Urban Climate Change and Climate Services

Claire Scannell, Urban Climate Services, Met Office
Elizabeth Kendon, Understanding Climate Change, Met Office
Lucy Vilarkin, Sustainability Project Manager (Climate Adaptation), Bristol City Council

16/12/2020

Met Office

UK Research and Innovation

UK CLIMATE RESILIENCE PROGRAMME

Overview

1. Urban Climate Services – Claire Scannell
2. Urban Climate Change – Lizzie Kendon
3. User Response – Lucy Vilarkin

Met Office

UK Research and Innovation

Urban Climate Services

Claire Scannell
Victoria Ramsey
Elizabeth Fuller
Rebecca Parrfit

- Why do we need Urban Climate Services?
- Creating Urban Climate Services
- Current Urban Climate Services
- Future plans

Met Office

UK Research and Innovation

Why Do We Need Urban Climate Services?

UK CLIMATE RESILIENCE PROGRAMME

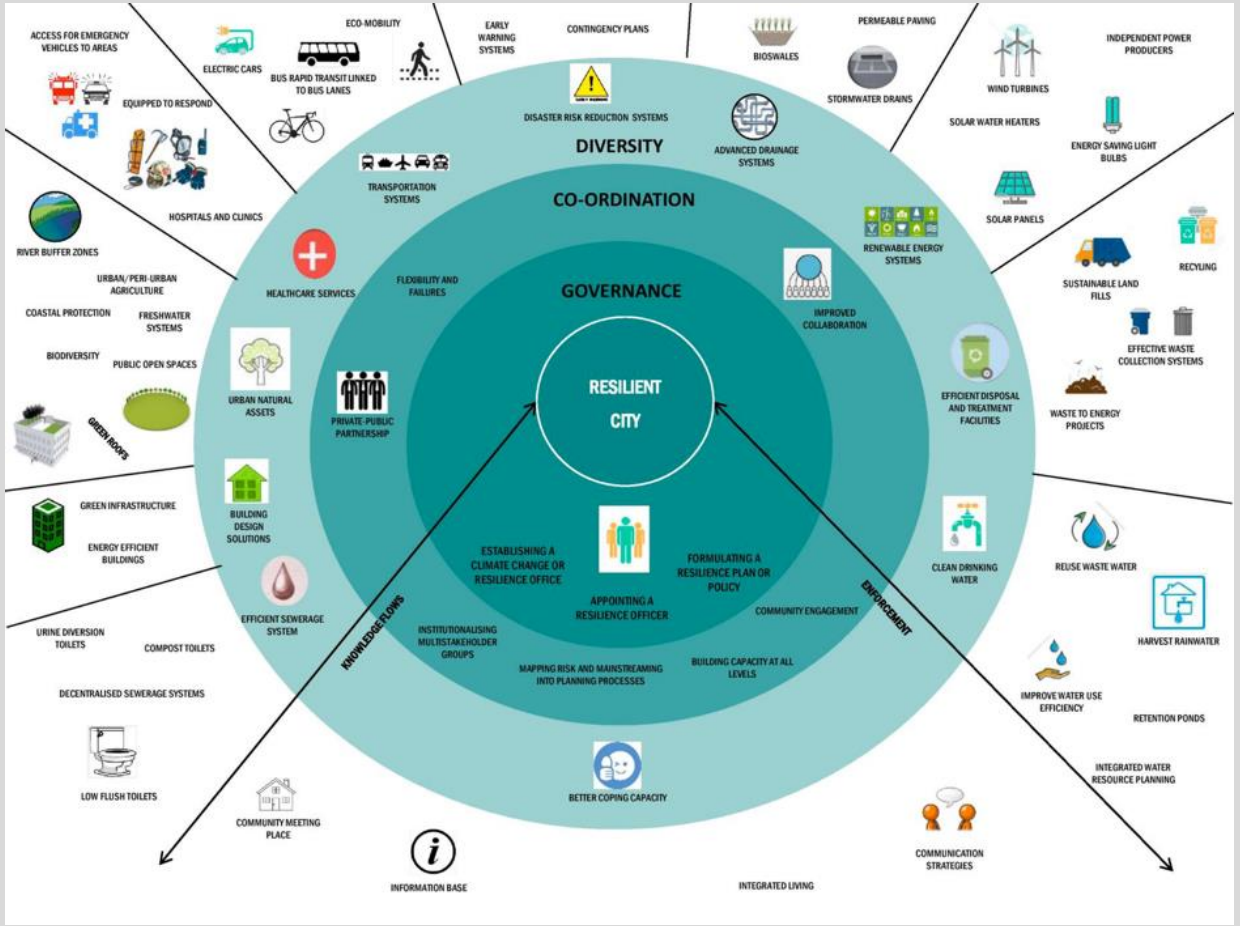
Complex, interconnected systems with vastly varying degrees of risk, resilience and vulnerability

Cities are particularly vulnerable to climate change

The effects of climate change can often be **amplified** within the urban environment compared to the surrounding country side (Urban Heat Island)

The financial effects of climate change can be just as devastating as the physical ones.

URBAN GROWTH SHOWS NO SIGN OF SLOWING



Met Office

UK Research and Innovation

Creating Urban Climate Services: Key Components

Key Components for creating urban Climate Services

1. **Pull through of underpinning and emerging science**

2. **Co-Production and Co-Development**

Creating Urban Climate Services: Co-Production

UK CLIMATE RESILIENCE PROGRAMME

A shift from one-way push of scientific information to a two-way collaborative process of knowledge construction & sharing

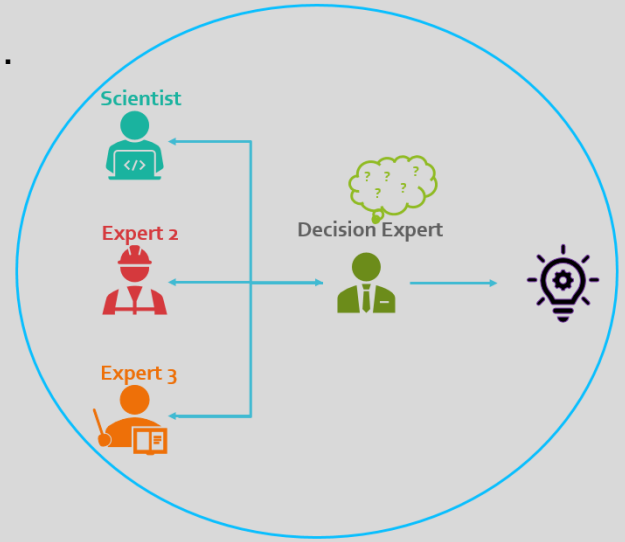
Easy & Quick

Complicated & Time intensive

WHY?

1.
I want to produce a service that not only presents climate information in a way that is understandable and interpretable but also in a way that is relevant to the decisions that need to be made.

2.



3.
Sustainability
Reach

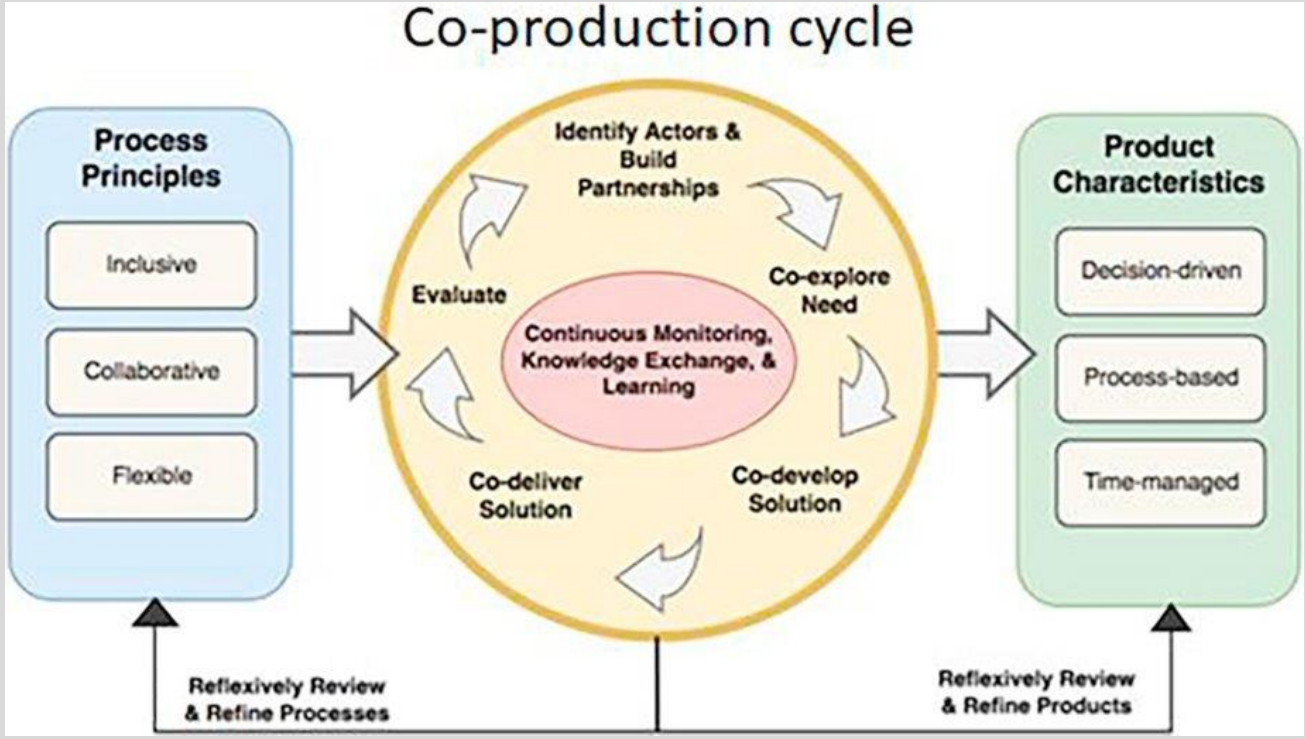
Met Office

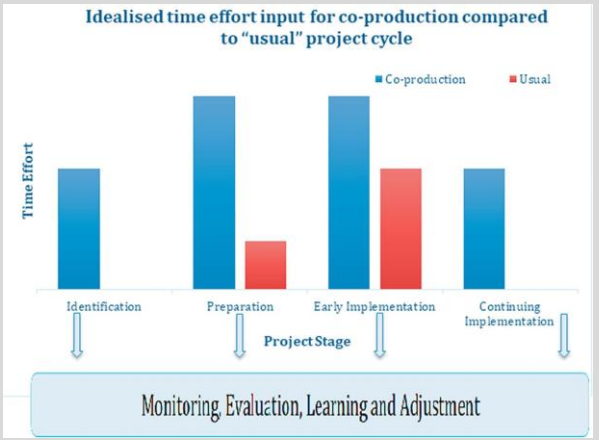
UK Research and Innovation

Creating Urban Climate Services: Co-Production

UK CLIMATE RESILIENCE PROGRAMME

APPROACH





(Vincent et al., 2018)

Met Office

UK Research and Innovation

UK CLIMATE RESILIENCE PROGRAMME

Urban Climate Services

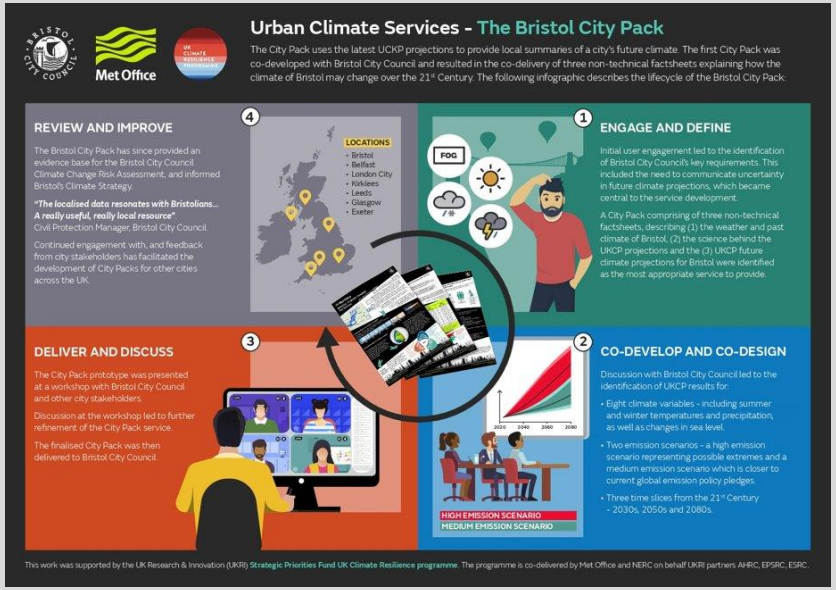
City Pack

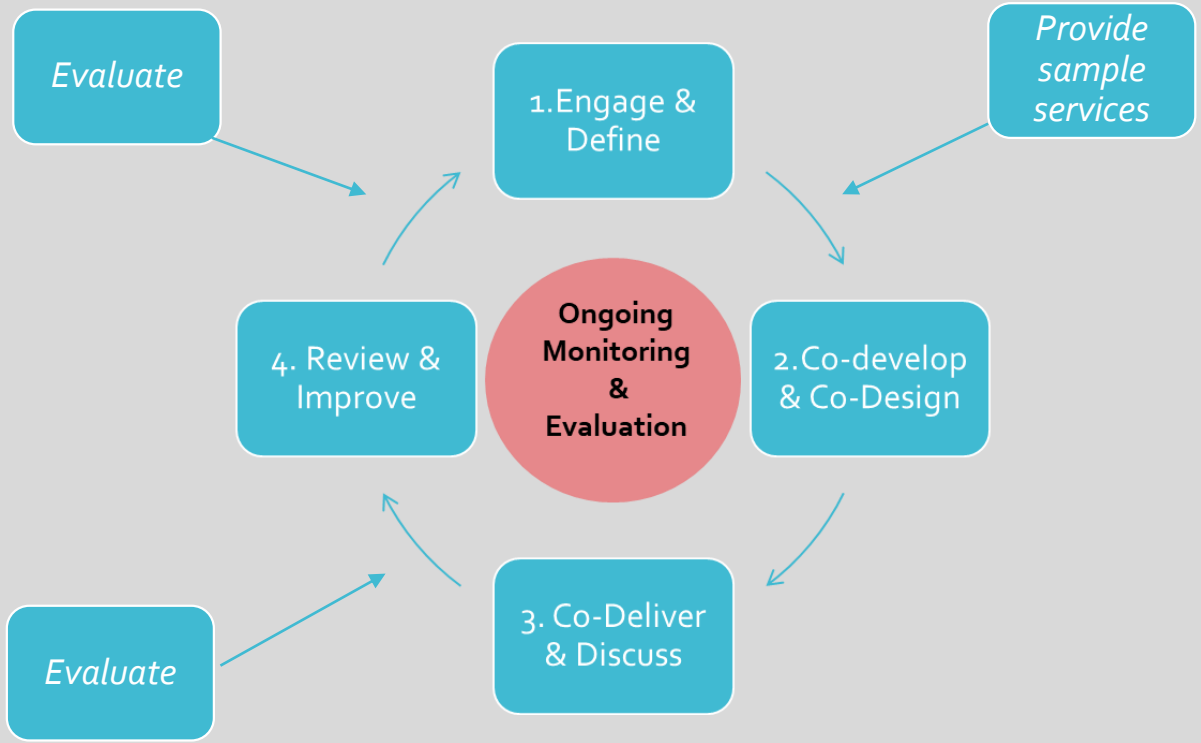
Other Services

Met Office

UKRI UK Research and Innovation

Bristol City Pack: Approach

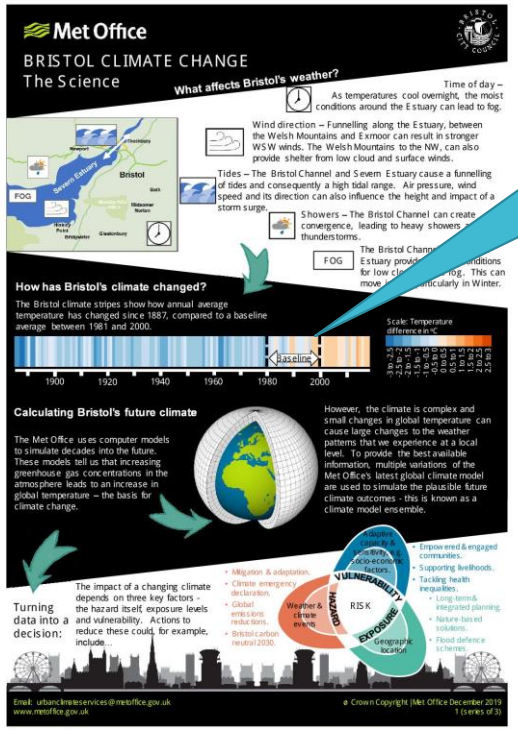




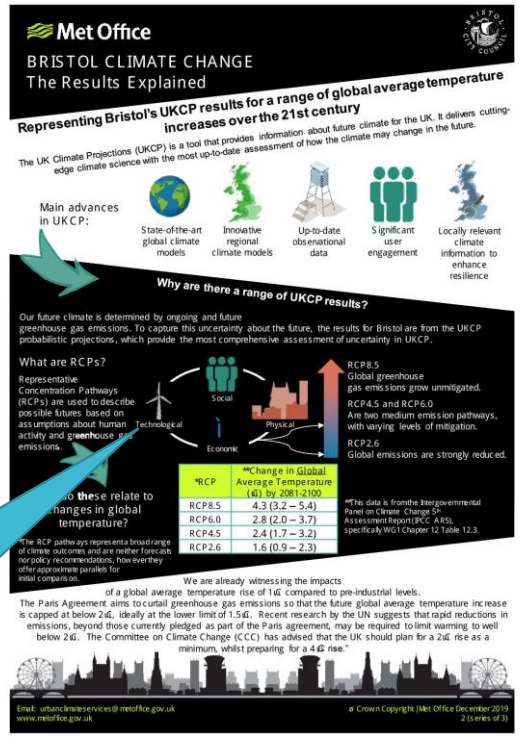
User Requirements:

- Build a collective understanding of future climate change for Bristol within the council
- Communicate uncertainty in climate projections

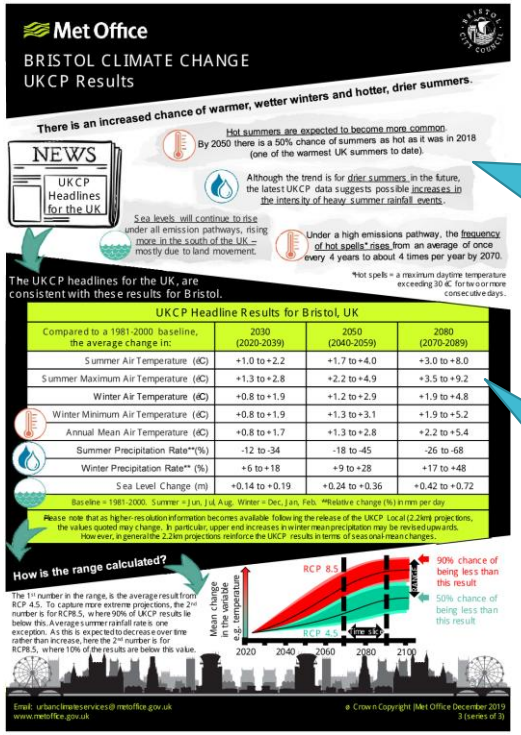
Bristol City Pack



Climate stripe illustrating current climate trends in the city



High level information on how climate projections are developed



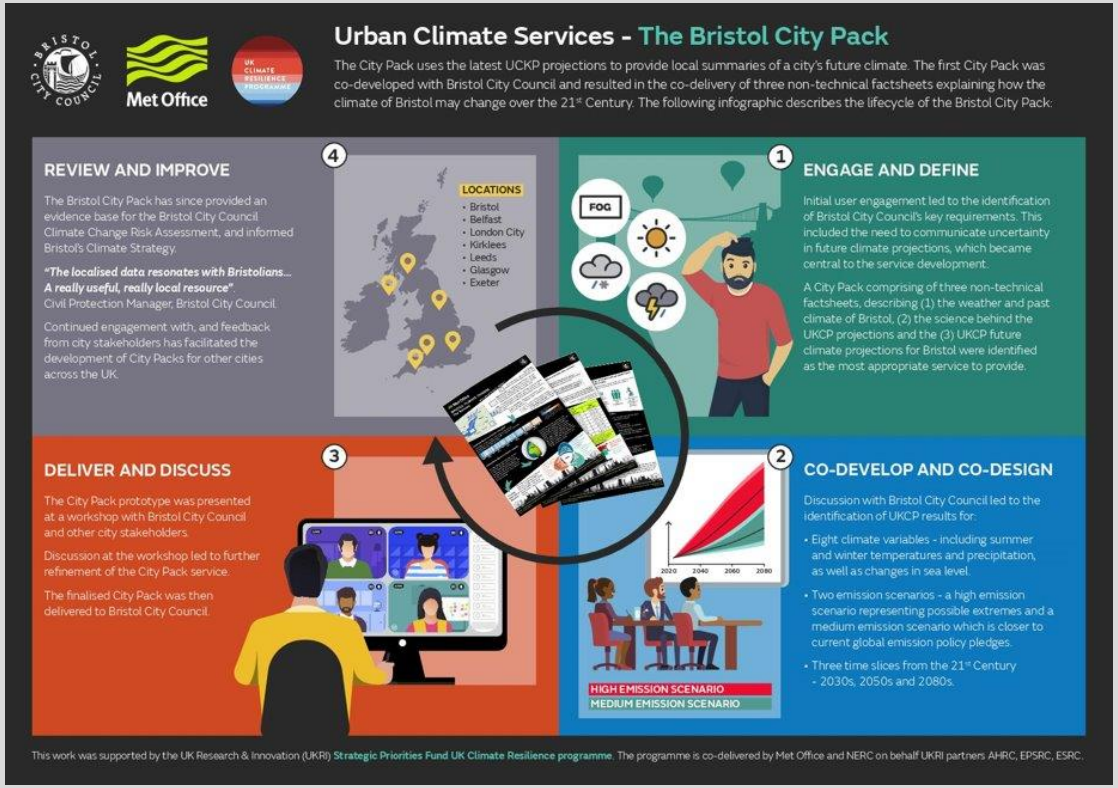
Headline statements of future climate change in wider region to provide context

Future changes in temperature, rainfall and sea level rise at city level

Met Office

UK Research and Innovation

Bristol City Pack: Feedback



'The Climate Change fact sheets for Bristol have allowed us to engage a wide range of city stakeholders in climate change issues…A really useful, really local resource.'

Civil Protection Manager, Management of Place, Bristol City Council

Met Office

UK Research and Innovation

Bristol City Pack: What Next?

- A few further city packs to be produced
- Feedback questionnaire
- How can we make these reproducible and useful across the UK?
- Future version may look quite different

Current Services : Urban Heat Service

- Heat is one of six priority areas identified in UK Climate Change Risk Assessment (2017) where more action is needed.
- Recent heat events in UK – Summer 2018, July 2019, July & August 2020
- Cities are particularly vulnerable to heat
- UKCP local dataset @ 2.2km
- Pull-through some novel science into service

The Urban heat island effect that causes cities to be warmer than surrounding rural areas can increase already high background temperatures.

Greater population exposure to extreme heat events due to the concentration of people in cities

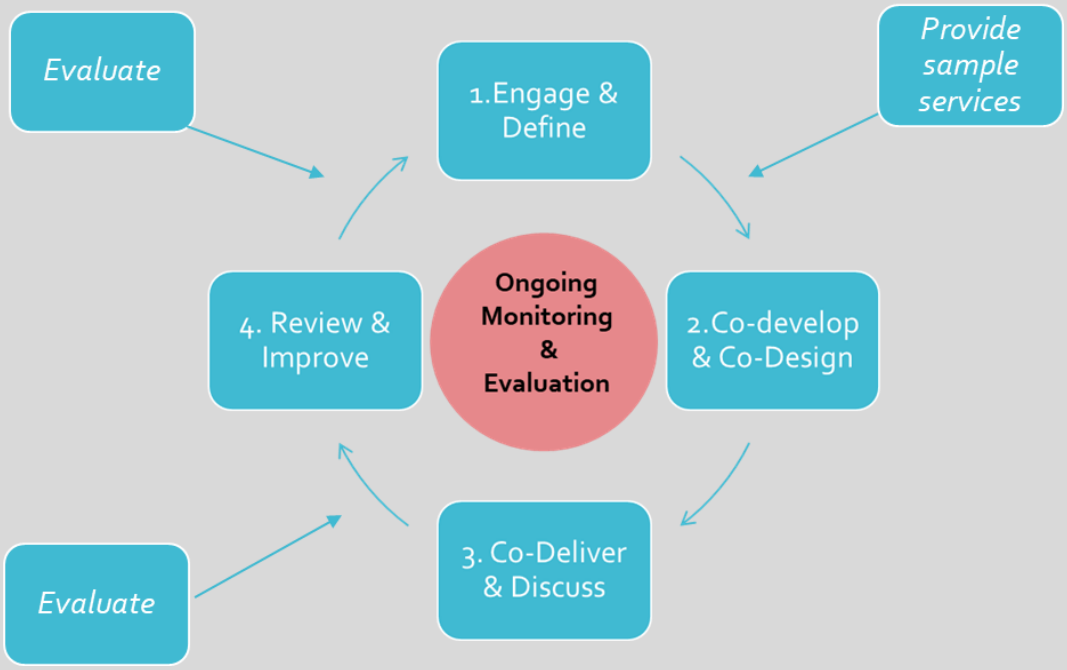
Cities are home to many valuable assets such as transport hubs, key government buildings, and infrastructure networks, increasing the exposure of assets to extreme heat.

Heat emissions from air conditioning units and transport in the city can add excess heat into urban environments.

Met Office

UK Research and Innovation

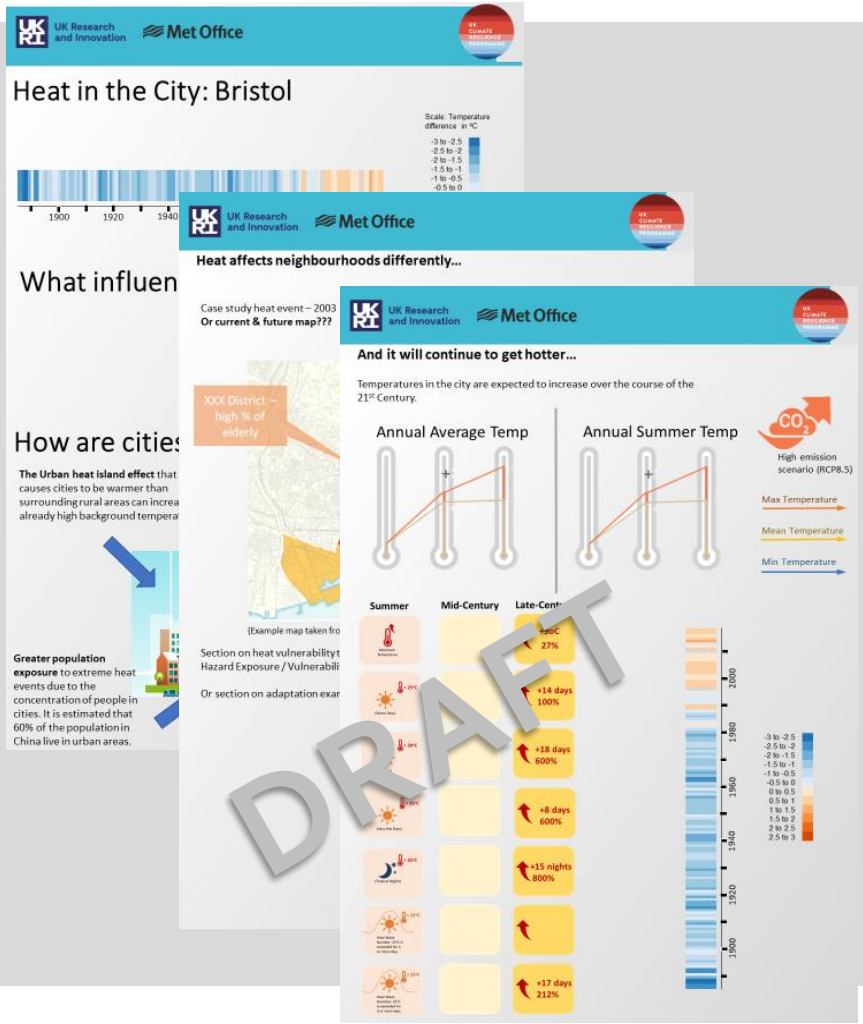
Urban Heat Service: Approach



User Requirements:

- Evidence base of the heat hazard
- Identification of hot spots within the city for further action
- City specific vulnerabilities – health, built environment, social housing and social vulnerability

Urban Heat Service: Tier 1



An increase in heatwaves can put the most vulnerable within the city at risk

An increase in the number of hot days can put pressure on city services due to increased energy demand for cooling and increased water demand.

E.G. An increase of hot days can cause buckling of trainlines and roads to melt (needs rewording)

A rise in tropical night can have significant health impacts as there is little relief from hot day time temperatures

High level city specific information related to future heat changes

Heat indices such as ETCCDI (changes in max/mean temp, # of days exceeding certain temperatures, consecutive hot days & nights

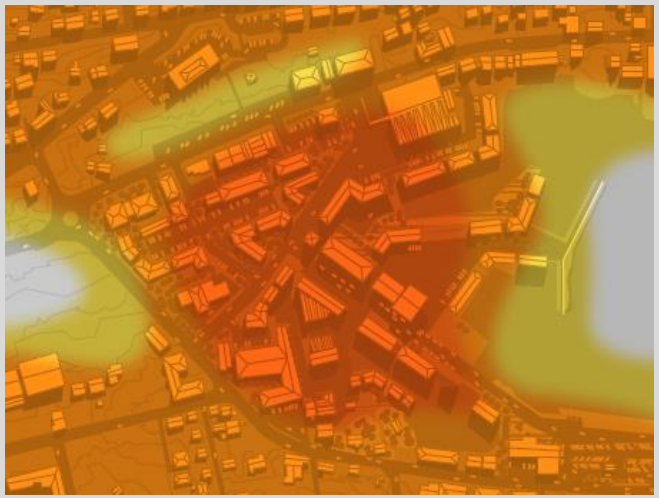
UKCP Local for UK cities

Graphical

Urban Heat Service: Tier 2

UK CLIMATE RESILIENCE PROGRAMME

- User driven based on a city specific requirement
- Examine heat relationships to health, built environment or other socio-economic vulnerability identified by the city
- Requires user engagement and buy in
- Map/GIS based



Met Office

UK Research and Innovation

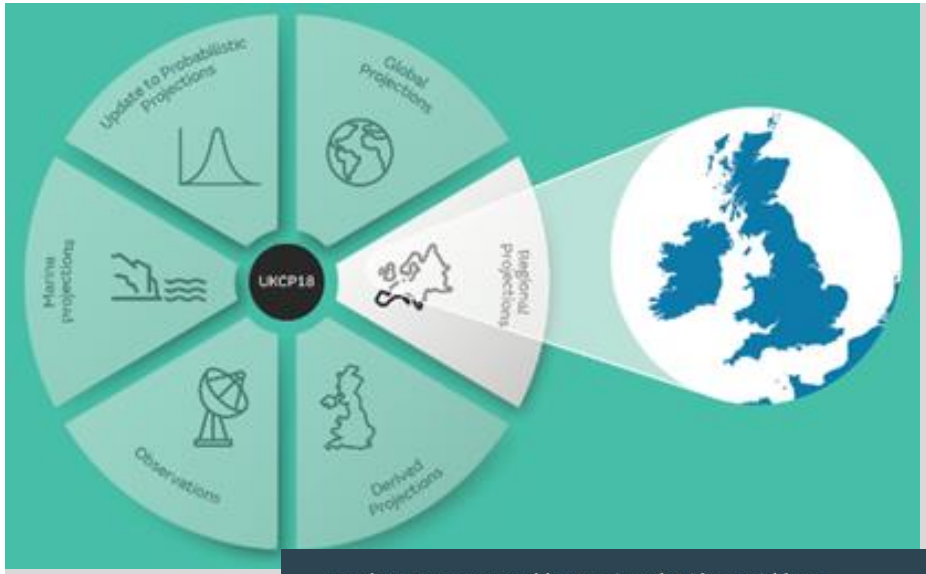
Future Plans

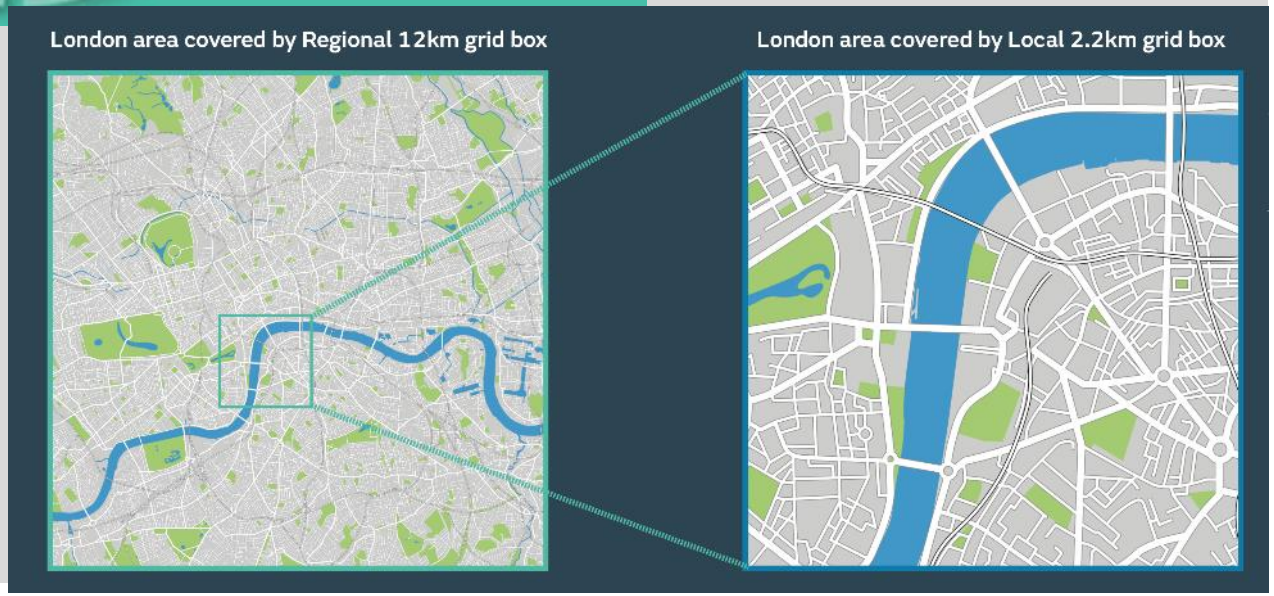
- Further develop current offering
- Explore new services – coastal cities? Drought? Multiple hazards?
- Strengthen the decision support interface
- Identify and address gaps and limitations
- Pull-through and drive future science for service development

UK CLIMATE RESILIENCE PROGRAMME

SPF Climate Resilience: New understanding of climate change over cities

Lizzie Kendon
Will Keat

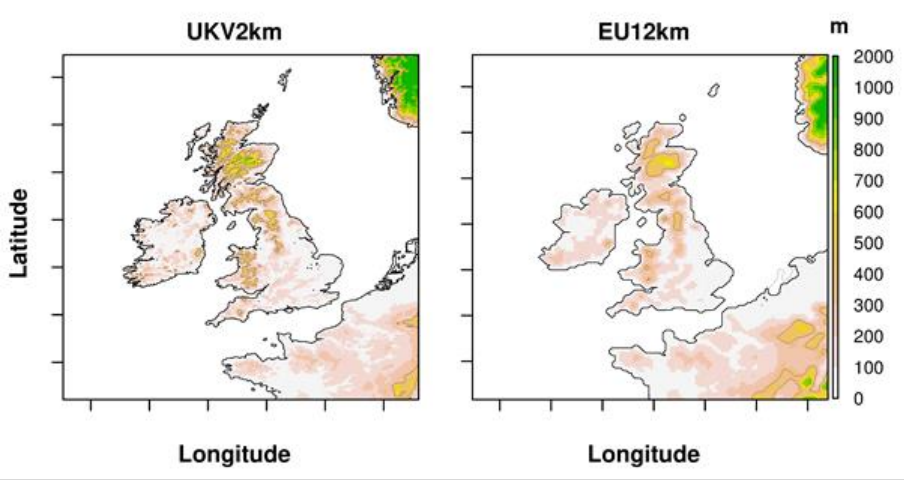




Met Office

UK Research and Innovation

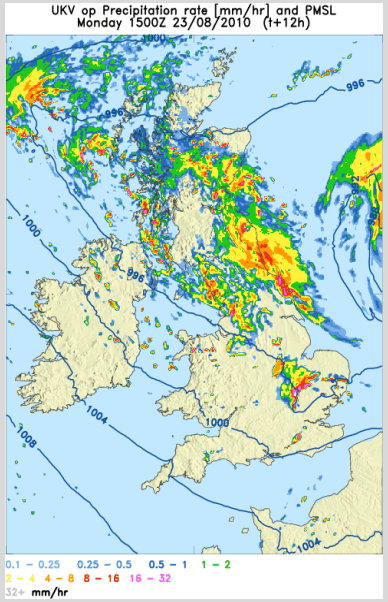
UKCP Local (2.2km) projections



UKCP 2.2km ensemble

- 2.2km resolution for UK
- 12 members
- Driven by 12km RCM
- Data for 1981-2000, 2021-40, 2061-80
- High emissions scenario RCP8.5

New set of 12 climate projections using a model as detailed as that typically used for weather forecasts.



New estimates of changes in daily and hourly extremes
- Storms
- Summer downpours
- Severe wind gusts

Supports UK risk assessments

Hydrological impacts modelling e.g. flash floods

Climate change for cities e.g. urban extremes

First national climate scenarios at convection-permitting scale

Met Office

UK Research and Innovation

How much might hot summer days warm?

Hot summer days will warm more than the summer average

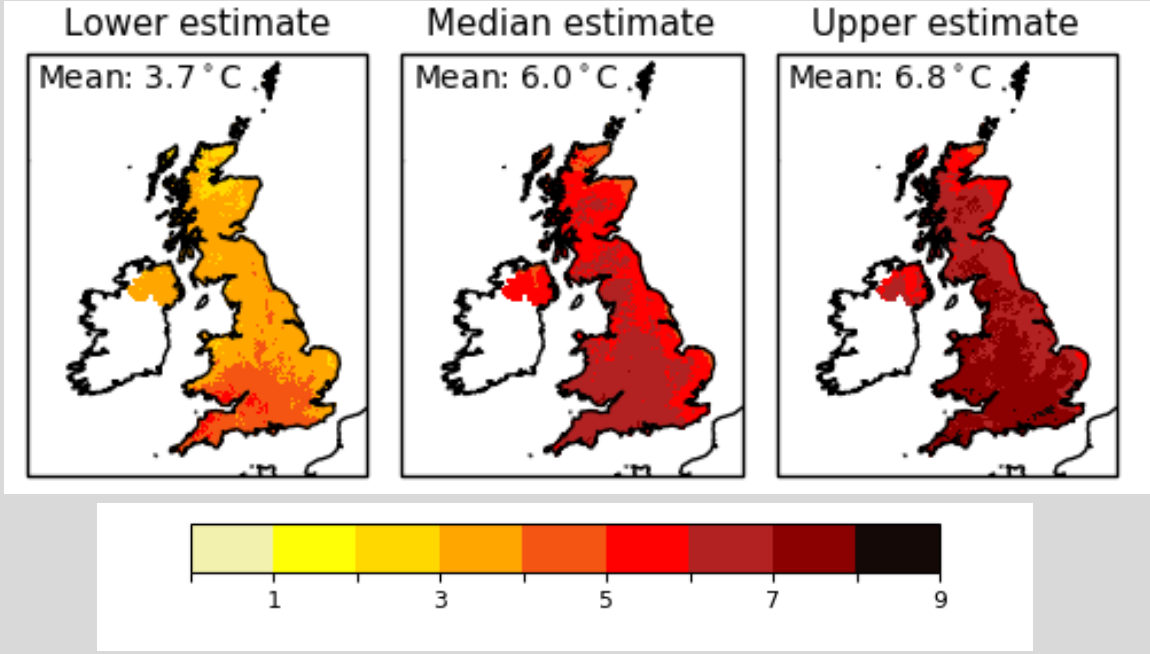
- Range is 3.7 to 6.8ºC

Hot summer days warm more than cold winter days

Hot spells (exceeding 30ºC for 2+ days) become 16 times more frequent by 2070s compared to 20 years ago.

Results for RCP8.5. Changes approx. halved for RCP2.6

Local (2.2km) reinforces Regional (12km) for UK picture, but adds local detail



Projected changes to 2061-2080 for RCP8.5 (ºC)

Local (2.2km) provides detail on how temperatures will warm across UK

Met Office

UK Research and Innovation

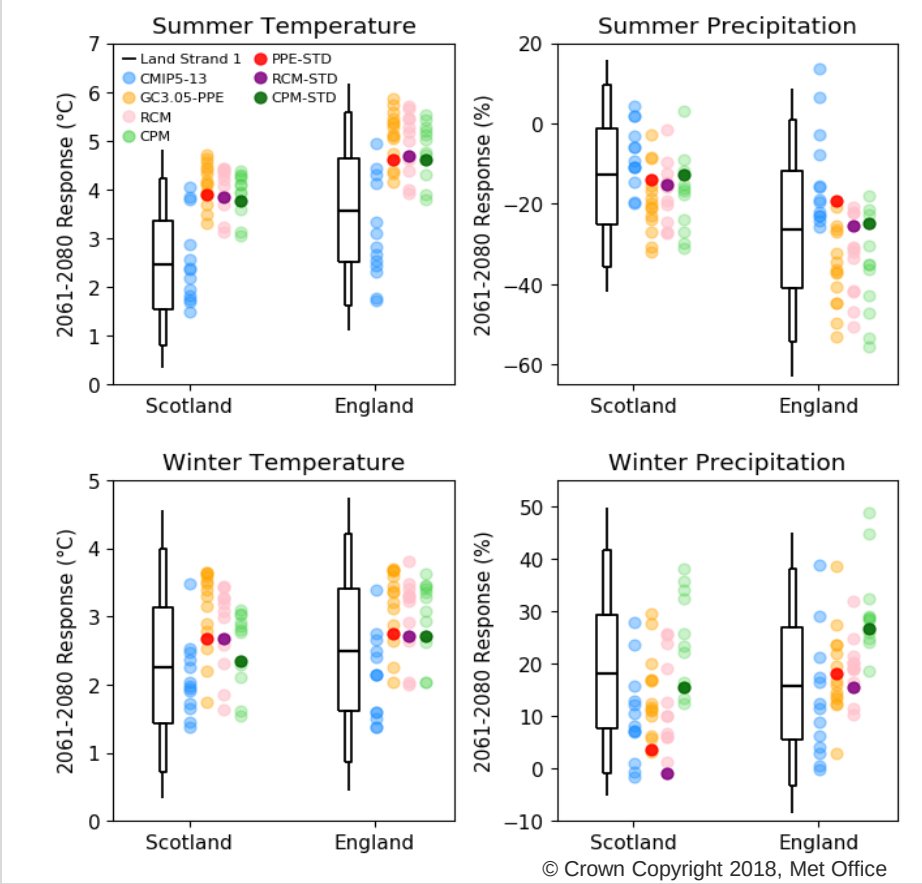
Uncertainty in future changes across UKCP18 products

Local 2.2km projections for first time sample uncertainty in future changes at local and hourly scales.

Local 2.2km projections (green) only downscale Hadley Centre models (yellow = global, pink = 12km) that simulate relatively high levels of global warming.

In summer, Hadley Centre models sample warmer drier outcomes compared to CMIP5 (blue). In winter, 2.2km shows greater increase in winter precipitation compared to driving 12km. For one member, increase is outside 5-95% range from probabilistic projections.

Projected changes to 2061-2080 for RCP8.5

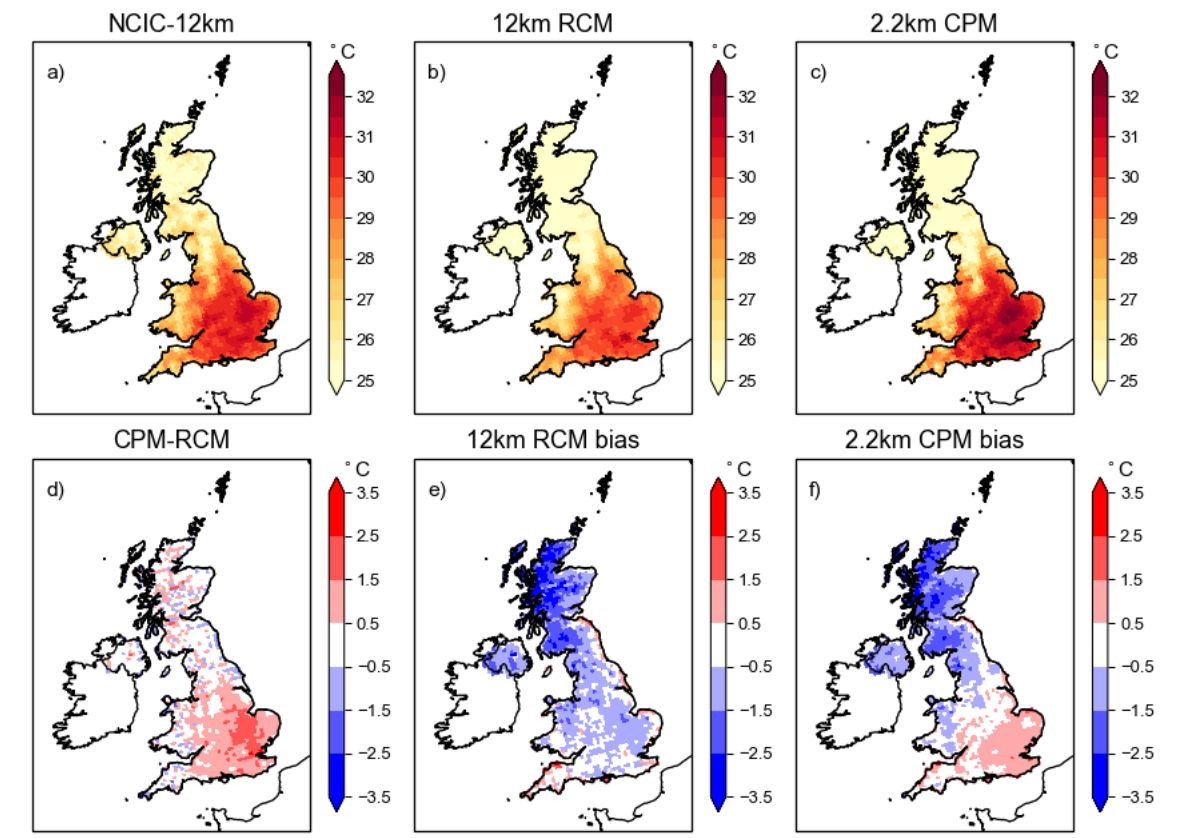


Local (2.2km) projections do not sample full uncertainty range

Met Office

UK Research and Innovation

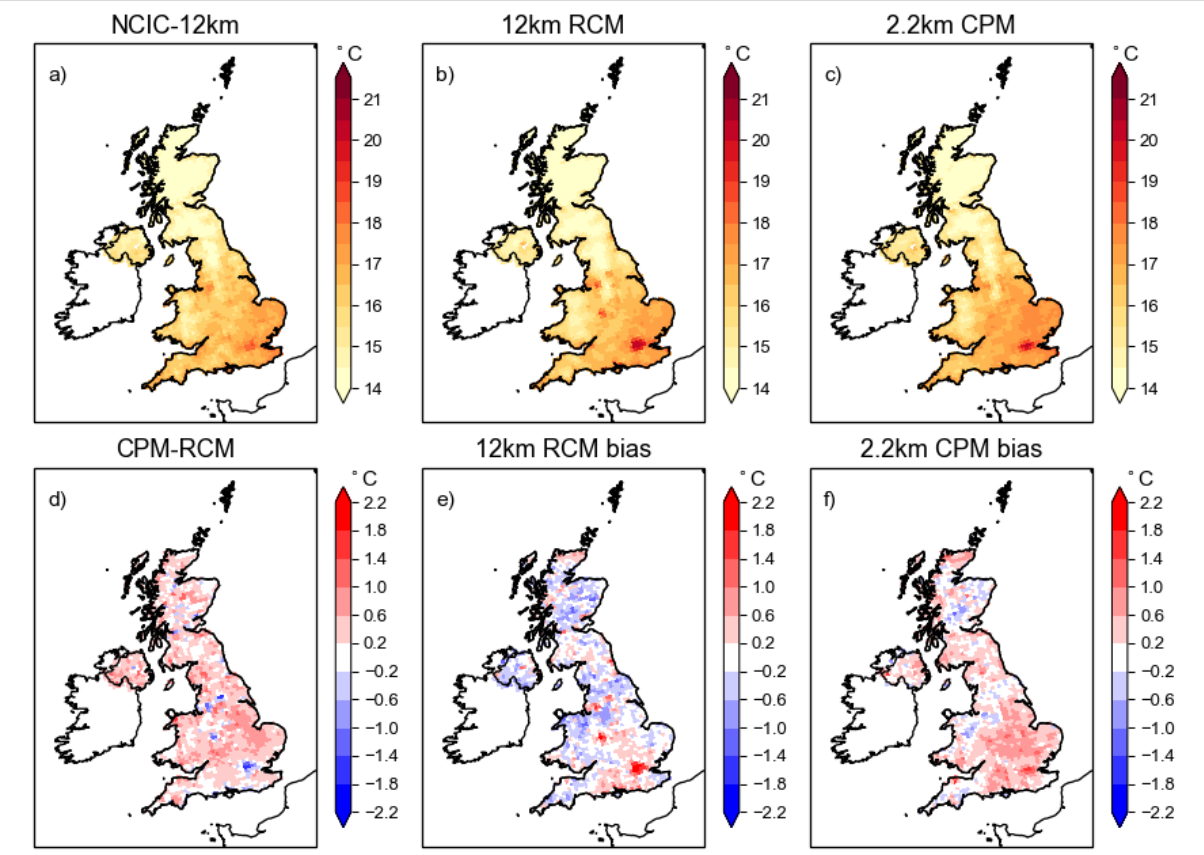
Urban temperature extremes in UKCP Local



Present-day hot summer days

- Large differences in representation of urban temperature extremes between UKCP Regional 12km (RCM) and Local 2.2km (CPM) projections
- Hot summer days are warmer in 2.2km CPM, in better agreement with observations

Urban temperature extremes in UKCP Local



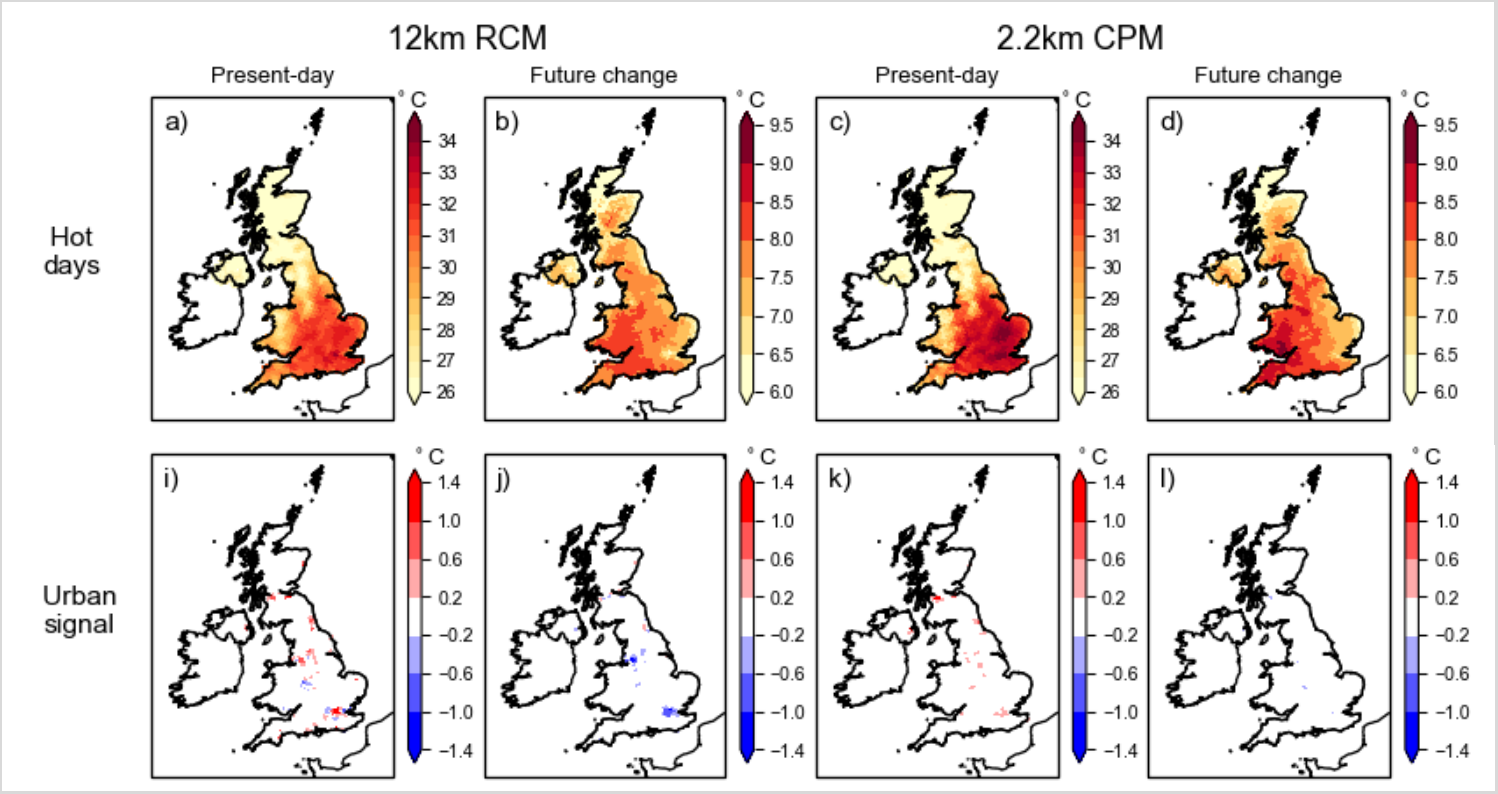
Present-day warm summer nights

- In RCM, night-time temperatures over cities too high
- 2.2km CPM giving better representation of warm nights compared to observations

Met Office

UK Research and Innovation

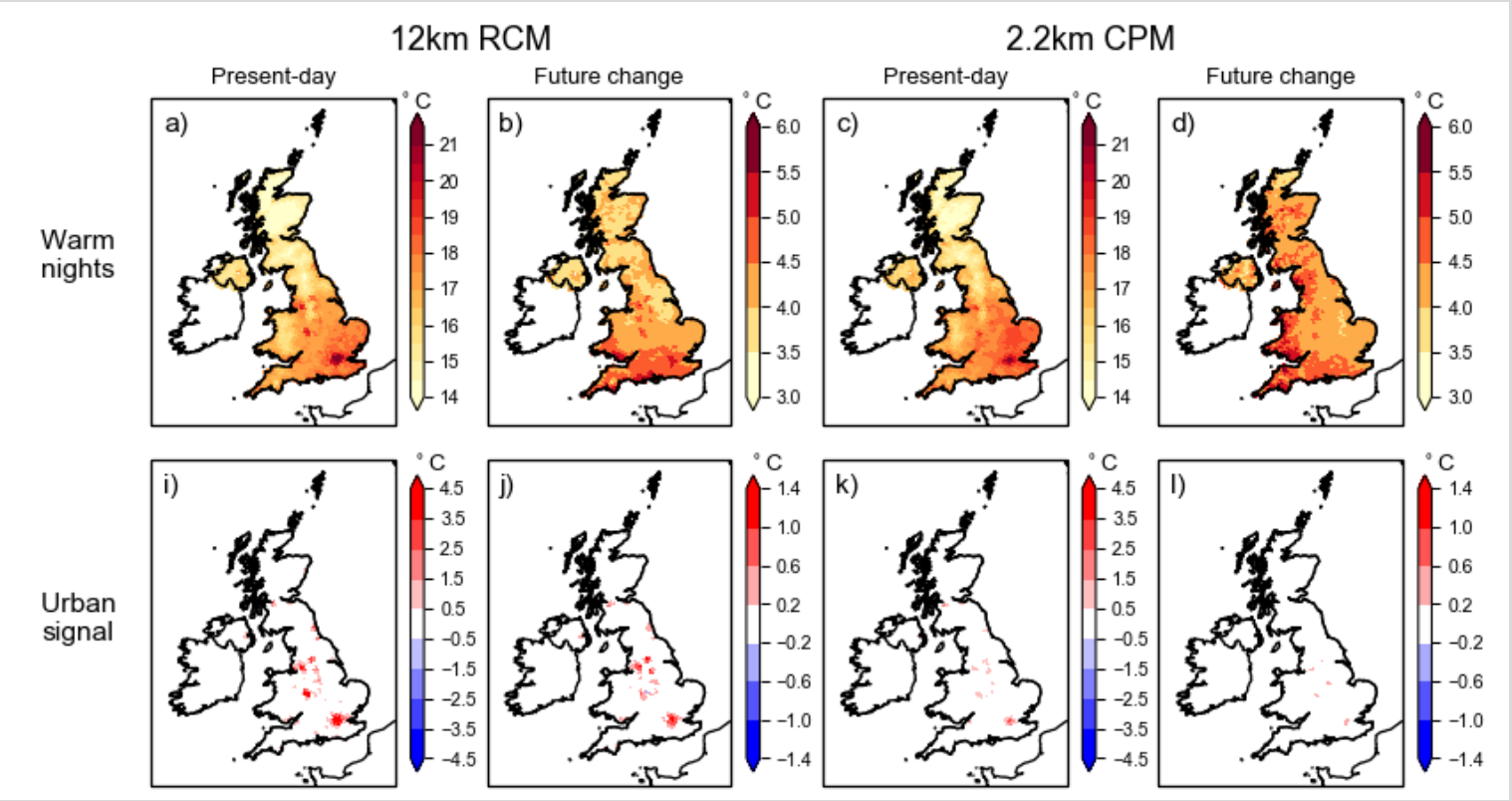
Urban contribution to hot days



- New methodology to extract urban influence on temperature
- Stronger urban signal in RCM, but daytime UHI seen to decrease in future
- Greater future increase in rural background on hot days in CPM v RCM
- Little change in daytime UHI in future in CPM

Urban contribution to summertime hot days and their future change

Urban contribution to warm nights

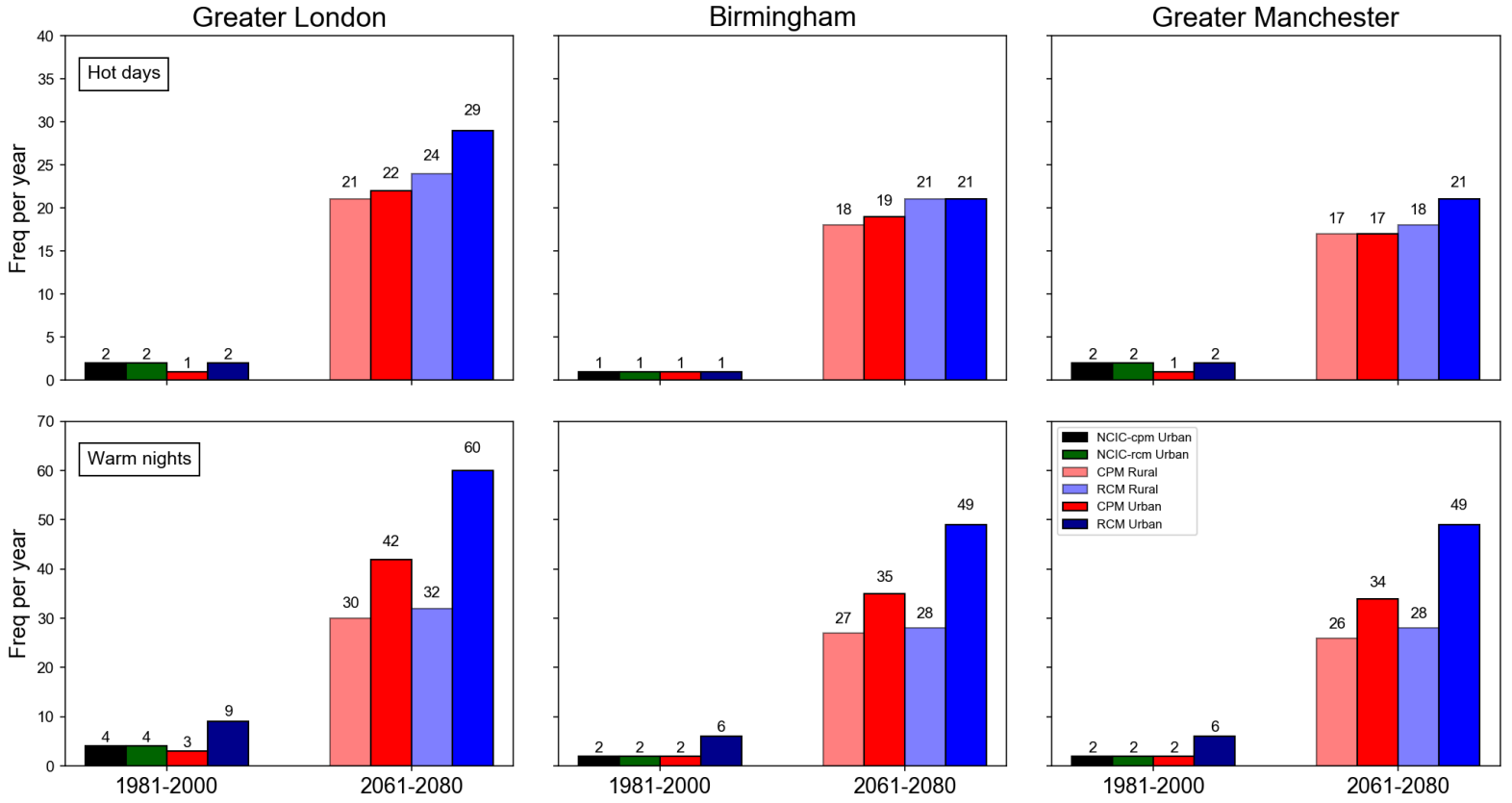


- UHI effect is more pronounced at night
- Stronger urban signal in RCM, and night-time UHI seen to increase in future
- Greater future increase in rural background on warm nights in CPM v RCM
- Little change in night-time UHI in future in CPM

Urban contribution to summertime warm nights and their future change

Future frequency of hot days and warm nights

Frequency of hot days and warm nights for three cities.



Met Office

UK Research and Innovation

Future Plans

- Develop process-based understanding of CPM-RCM UHI differences, allowing assessment of reliability of future projections
  - Underlying scientific knowledge to support Bristol heat prototype
- Extend to precipitation, assessing urban influence on convective storms and future changes in hourly extremes.
  - Feeds into planned work on city rainfall prototypes, with urban areas prone to flash flooding
- Guidance on strengths and limitations of different UKCP18 products for urban climate services
  - Advise on where need high resolution projections and how to provide wider uncertainty context
- New UKCP Local (2.2km) projections downscaling CMIP5 models and multi-model CPM information from EUCP
  - Better sampling of uncertainty feeding into urban climate services
- Develop methods to synthesize information from new convection-permitting projections with larger global model ensembles

User Response

Lucy Vilarkin
Climate Change & Sustainable City Service
Bristol City Council

- How it all started
- How we've worked together
- Reflections: Successes & Lessons
- Reflections: Support for decision makers

Met Office

UK Research and Innovation

How it all started…nearly three years ago

- **Context** - Bristol's strong track record climate action result many forces incl. partnership working across city & links two universities
- **First contact** - Cabot Institute put us in touch with Met Office after approach regarding provision climate services & talking to cities about climate info needs
- **World class expertise** - Recognised huge potential closer working with Met Office – access expertise & climate data to support climate resilience
- **Perfect timing** – imminent release UKCP18 plus early explorations into UHI & building urban heat evidence base
- **Challenge** – UKCP09 lessons navigate complexity, bridge gap between science & practitioner & maximising utility for Bristol

Met Office

UK Research and Innovation

How we've worked together so far

- **Defining BCC needs** – evolves with time – articulate Bristol's climate challenge, address heat risks & effective use Met Office data/services
- **Produced climate factsheets** - Bristol UKCP18 headlines – used in Bristol Preliminary Climate Resilience Assessment part of evidence base for One City Climate Strategy
- **Supported events** – trusted voice - heat vulnerability workshops – practitioners & politicians
- **Filling evidence gap heat risks** – UKCP Local data hot off press and support development Urban Heat Resilience Plan, lead by UKCRP funded researcher – link problem areas, services/functions & adaptation solutions
- **Community of practice** – invitation to Core Cities Adaptation Working Group – urban climate services workshop Winter/Spring 2021
- **Future plans** – feed into BCC climate training, Climate Hub website, vulnerability mapping portal Bristol Climate Atlas etc.

Reflections: successes & lessons

- **How we work together** - as important as the science - long-term partnership – understand each others perspective, flexible scope, safe environment to ask 'stupid' questions, benefits of sustained engagement
- **Get balancing act right** – simplicity & scientific integrity – more icons, fewer graphs/tables in communicating climate risks – create derivatives & develop narrative
- **Testing prototypes** – finding out what approaches works best, drawing more voices into process - benefits of wider CC programme and other structures e.g. ISO14001, groundwork paves the way for testing phase
- **Innovation & experimentation** - early versions critical step but likely to evolve
- **Right data, right job** – still learning how data can support building climate resilience LA and city

Reflections: support for decision makers

- **Local context:** Recognise similarities between cities, but also differences - support current & planned initiatives – maximise impact
- **Climate services:** Recognise need for 'oven ready' services due to limited resources, effective & appropriate use
- **Entry points:** Identify plug-in points for LA services & be clear on nature of service e.g. comms piece – universal audience versus technical data – skilled users only
- **Fertile ground:** Recognise need for enabling conditions for change to be in place for traction
- **Wider system:** Identify areas which need influencing 'upstream' i.e. integrate climate data into regulations, design standards, guidance etc.

Contact details

Website: www.ukclimateresilience.org

Twitter: @UKCRP_SPF

YouTube: UK Climate Resilience programme

Met Office

UK Research and Innovation

UK CLIMATE RESILIENCE PROGRAMME

The UK Climate Resilience programme is supported by the UKRI Strategic Priorities Fund.
The programme is co-delivered by the Met Office and NERC on behalf of UKRI partners AHRC, EPSRC, ESRC.