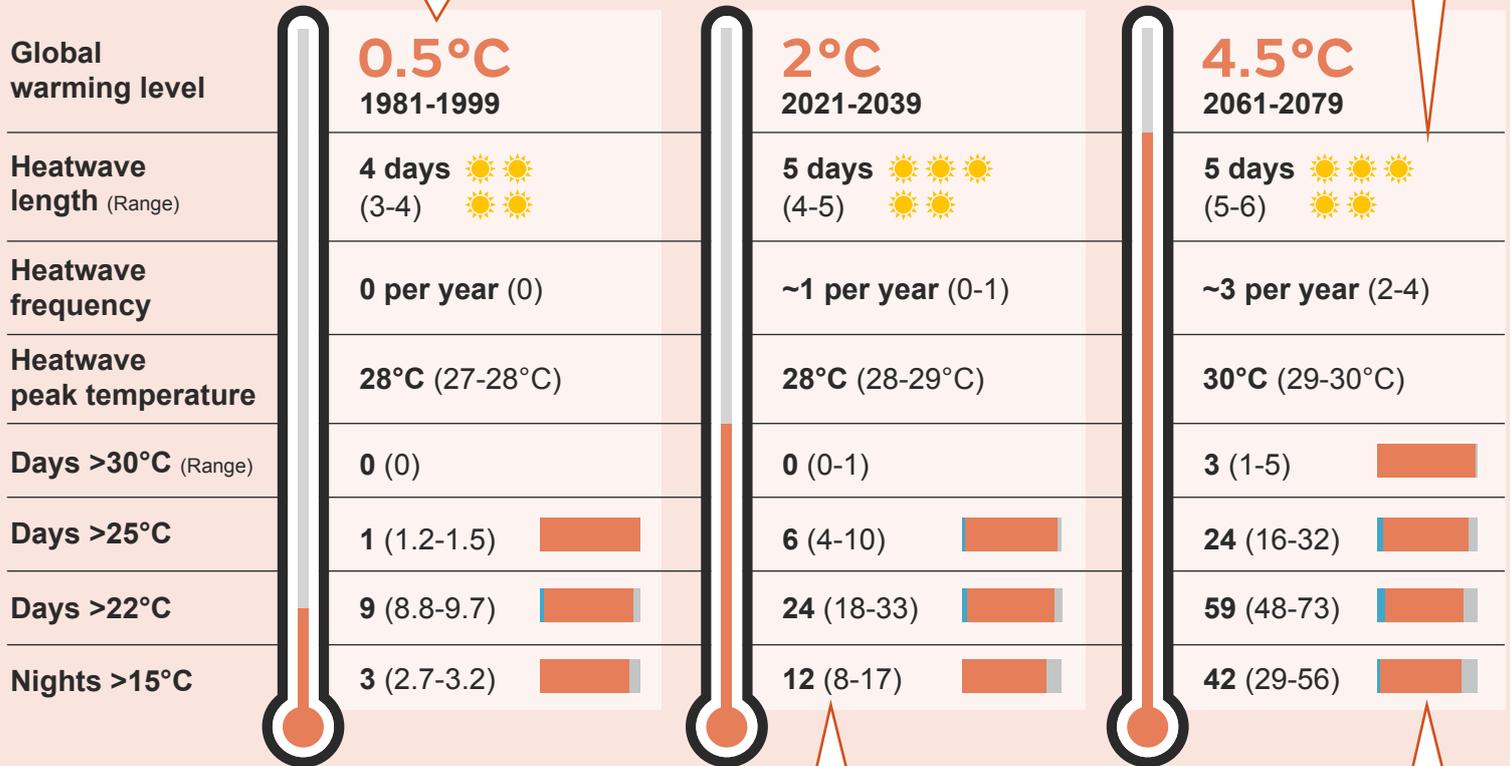
\*Climate Northern Ireland (2021) Extreme Weather Events in Northern Ireland. <https://www.climate-northernireland.org.uk/about-us/extreme-weather-events.php>

\*\*Projections based on high resolution UK Climate Projections (UKCP Local) for a high emissions scenario (RCP8.5) and is the average change across the city. See page 8 for more details.

## FUTURE TRENDS IN IMPACT BASED HEAT INDICATORS\*

Global warming levels are used to estimate the date at which global temperatures may reach a certain temperature in the future\*\*.

Heatwaves will happen more frequently, be longer in duration and hotter when they occur.



Proportion of days falling in:  
 Spring Summer Autumn

The number of hot days and nights is projected to increase throughout the 21st century.

Most hot days still happen in summer, but there are also increases in hot days occurring in spring and autumn.

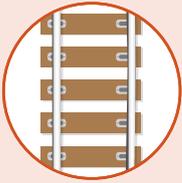
## EXAMPLES OF IMPACTS AT DIFFERENT TEMPERATURE THRESHOLDS



**Days above 22°C**  
 Increased water consumption and energy demand for cooling.



**Nights above 15°C**  
 Prevent the human body cooling down, leading to thermal discomfort, heat related illnesses and mortality, particularly among the vulnerable.



**Days above 25°C**  
 Increased risk of heat-related health conditions and mortality. Rail network begins to implement staged precautions to avoid buckling of tracks.



**Heatwaves**  
 3 consecutive days when maximum temperature meets or exceeds 25°C. During the summer 2018 heatwave NI Water introduced a hosepipe ban and water consumption increased by 30%. Translink restricted rail services and introduced speed restrictions.



**Days above 30°C**  
 Overhead power lines become less efficient.

(See page 9 for further resources on temperature thresholds)

\*Results based on UKCP Local projections, for a high emissions scenario (RCP8.5) and are the average across the city. The climate model ensemble median is shown along with the range from the 10th & 90th percentiles.

The results should be interpreted as an approximation of the projected number of days when temperature thresholds are exceeded.

There will be many factors influencing this value including natural variability and local scale processes of a higher resolution than the climate model is able to represent.

\*\*Global warming levels based on UKCP Global projections, for a high emissions scenario (RCP8.5) and relative to pre-industrial period (1850-1900).

The ensemble median is presented. See supplementary document for further information.

# HEAT IMPACTS VARY SPATIALLY ACROSS A CITY



The age, condition and type of building fabric can cause some neighbourhoods to be warmer than others.



The presence of green spaces and bodies of water have a cooling effect.

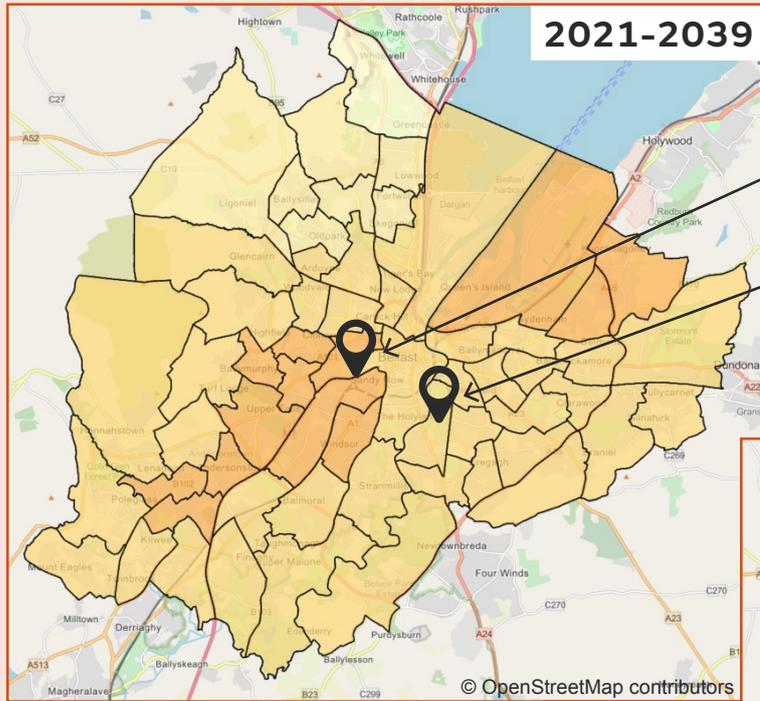


The positioning of buildings can promote or inhibit air flow.

All of these factors will determine how heat is distributed across the city under both current and future climate.

## WARM DAYS >25°C IN SUMMER

The average number of days in summer when daily maximum temperatures are greater than 25°C, under a high emissions scenario\*.

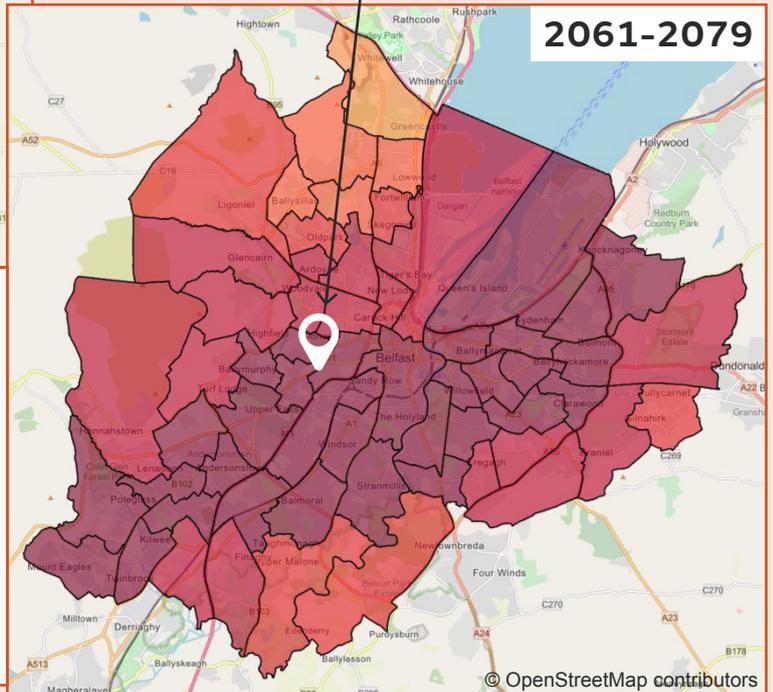


Parts of the city could experience ~8 days above 25°C in summer.

Great Victoria Street transport hub

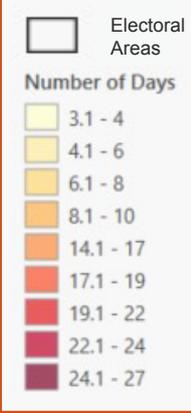
Ormeau Park

Royal Victoria Hospital



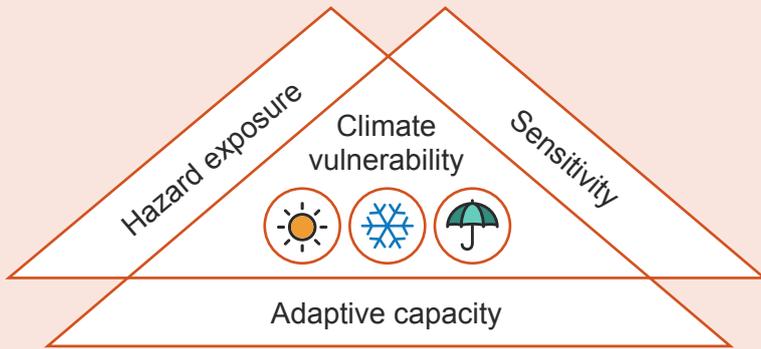
Some of Belfast's key infrastructure and services may be impacted by more extreme temperatures.

Central parts of the city could experience almost a month of days above 25°C in summer.



\*Results based on UKCP Local projections, for a high emissions scenario (RCP8.5) and the ensemble median. The results should be interpreted as an approximation of the projected number of days when temperature thresholds are exceeded. There will be many factors influencing this value including natural variability and local scale processes of a higher resolution than the climate model is able to represent.

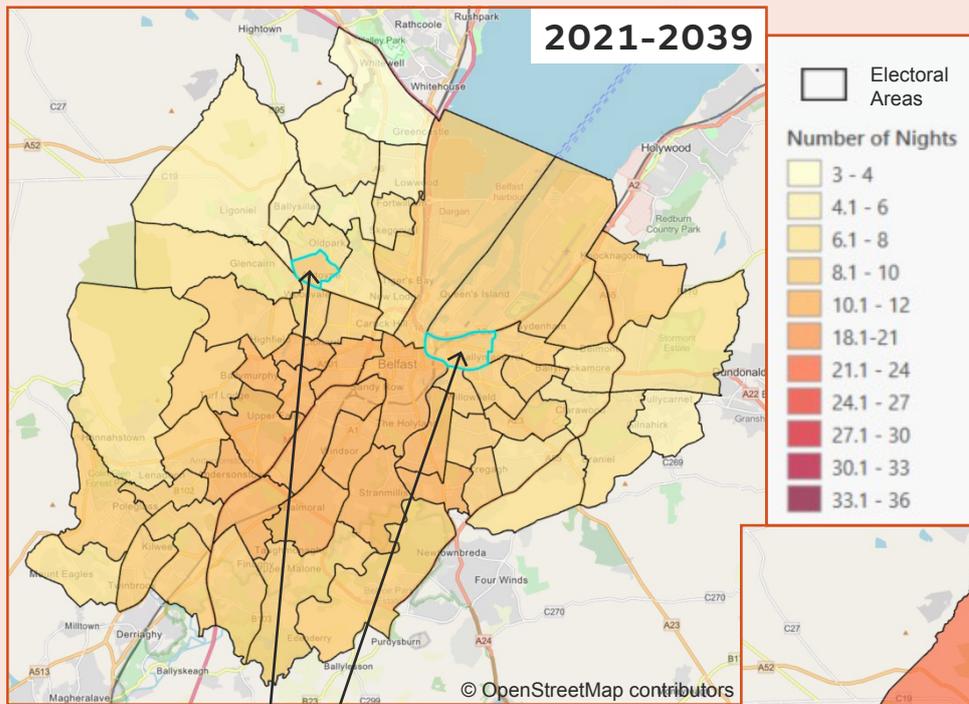
## HEAT IMPACTS VARY SPATIALLY ACROSS A CITY



Climate information can be combined with data on population, socio-economics, health and built environment and infrastructure to understand the city's exposure and vulnerability to heat hazards.

## WARM NIGHTS >15°C IN SUMMER

The average number of days in summer when daily minimum temperatures are greater than 15°C under a high GHG emissions scenario\*.



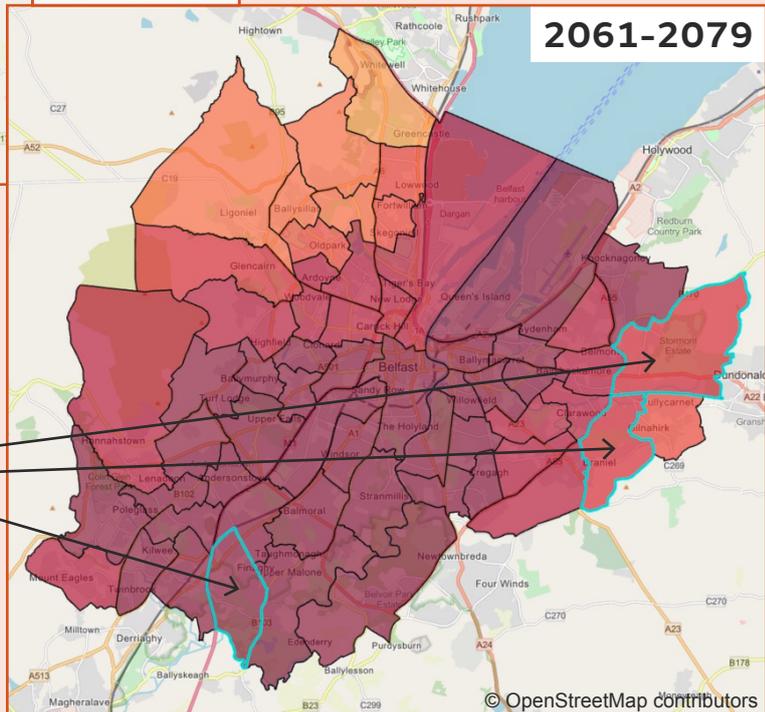
Warm nights are an important factor for heat-health impacts.

The Urban Heat Island effect can be seen with central areas of the city experiencing greater numbers of tropical nights than the city edges.

Towards the end of the century one in three nights in summer could be higher than 15°C in most parts of the city.

These wards have the highest proportion of apartments and terraced housing which can be at a greater risk of overheating and usually have less green space for residents.

These wards have the highest proportion of people aged 65+ who can be more sensitive to heat health impacts.



\*Results based on UKCP Local projections, for a high emissions scenario (RCP8.5) and the ensemble median. The results should be interpreted as an approximation of the projected number of days when temperature thresholds are exceeded. There will be many factors influencing this value including natural variability and local scale processes of a higher resolution than the climate model is able to represent.

## HEATWAVE PLANNING, CO-ORDINATION & RESPONSE

### RESOURCES FOR HEATWAVE PREPARATION

#### Early warning

- Met Office [extreme heat warnings](#) for the public.
- Met Office [heatwave forecasts](#).

#### Planning

- Regional severe weather plans set out coordinating actions for organisations and individuals.
- The [Health & Safety Executive](#) provide guidance for working in hot weather.

#### Action

- NI Direct website provides advice on [heatwaves](#), and [looking after yourself in very hot weather](#), as well as the [UK Health Security Agency](#), [NHS](#), [Met Office](#), [Age UK](#) and [British Red Cross](#).

### ADVICE FOR DURING A HEATWAVE



Look out for those who may struggle to keep themselves cool and hydrated. Older people, under 5's, those with underlying conditions and those who live alone are particularly at risk.



Never leave anyone in a closed, parked vehicle, especially infants, young children or animals.



Close curtains on rooms that face the sun to keep indoor spaces cooler. It may be cooler outdoors than indoors.



Walk in the shade, use cool spaces, apply sunscreen and wear a wide-brimmed hat, if you have to go out in the heat.



Drink plenty of fluids and avoid excess alcohol.



Avoid physical exertion and try to keep out of the sun between 11am to 3pm, when the UV rays are strongest.

More information can be found on the [Met Office website](#).

### BUILDING LONGER TERM URBAN HEAT RESILIENCE

The [UK Climate Change Risk Assessment](#) sets out actions for the next 5 years to tackle risks from high temperatures:

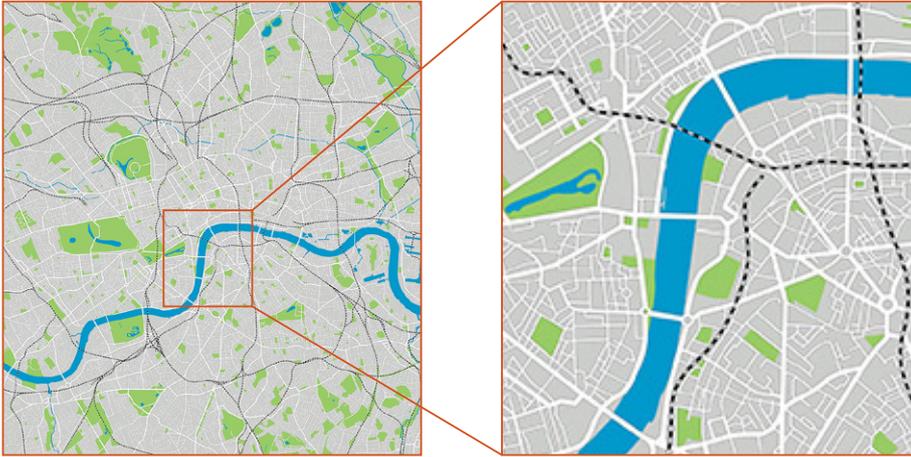
- Updating building regulations to address overheating.
- Retrofitting of existing buildings e.g. green roofs, shading, reflective surfaces.
- Coordination between decarbonisation and adaptation strategies.
- Adaptation reporting by businesses and collection of business continuity information.
- Implementing green infrastructure.
- Mainstreaming climate change adaptation into planning and design of new transport infrastructure.

Belfast City Council have a number of plans to address climate change impacts within the city, including heat risks:

- [Belfast Resilience Assessment](#)
- [Belfast Resilience Ambitions: A climate plan for Belfast](#)
- For further information see the [Council's action on climate change page](#).

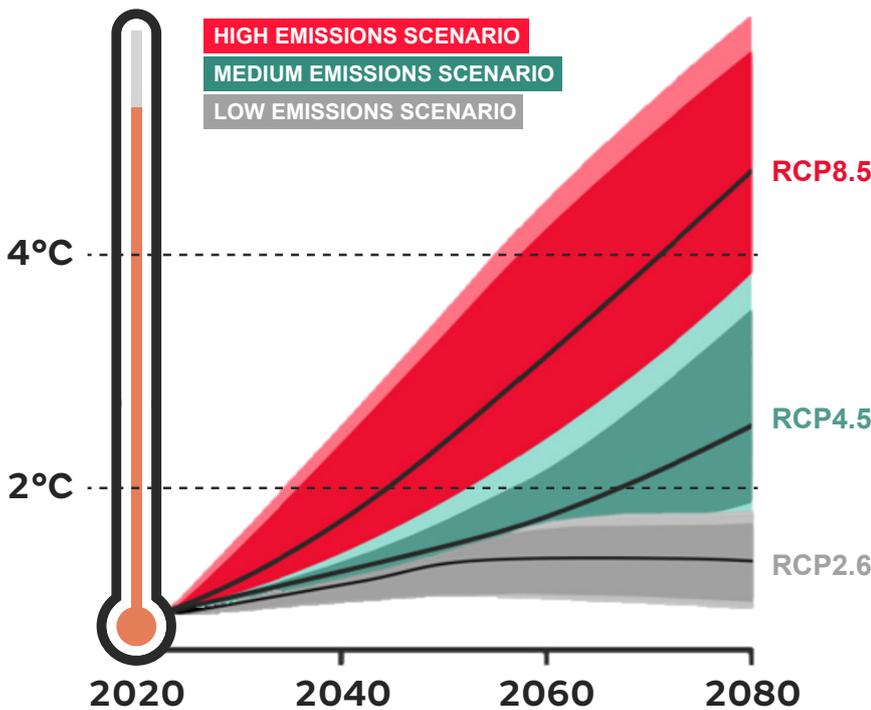
## THE SCIENCE BEHIND THE HEAT PACK

Local-scale information from high resolution climate projections are extremely useful for understanding climate change in cities. This Heat Pack uses the Met Office’s state of the art high resolution UK Climate Projections (UKCP Local) to understand how heat hazards may change in UK cities over the 21st century.



The UKCP Local projections include a more detailed urban land surface compared to other climate model projections, giving a better representation of urban climate effects, such as the urban heat island.

UKCP Local is driven by the Met Office’s Hadley Centre Global Climate model, which has a higher climate sensitivity to greenhouse gases compared to other models and therefore tends to be on the warmer end of the warming climate response. Furthermore, UKCP Local is driven by a high emissions scenario called RCP8.5. This represents a future where global greenhouse gas emissions continue to grow beyond current policy commitments, leading to a large global temperature rise sooner rather than later under lower emissions scenarios as illustrated below. The heat pack therefore helps decision makers adopt a precautionary approach.



UKCP Local provides information for two future time periods, 2021-2040 and 2061-2080, which reflect global warming levels of 2°C and 4.5°C warming, respectively.

The Committee on Climate Change (CCC) advises the UK to adapt to a 2°C rise in global temperatures, whilst assessing the risk for 4°C\*.

The Heat Pack therefore provides a useful comparison of impacts that could be expected at 2°C and at a more precautionary 4.5°C.

Graph for illustrative purposes only.

\*Committee on Climate Change (2021) Independent Assessment of UK Climate Risk.

Available at: <https://www.theccc.org.uk/wp-content/uploads/2021/07/Independent-Assessment-of-UK-Climate-Risk-Advice-to-Govt-for-CCRA3-CCC.pdf>

## FIND OUT MORE

### Current Trends in UK Climate

Latest State of the UK Climate 2020 report:

<https://www.metoffice.gov.uk/research/climate/maps-and-data/about/state-of-climate>

### Future Trends in UK Climate

UK Climate Projections Headline Findings report:

<https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp-headline-findings-v2.pdf>

### Observation data used in climate stripes

HadUK Grid:

<https://www.metoffice.gov.uk/research/climate/maps-and-data/data/haduk-grid/haduk-grid>

### UK Climate Projections (UKCP) Local 2.2km

<https://www.metoffice.gov.uk/research/approach/collaboration/ukcp/index>

<https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-factsheet-local-2.2km.pdf>

Convection-permitting model projections – science report:

<https://www.metoffice.gov.uk/pub/data/weather/uk/ukcp18/science-reports/UKCP-Convection-permitting-model-projections-report.pdf>

UKCP18 Science Overview Report:

<https://www.metoffice.gov.uk/pub/data/weather/uk/ukcp18/science-reports/UKCP18-Overview-report.pdf>

### Extreme Heat Indicators

Public Health England (2018) Heatwave Plan for England

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/888668/Heatwave\\_plan\\_for\\_England\\_2020.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/888668/Heatwave_plan_for_England_2020.pdf)

London Climate Change Partnership / Environment Agency (2012) Heat Thresholds Report

[http://climatelondon.org/wp-content/uploads/2013/01/LCCP\\_HeatThresholds\\_final-report-PUBLIC.pdf](http://climatelondon.org/wp-content/uploads/2013/01/LCCP_HeatThresholds_final-report-PUBLIC.pdf)

Public Health England (2020) Heatwave mortality monitoring report: 2020

<https://www.gov.uk/government/publications/phe-heatwave-mortality-monitoring/heatwave-mortality-monitoring-report-2020>

N.W. Arnell, A.L. Kay, A. Freeman, A.C. Rudd, J.A. Lowe, (2021) Changing climate risk in the UK:

A multi-sectoral analysis using policy-relevant indicators. Climate Risk Management, Vol 31

<https://doi.org/10.1016/j.crm.2020.100265>

## FUNDING

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