Public Health England

Maths and Public Policy for Health and Society – 24th March 2015

Health Effects & Risks of Climate Change

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Public Health England

Public Health England

Our mission is to protect and improve the nation’s health and to address inequalities.

We work with national and local government, industry and the NHS to protect and improve the nation's health and support healthier choices. We are addressing inequalities by focusing on removing barriers to good health.

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Outline

- Climate Change & Air Pollution
- Climate Change & Extreme Events
- Health Protection Research Unit
- MED-MI

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HECC2012, CCRA, CCRA2, NAP

- **H**ealth **E**ffects of **C**limate **C**hange in the UK **2012** (HECC2012, edited by SV & CH)
- Co-authored Health Chapter of 1st **C**limate **C**hange **R**isk **A**ssessment (CCRA, SV)
- Authored Transport Chapter of CCRA (JET)
- Involved in Evidence for CCRA2
- Involved in **N**ational **A**daptation **P**rogramme (NAP) on Health Topics

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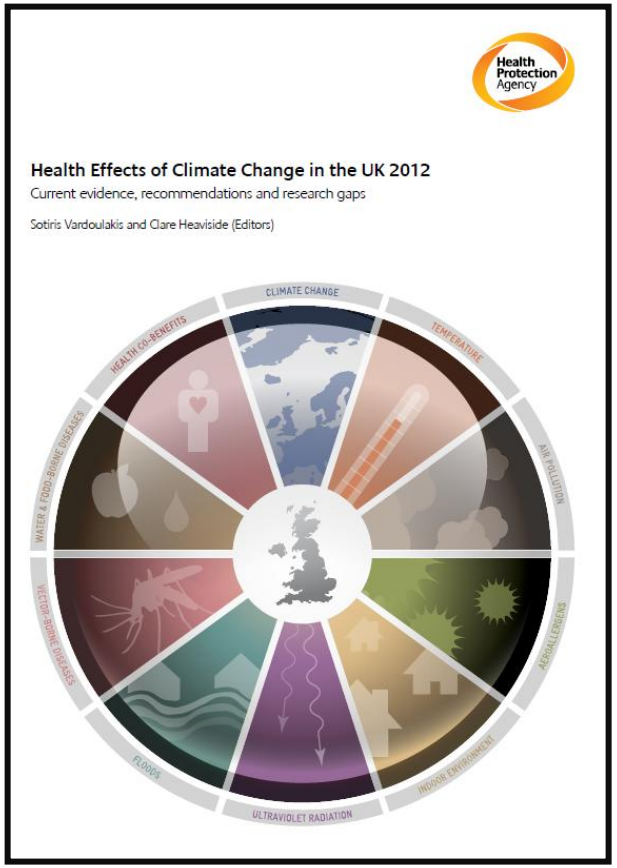
Health effects of climate change in the UK – Current evidence, recommendations and research gaps

1. Climate change in the UK: current evidence and projections
2. **Temperature effects of climate change on human health**
3. Health effects due to changes in air pollution under future scenarios
4. Effects of aeroallergens on human health under climate change
5. Health effects of climate change in the indoor environment
6. Climate change, ultraviolet radiation and health
7. **Health effects of flooding, and adaptation to climate change**
8. Effects of climate change on vector-borne diseases
9. Water and food-borne diseases under climate change
10. Health co-benefits of policies to reduce greenhouse gas emissions



UK 2012 | Climate Change Risk Assessment

Summary of the Key Findings from the UK Climate Change Risk Assessment 2012

Selection of impacts on…

Health & Wellbeing

Climate change is projected to have a significant impact on the health and wellbeing of many people in the UK. There may be some extremely welcome benefits, but these need to be considered alongside a range of negative effects.

Confidence

M **Milder winters are projected to result in a major reduction in the risk of cold-related death and illness.**

H **Hotter summers are projected to increase the risk of heat-related death and illness.**

mental problems is projected to rise by between 4000 and 7000 by the 2050s, from present day figures of between 3500 and 4500.[9] The 18 deaths on average a year currently attributed to the direct or indirect effects of flooding and storms are projected to increase by between 6 and 34 by the 2050s.

Confidence

M **The risk of health problems caused by marine and freshwater pathogens[10] is projected to increase.**

H **Hotter summers are projected to increase the risk of heat-related death and illness.**

increase.

M **The number of casualties due to flooding and the impact of floods on mental wellbeing are both projected to increase.**

[9] The figures presented here apply to England and Wales only.

[10] Disease-carrying microbes.

[11] Results are based on the worst case assumption that there is no threshold for the effects of ozone.

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Climate Change & Air Pollution

- Health Effects of Temperature Changes
  - using UKCP09 ensembles (daily data)
  - using ONS population projections
  - careful to keep winter & summer effects separate
  - large uncertainty range
- Tropospheric Ozone & Impacts on Health
  - high-res chemical dispersion models
  - debate whether there is / isn't a threshold
  - interactions with other air pollutants

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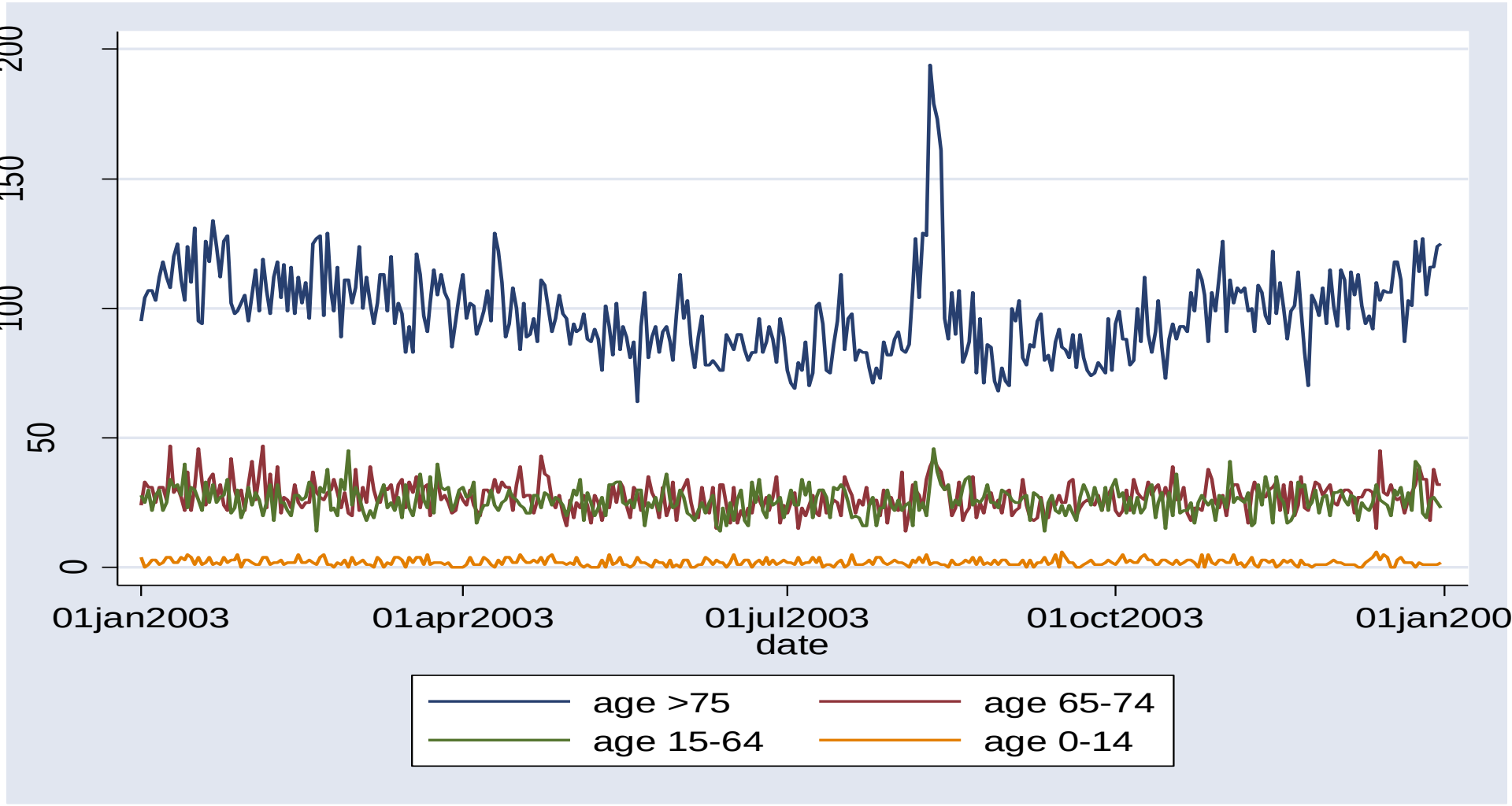
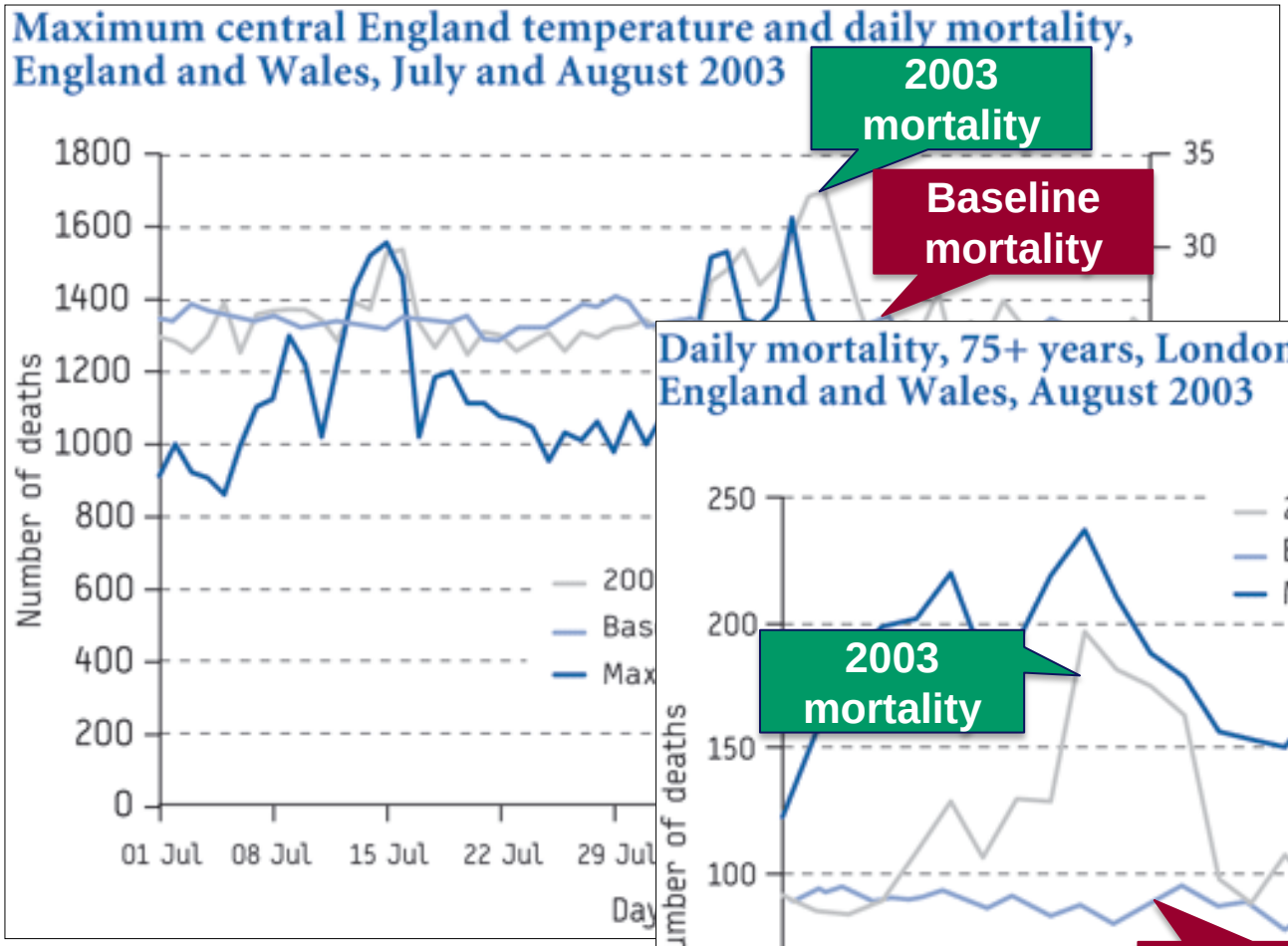
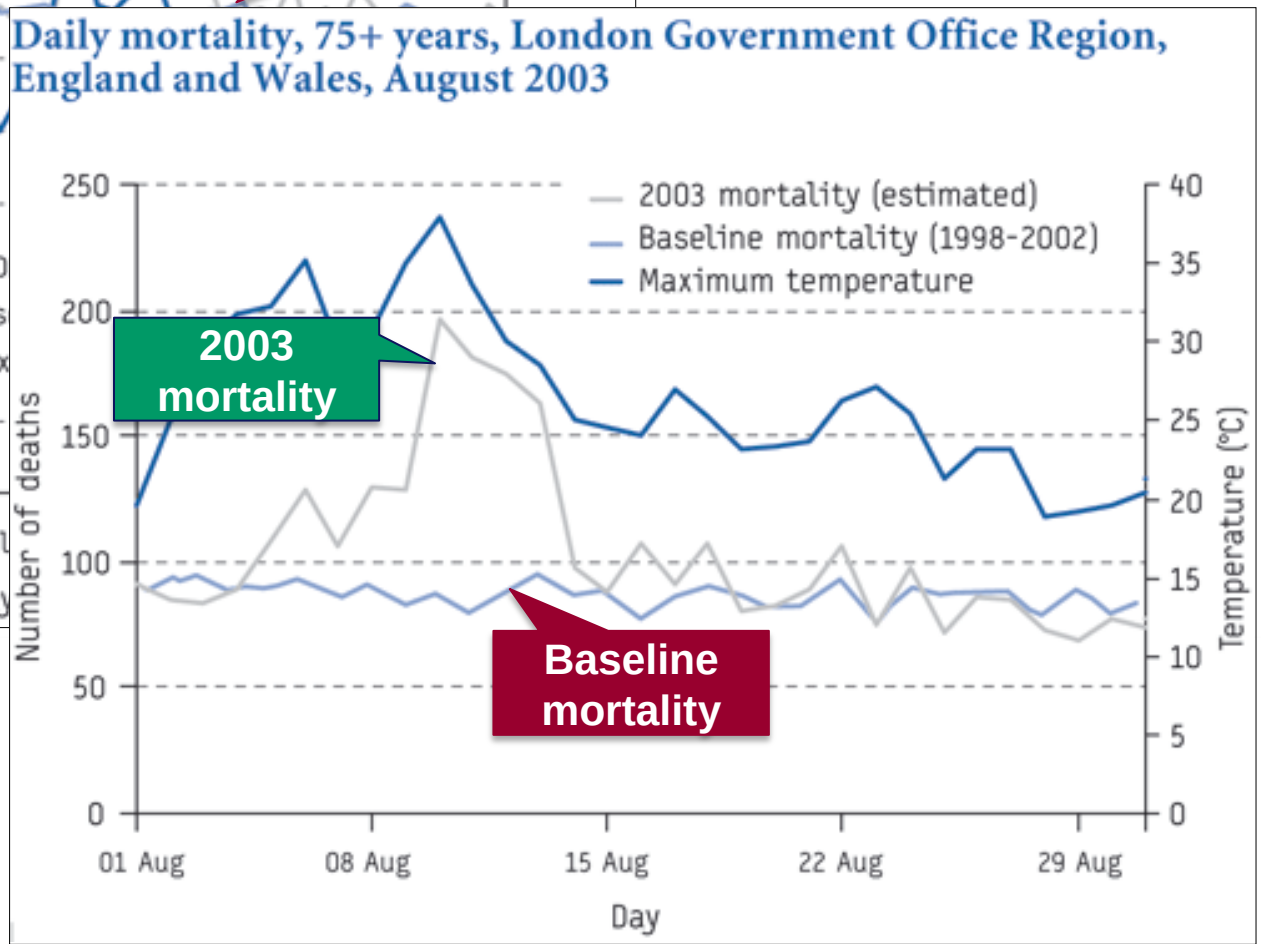
Daily mortality in London, 2003



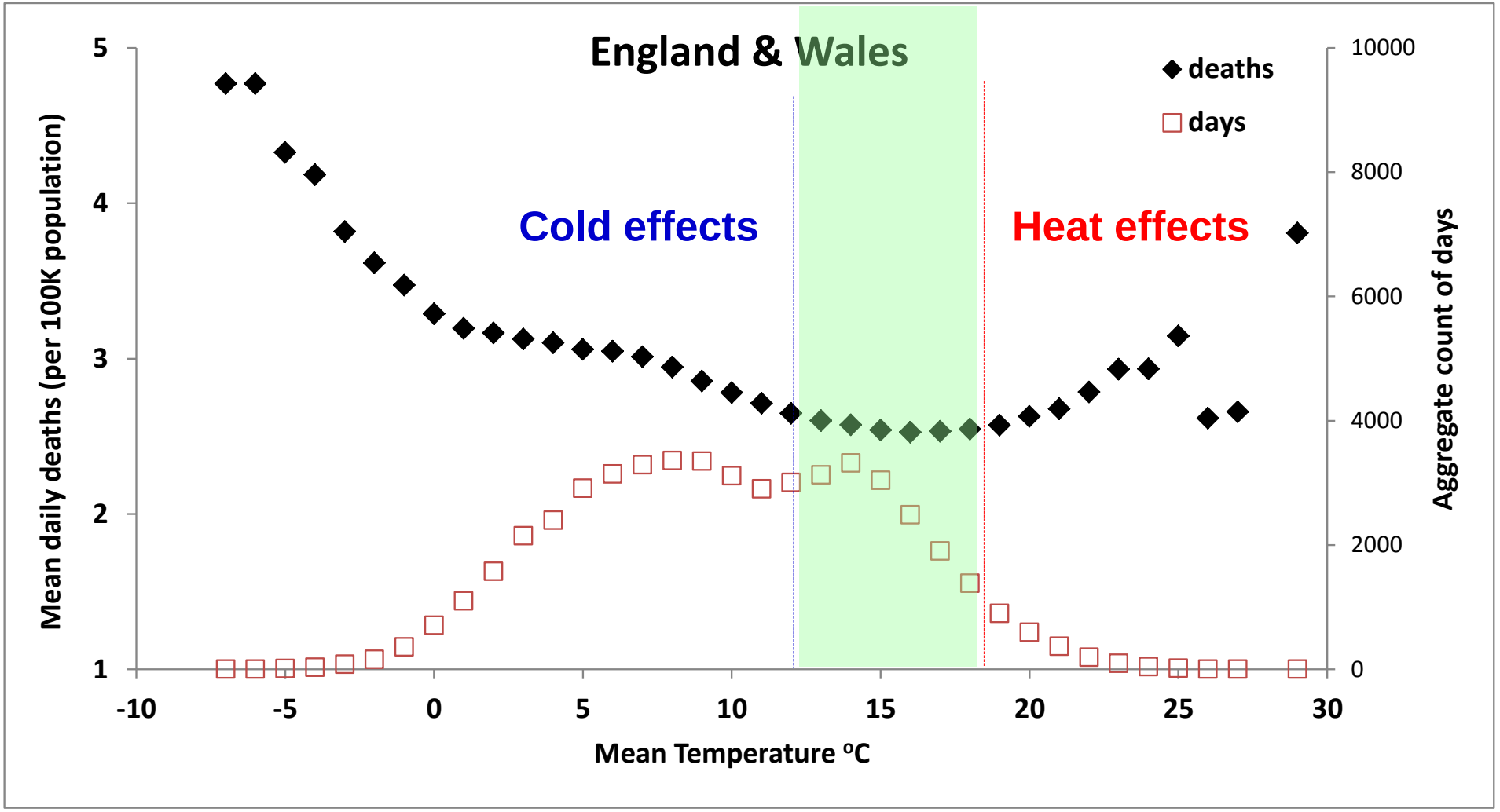
August 2003 Heatwave





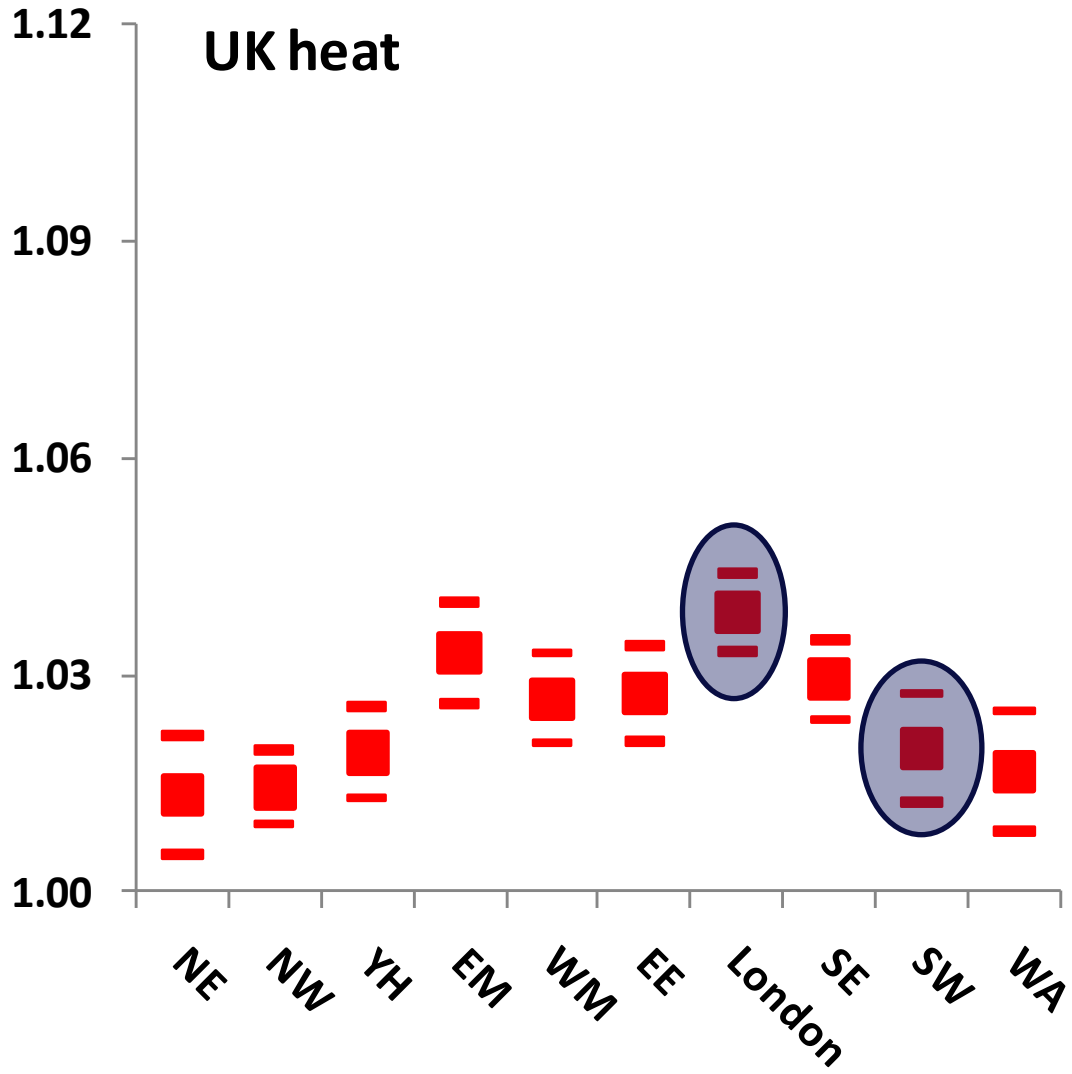
(Johnson et al. 2005)

Temperature Effects



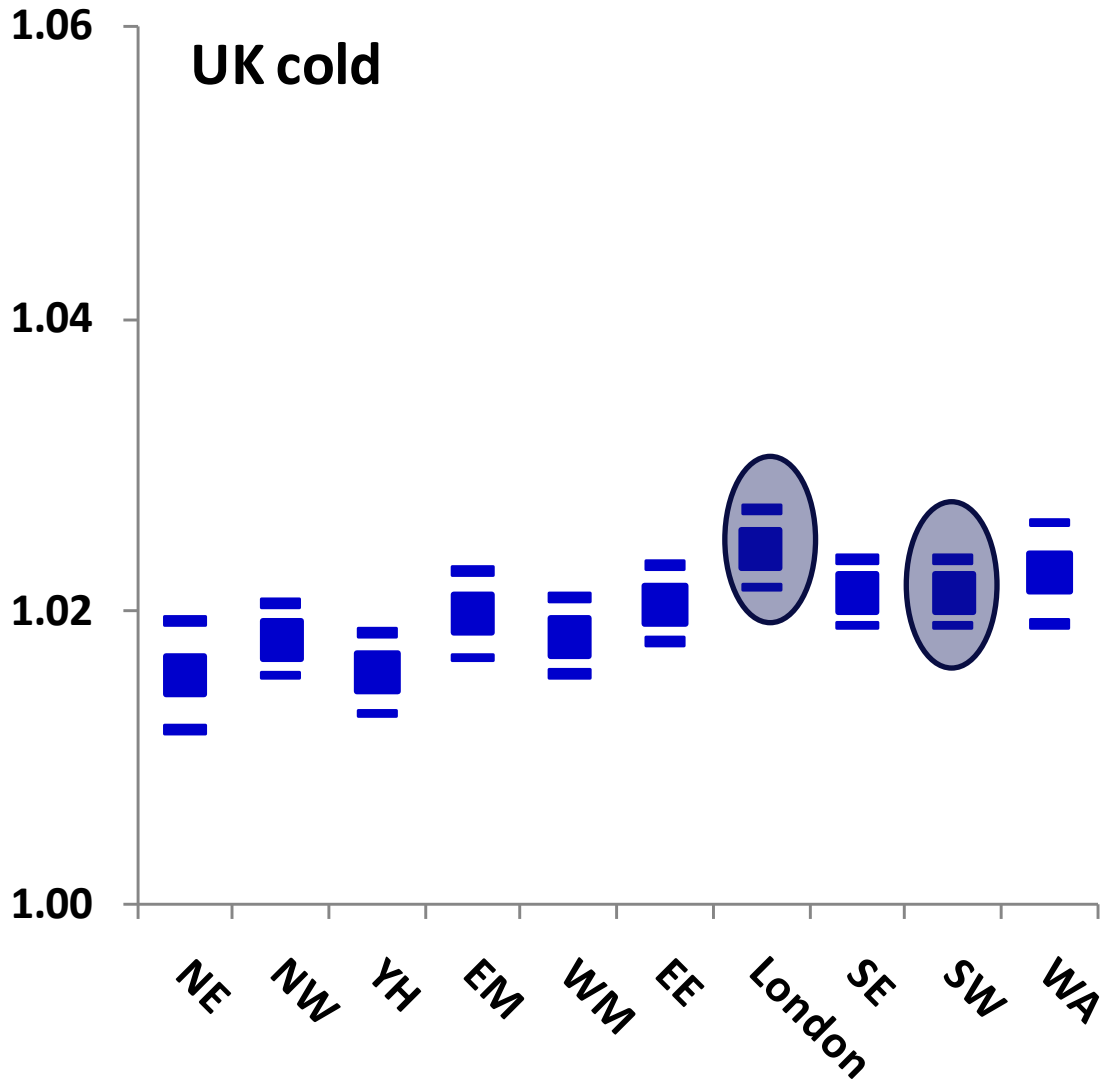
Relative Risks: Heat (all ages)

per 1°C increase above temp threshold (93rd %ile)

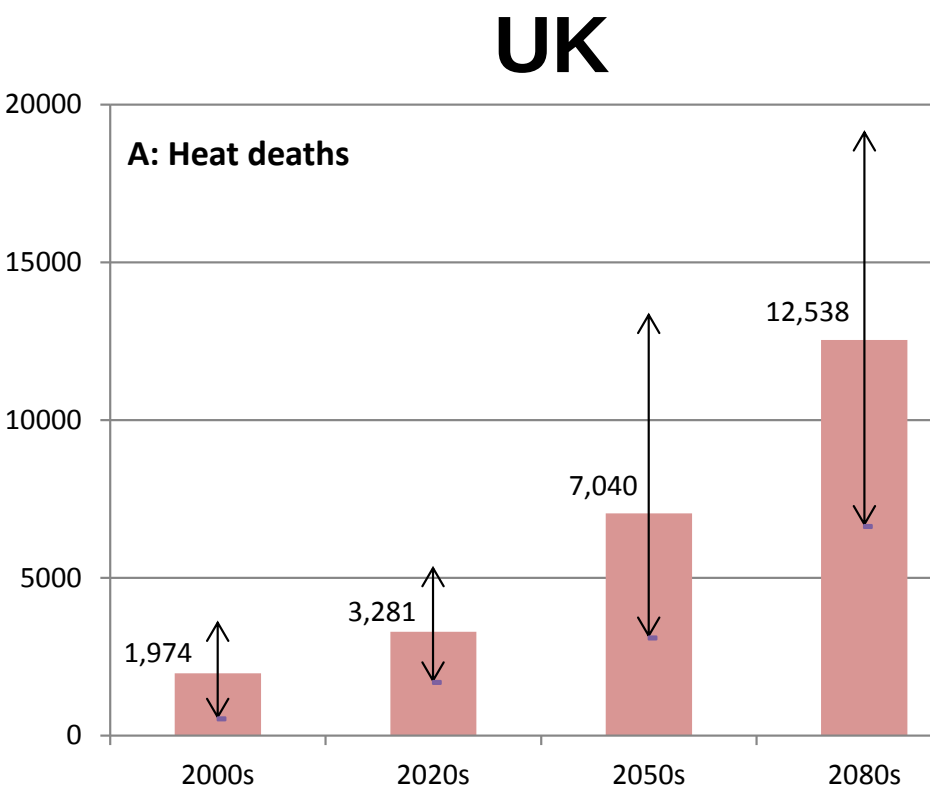


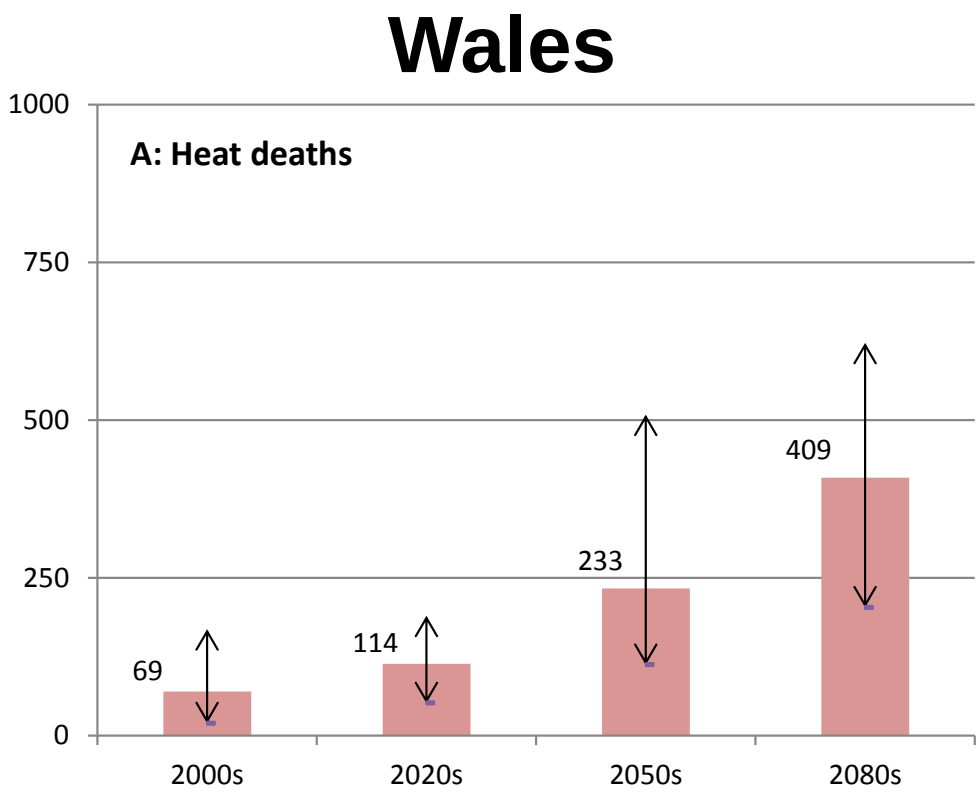
Relative Risks: Cold (all ages)

per 1°C decrease below temp threshold (60th %ile)

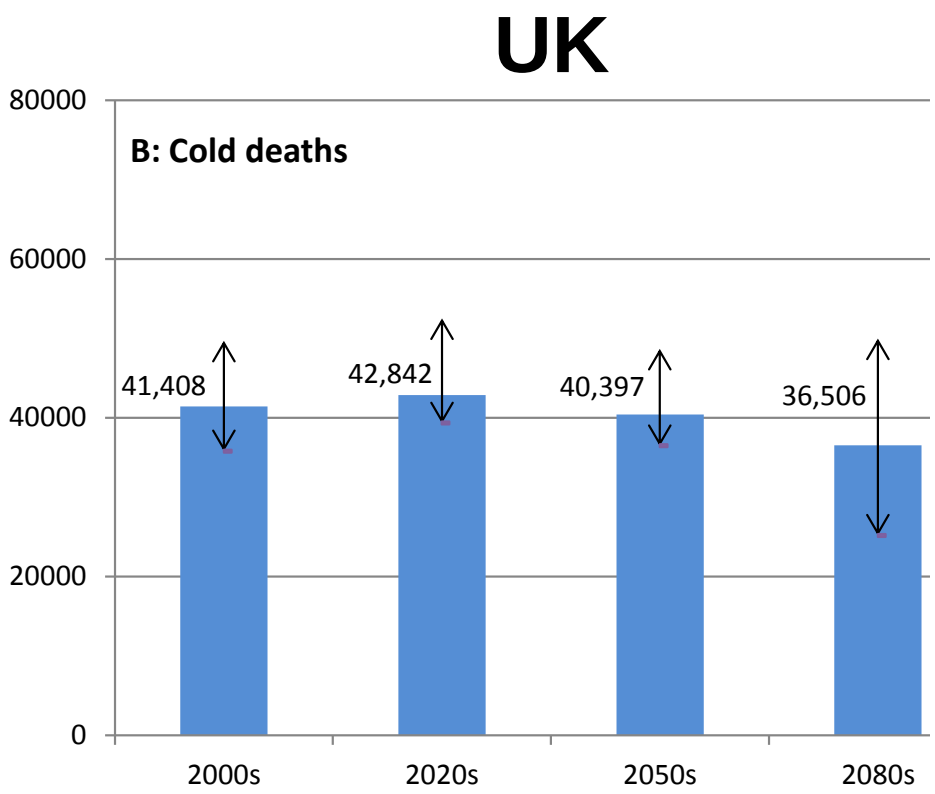


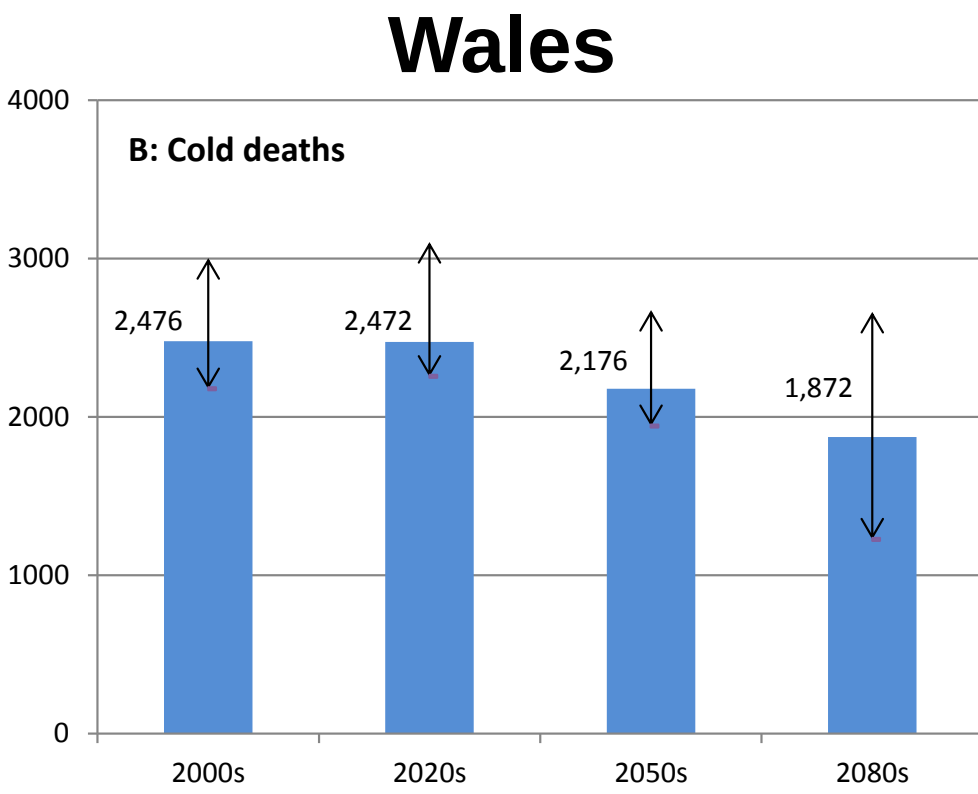
Heat deaths (per year for all ages)



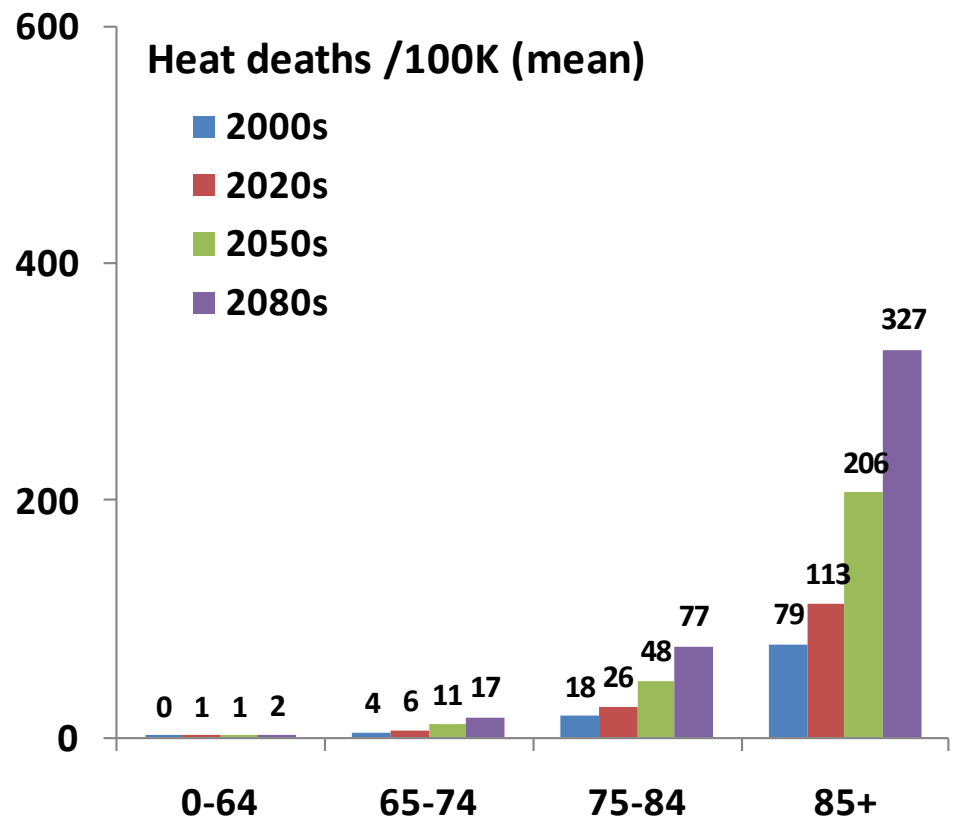


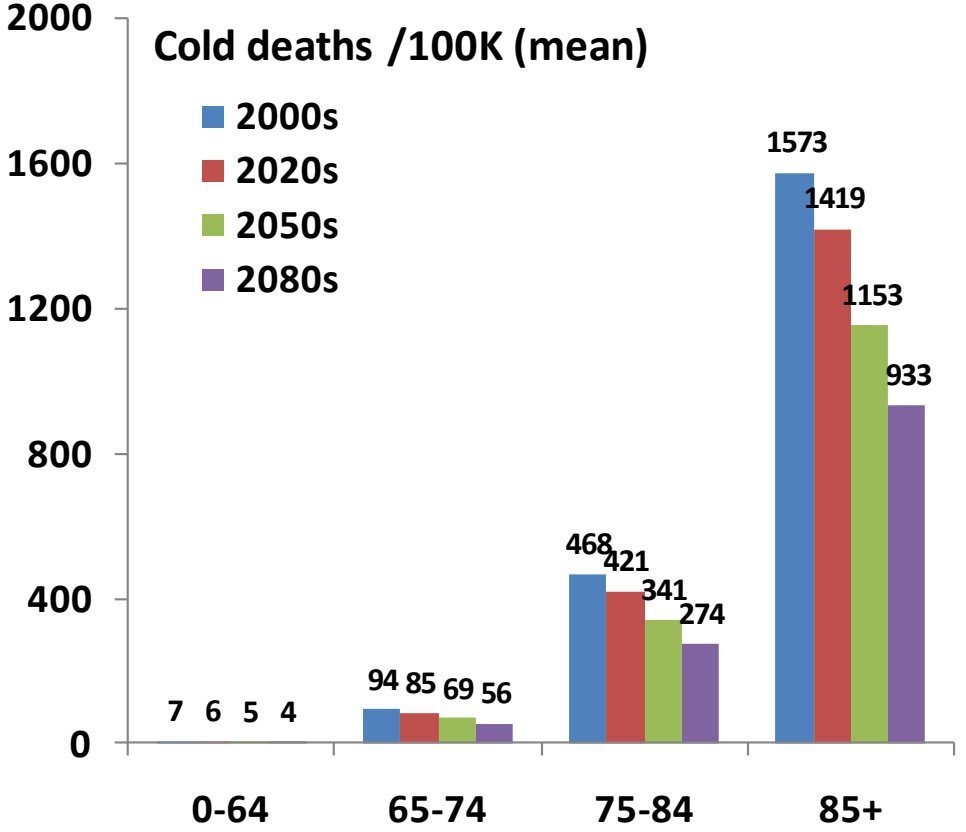
Cold deaths (per year for all ages)





Temperature mortality (by age group)

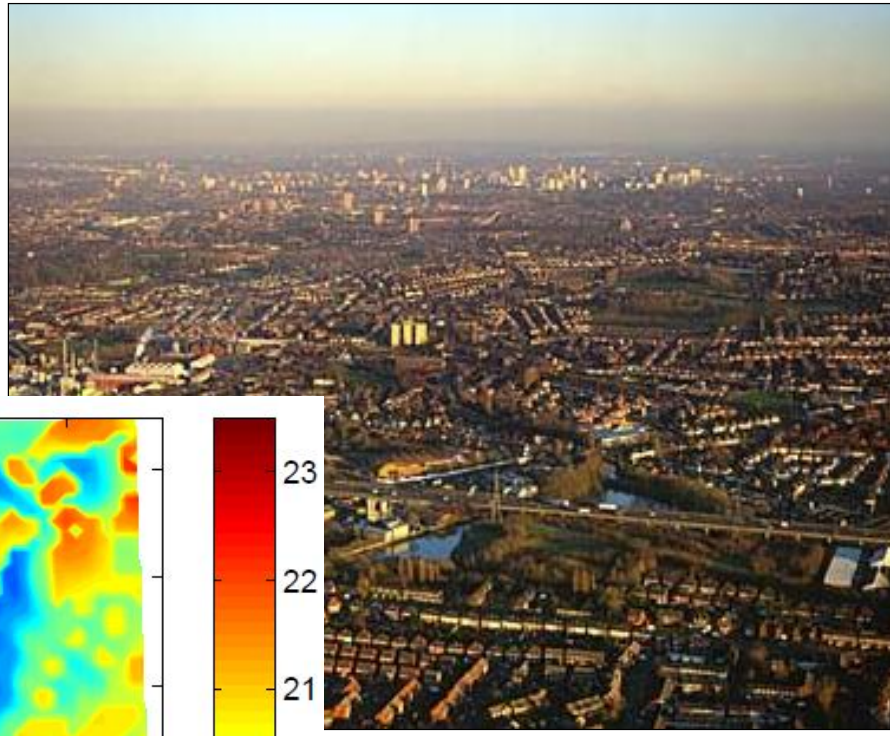


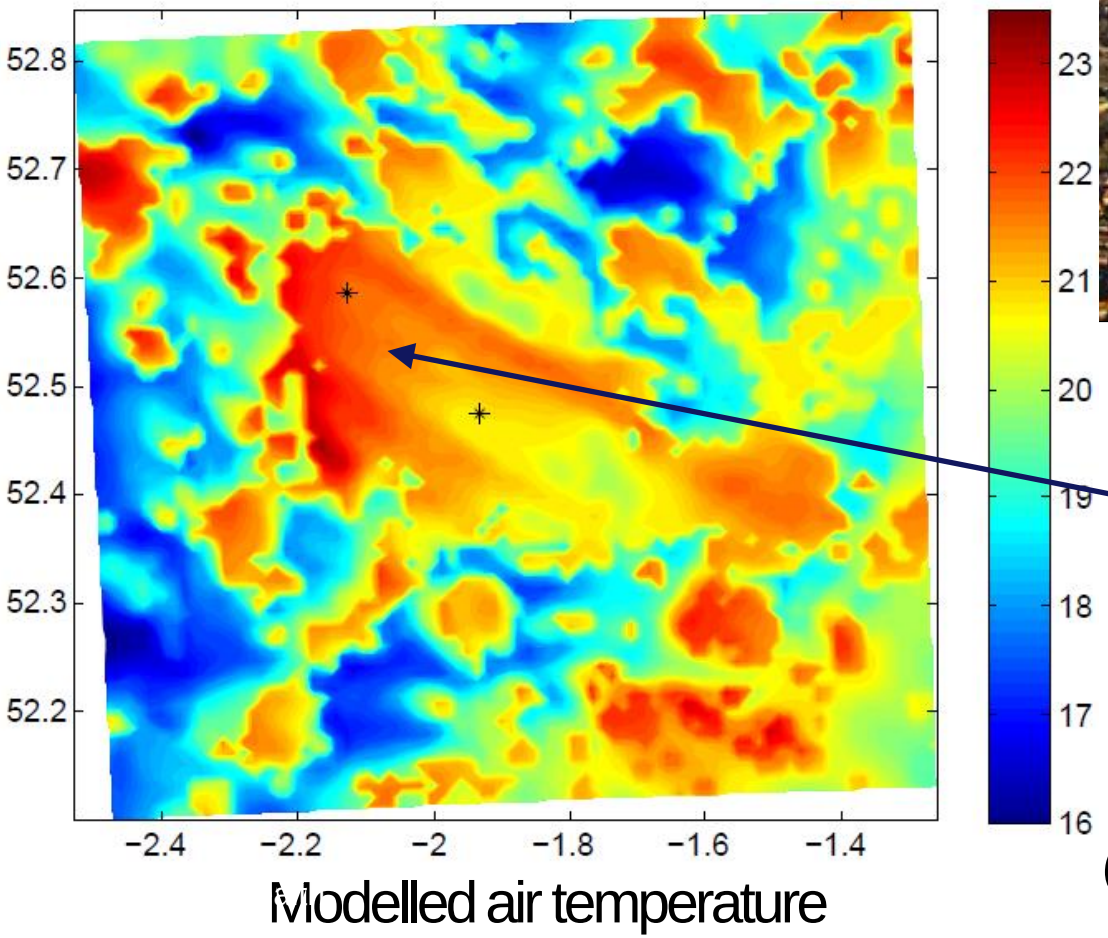


Mean estimates of heat- and cold-related deaths in the UK per year per 100,000 population

(Hajat et al. 2013)

Urban Heat Island West Midlands





Modelled air temperature

Birmingham 11pm 5th August 2003

(Heaviside et al. 2013)

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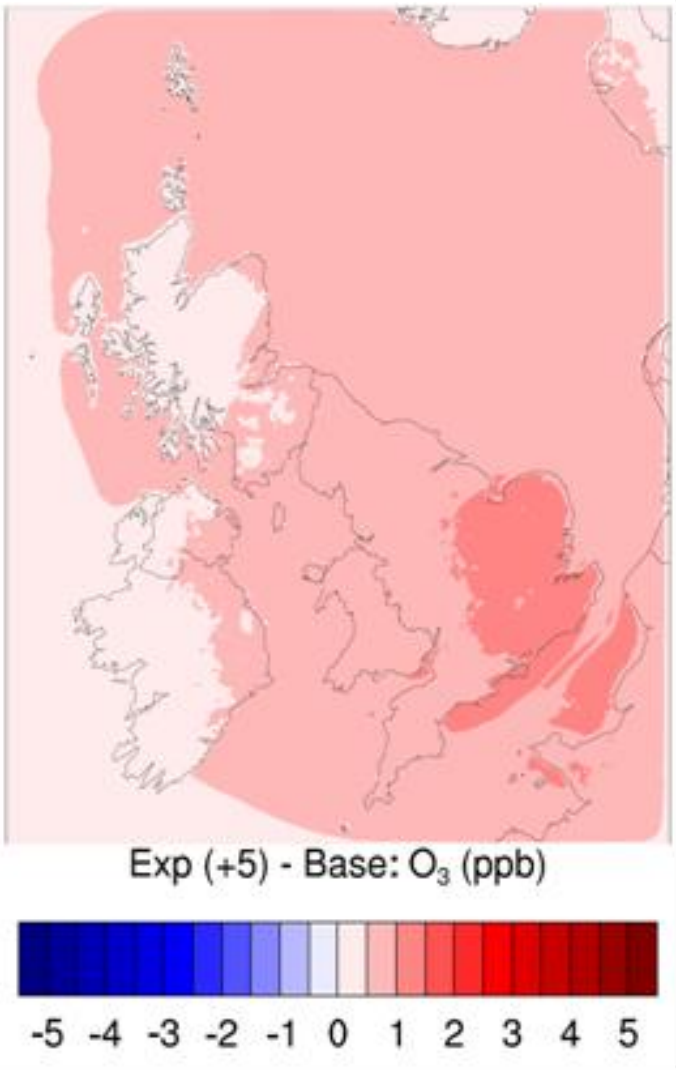
Air Pollution

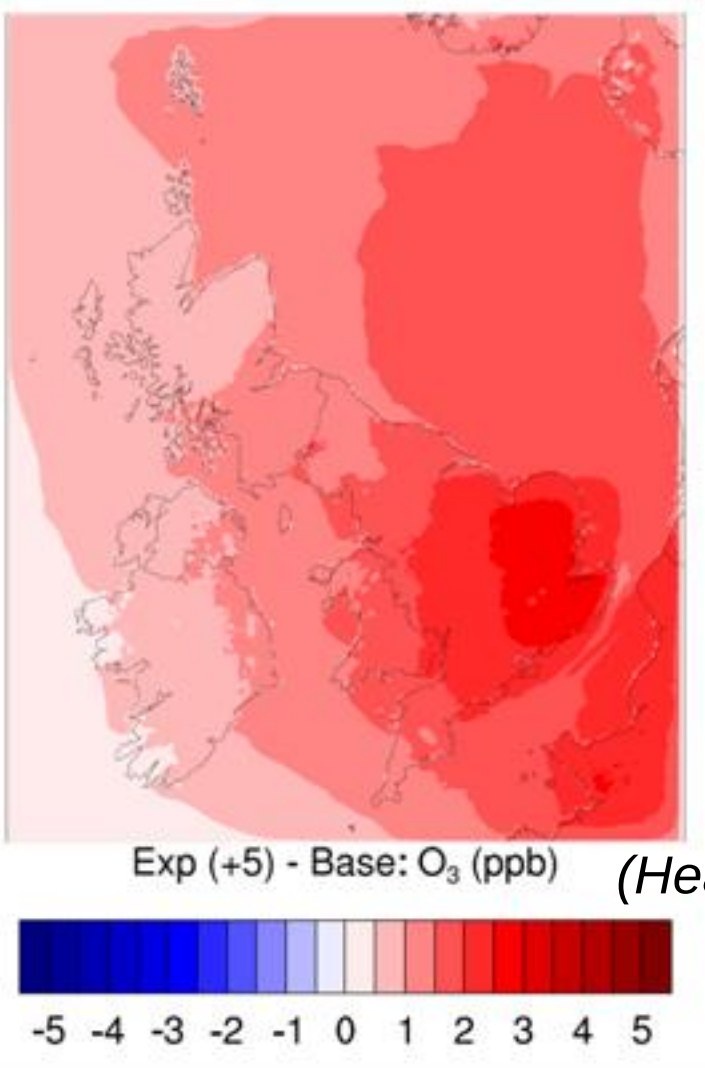
- Understanding how climate change interacts with ground level ozone and other climate sensitive air pollutants.
- Investigation of the range and extent of health effects of ozone, including those associated with chronic exposure.
- Understanding how vulnerable people (e.g. those with pre-existing respiratory illness) need to be protected.

Ground Level Ozone

Annual mean



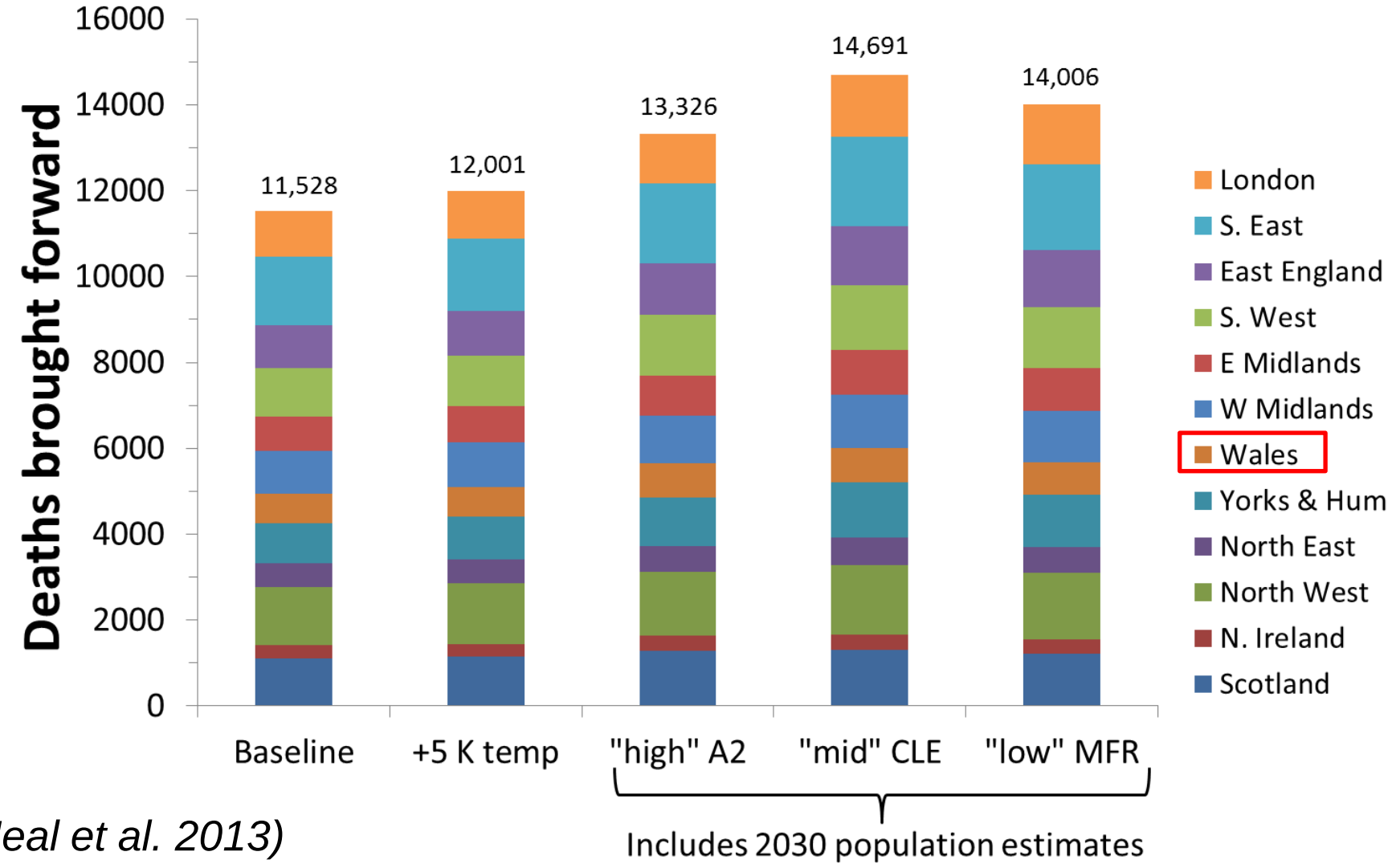
Summer mean



(Heal et al. 2013)

Change in ground level O_3 simulated by EMEP4UK for a +5°C increase in temperature relative to the base simulation for meteorological year 2003.

Ozone Mortality Burdens (no threshold)



(Heal et al. 2013)

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Aeroallergens

- Climate change may result in earlier seasonal appearance of respiratory symptoms and longer duration of exposure to aeroallergens (pollen and fungal spores).
- Changes in plant distribution can expose the population to pollen from more plants with different flowering seasons.
- Climate change / extreme weather events can change fungal speciation, distribution and allergenicity.
- Develop integrated system for modelling atmospheric concentrations of pollen, combining measurements with numerical forecast models.

The Plan & Companion Documents

Making the case: the impact of heat of heat on health - now and in the future

PDF, 350KB, 21 pages

This file may not be suitable for users of assistive technology. Request a different format.

Advice for health and social care professionals: supporting vulnerable people before and during a heatwave

PDF, 264KB, 18 pages

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Advice for care home managers and staff: supporting vulnerable people before and during a heatwave

PDF, 264KB, 14 pages

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Looking after yourself and others during hot weather

PDF, 328KB, 7 pages

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Extreme Events

‘Any extreme weather event or other natural hazard with the potential to cause adverse impact on human health’

Floods

Heatwave

Cold Weather

Drought

Wildfires

Landslides

Windstorms

Thunderstorm asthma

Earthquakes

Tsunamis

Volcanic ash

Space weather etc

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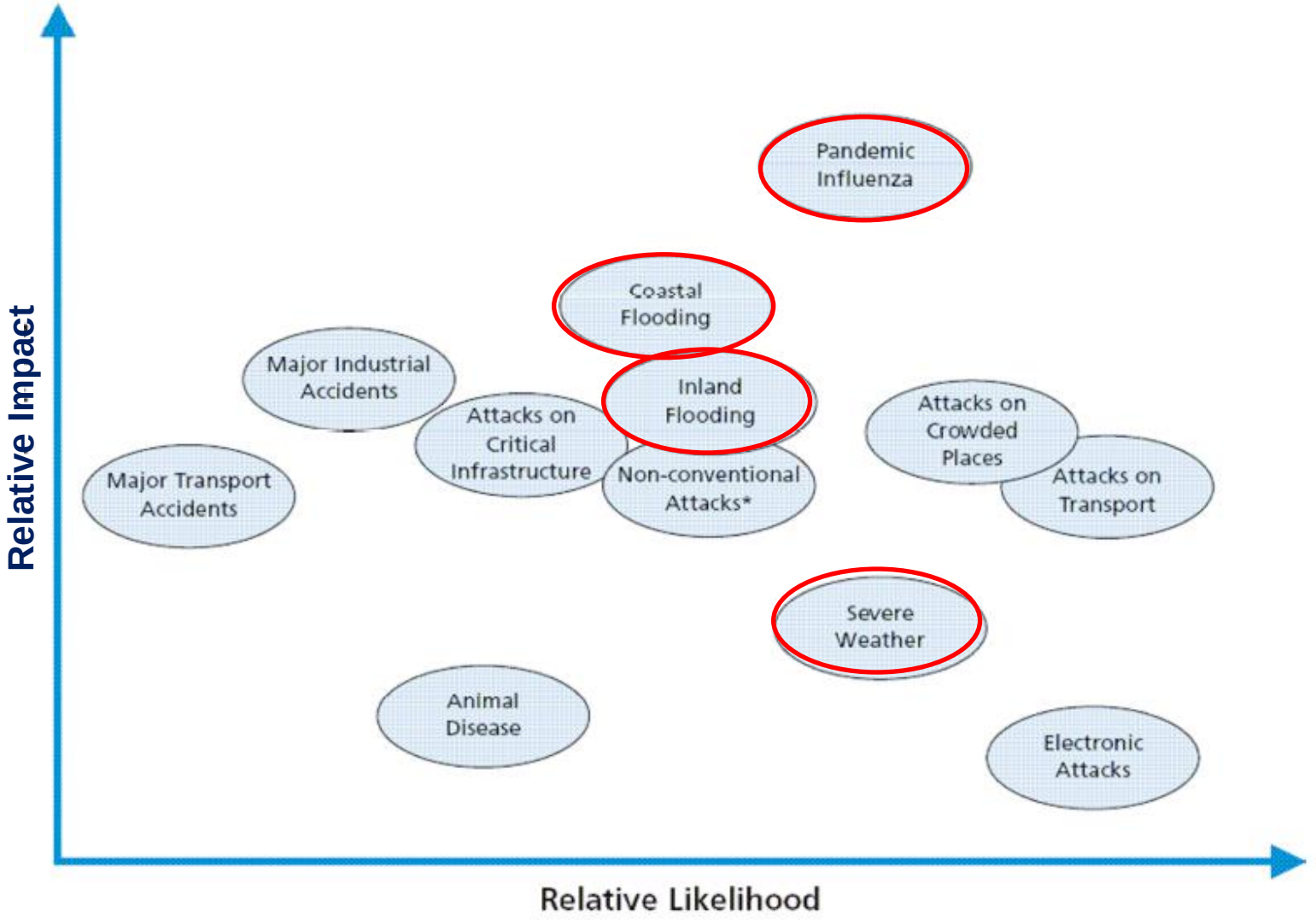
What are our biggest risks?

From the National Risk Register



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Extreme Events & Health Protection

Provides a focal point for **evidence-based** health protection **advice** and **guidance** for planning, response and recovery to extreme weather events and other natural hazards:

- Local
- National
- International

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Natural Hazards Partnership

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Health impacts of flooding

Direct health effects

Immediately associated with flood water and its debris:

- **Drowning** (walking or driving through flood water)
- **Physical trauma** (concealed or displaced objects; electrocution, fire)
- **Other health effects** such as heart attacks

Indirect health effects

Occur as a consequence of flooding:

- **Mental health impacts** (primary and secondary stressors)
- **Carbon monoxide poisoning** (Do not use petrol or diesel generators or other similar fuel-driven equipment indoors:
- **Skin & gut infections** from contaminated flood water
- **Respiratory disease** from mould & damp
- **Rodent-borne disease**

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Extreme Events and Climate Change

- Extreme Events already affect thousands of people across England and globally and cause huge health and economic impacts
- Extreme events *will* increase in frequency, duration and intensity because of climate change
- Need for research to support policy and practice is key – for example modelling of pollen release from plants; extreme event frequency, severity and location; tropical cyclones affecting Europe.

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Research Challenges

- Modelling of real-time events with spatially & temporal inhomogeneous data
- Sophisticated pollen & fungal spore modelling (species specific), meshing with data from national monitoring network & individual samplers & allergy/asthma data
- Detailed & high-res modelling of atmospheric conditions leading to thunderstorm asthma outbreaks
- Modelling of disease vectors & infectious diseases

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More Mathematical Challenges …"Blue-Sky Public Health Challenges"

- Windstorms: modelling of tropical cyclones impacting UK / European shorelines (TS Grace 2009, Hurricane Vince 2005)
- Modelling of "cold snaps" – will we get more or less under climate change ?
- Modelling of housing stock, damp & mould
- Spread of invasive allergenic species (eg ambrosia)
- Modelling of what causes allergenic potency to vary (could be a molecular issue)
- How can we get more out of syndromic surveillance ?

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Health Protection Research Unit – Environmental Change and Health

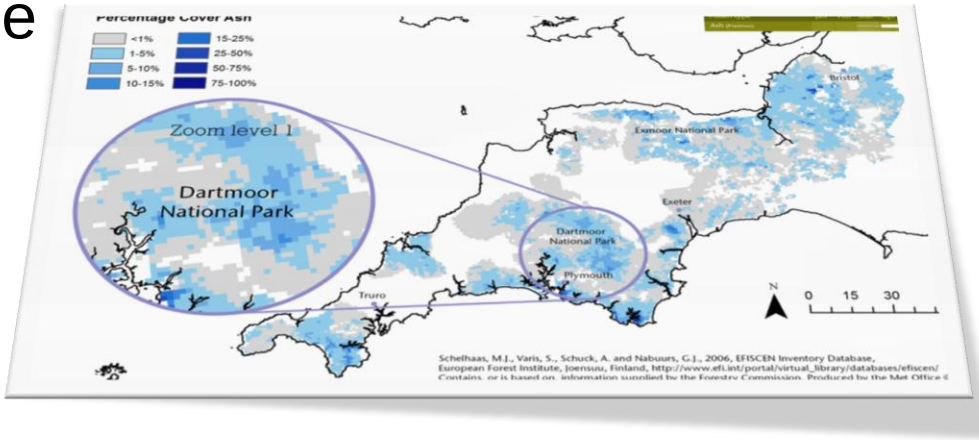
Research in this HPRU is organised in three interconnected themes:

Theme 1: Climate Resilience

Theme 2: Healthy Sustainable Cities

Theme 3: Public Health and the Natural Environment

Partners: LSHTM, UCL, Exeter / ECEHH Met Office, PHE



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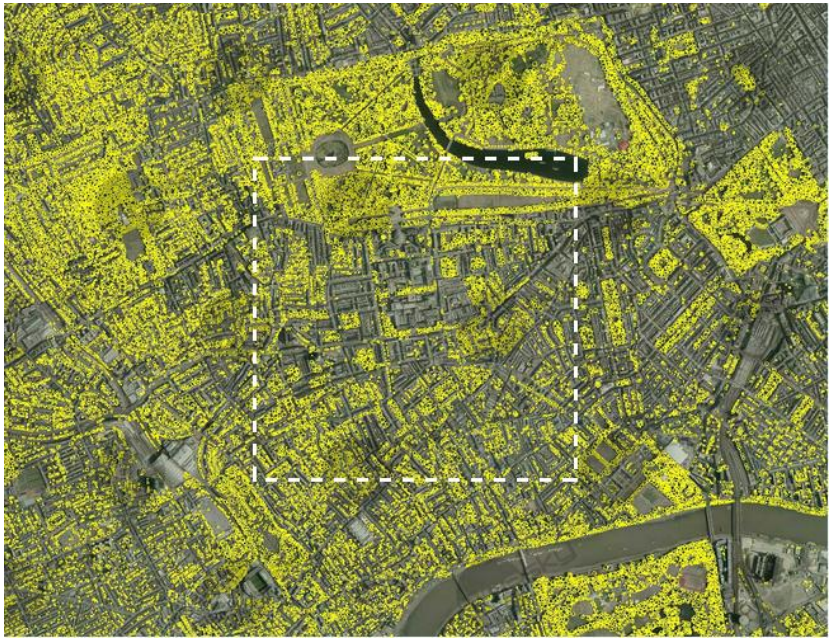
HPRU ECH – Mathematical Challenges

Pollen modelling:

Met Office utilising the "National Tree Map", which contains individual tree data for whole of UK (of order 10^8); however, species details not yet available; pollen monitoring data spatially coarse.



Map by Bluesky International Ltd.

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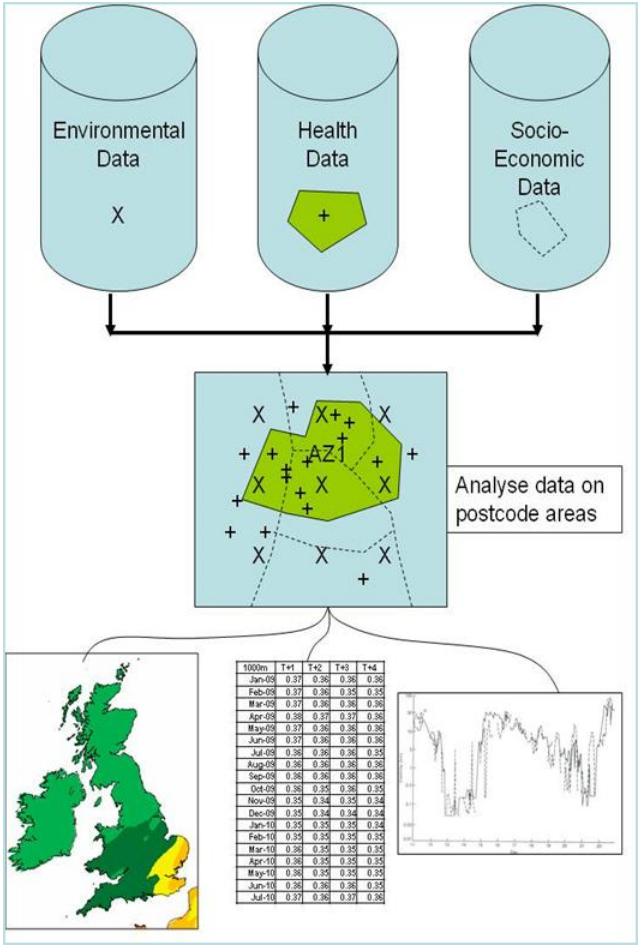
Medical and Environmental Data Mash-up Infrastructure (MED-MI)

Aims:

Create a central data and analysis source as an internet-based platform which will be a vital new common resource for medical and public health research in the UK and beyond.

Core partners: ECEHH, Met Office, PHE



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MED-MI Mathematical Challenges

Efficient handling of vast data volumes:

MED-MI currently holds:

9,145,624,478 records from weather observing stations.

843,975,846 grid point values from the National Climate Information Centre.

142,226,378 air quality measurements from DEFRA.

18,060 stratospheric ozone measurements.

- Individual health data likely to be confidential
- Aggregated at spatially large enough level results become non-confidential
- Establish mathematical framework to decide at what resolution data becomes non-confidential
- Can user accreditation be automated ? Even in international setting ?

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Acknowledgements

Dr Sotiris Vardoulakis

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Dr Alison Gowers

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Dr Sari Kovats

Carla Stanke

Anna Crossley

Dr Christophe Sarran (Met Office)

Prof Lora Fleming (ECEHH)

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The National Adaptation Programme

Making the country resilient to a changing climate

July 2013

www.gov.uk/defra

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NAP Vision and Topics

'*Building the UK's resilience to climate change is an economic, social and environmental challenge that cuts across every sector of society.*'

- Built environment,
- Infrastructure,
- **Healthy and Resilient Communities**
- Agriculture and forestry,
- Natural environment,
- Business and local government.

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NAP Objectives

Objective 11:

To reduce the risk of death and illness associated with severe weather events and climate change and increase preparedness and resilience to the impacts on public health.

Objective 12:

To promote climate resilience within the NHS, public health and social care system to ensure continuity of services and resilient assets/ estates including the ability to deal with the increased demand for services associated with severe weather related events.