



Population vulnerability to heat over time and space – lessons for climate change adaptation

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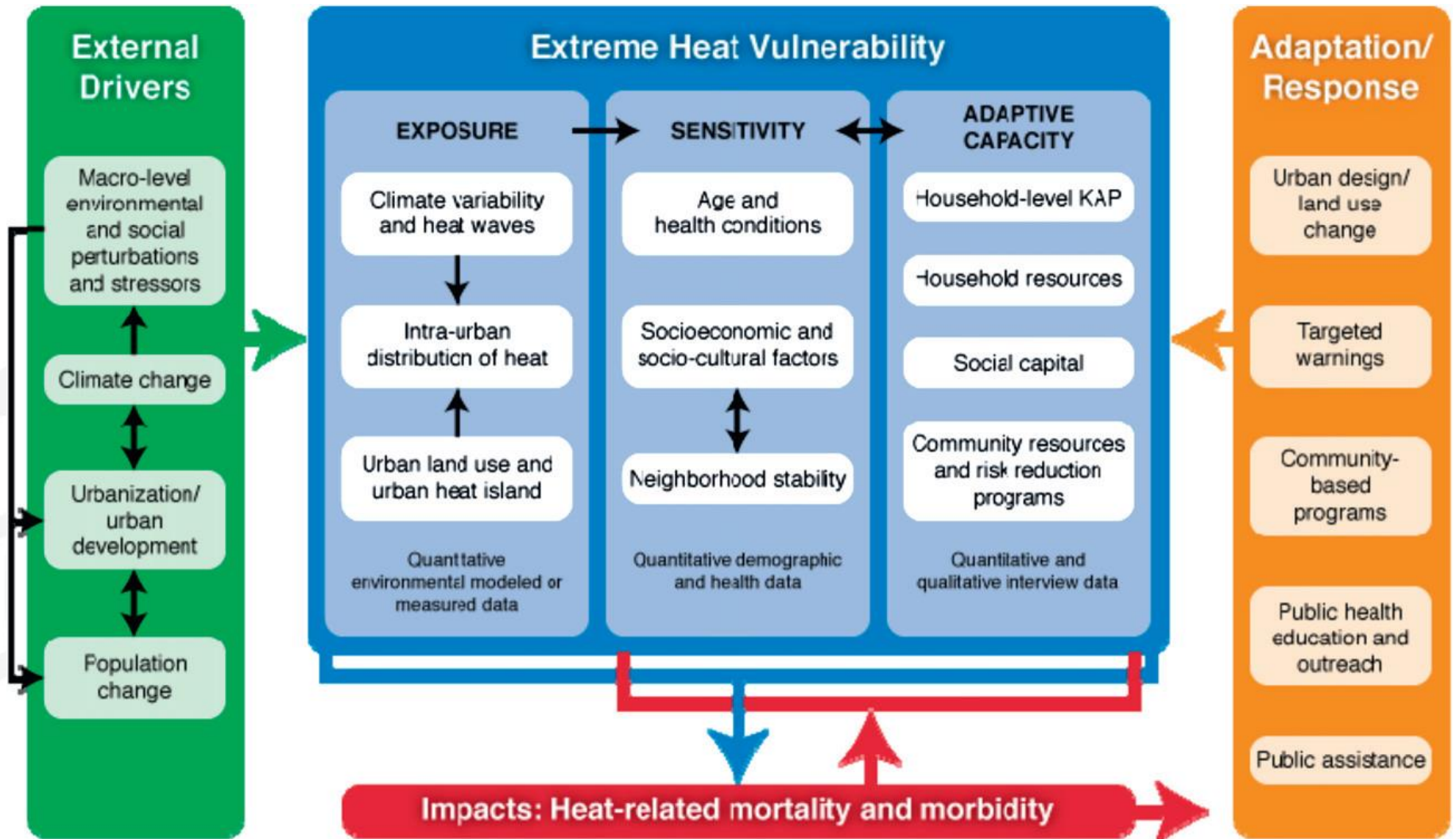
³London School of Hygiene & Tropical Medicine, ⁴UCL

What is vulnerability?



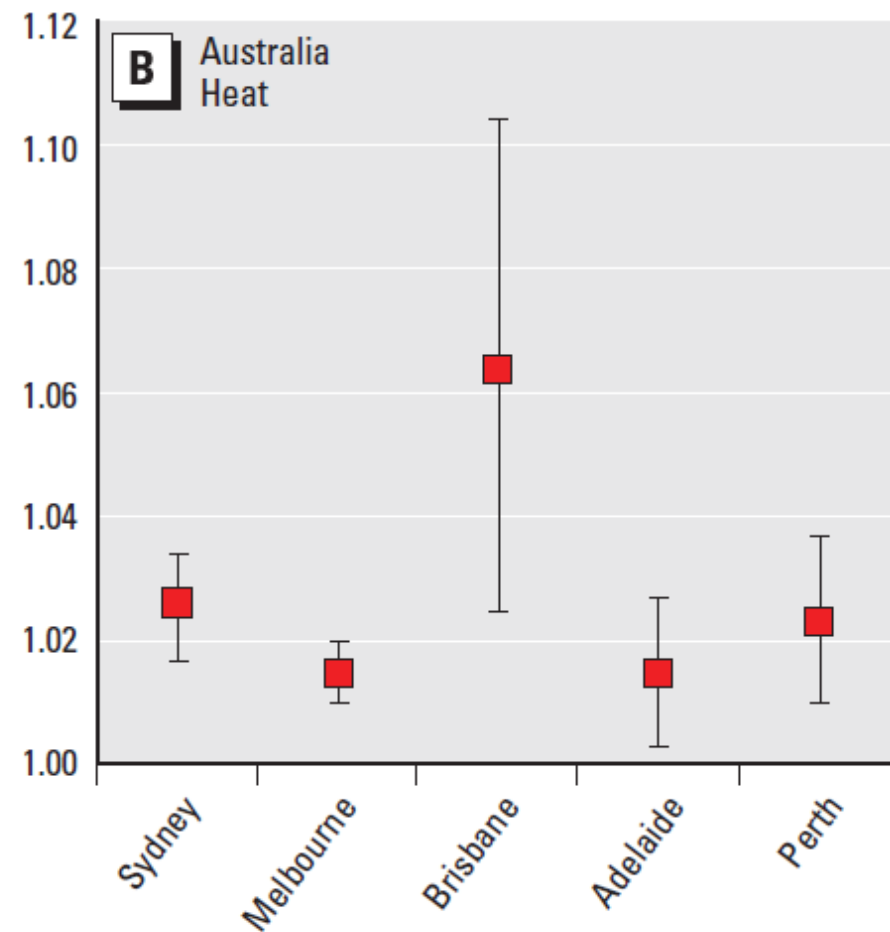
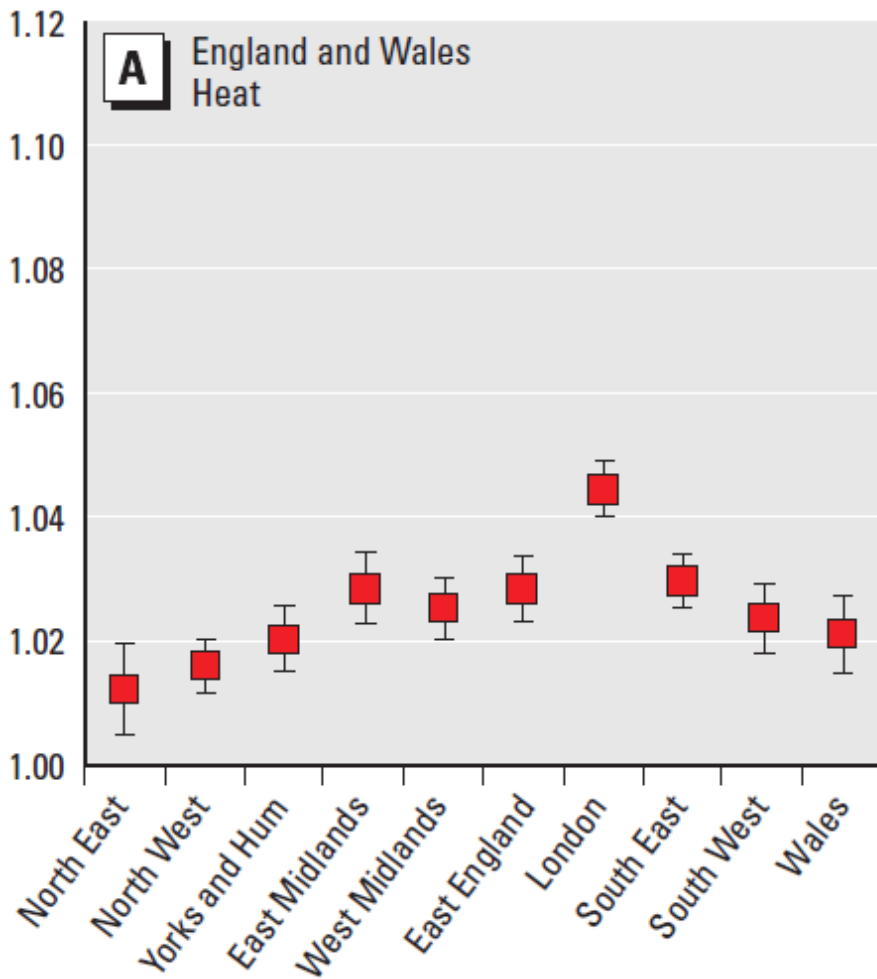
- **Vulnerability:** diminished capacity of an individual or group to anticipate, cope with, resist and recover from the impact of a natural or human-made hazard (IFRC)
- **Vulnerability:** the conditions determined by physical, social, economic, and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards (UNISDR)
- Counteracting vulnerability requires:
 - Reducing the impact of the hazard (through mitigation, warning, preparedness)
 - Building capacity to cope with hazards
 - Tackling the root causes (e.g. poverty)

Heat Vulnerability Framework



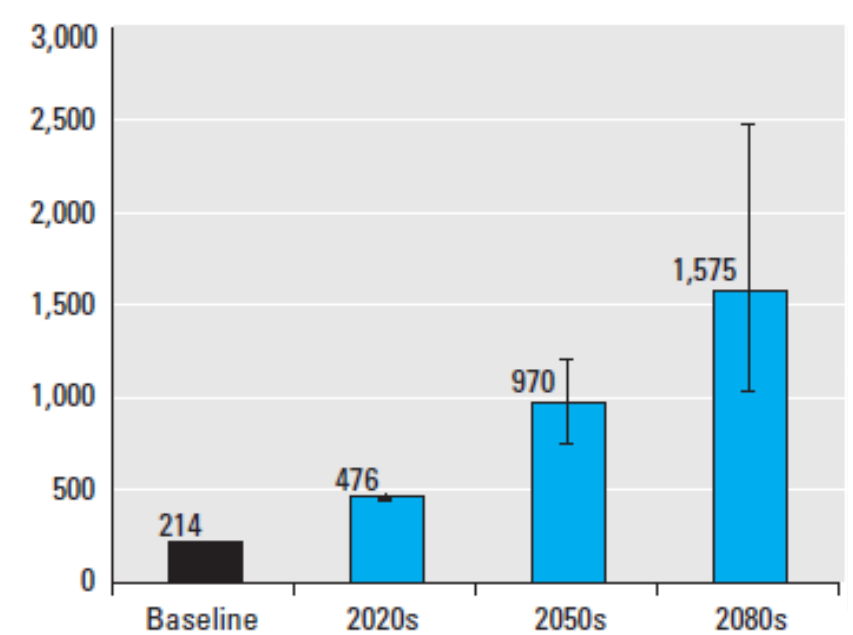
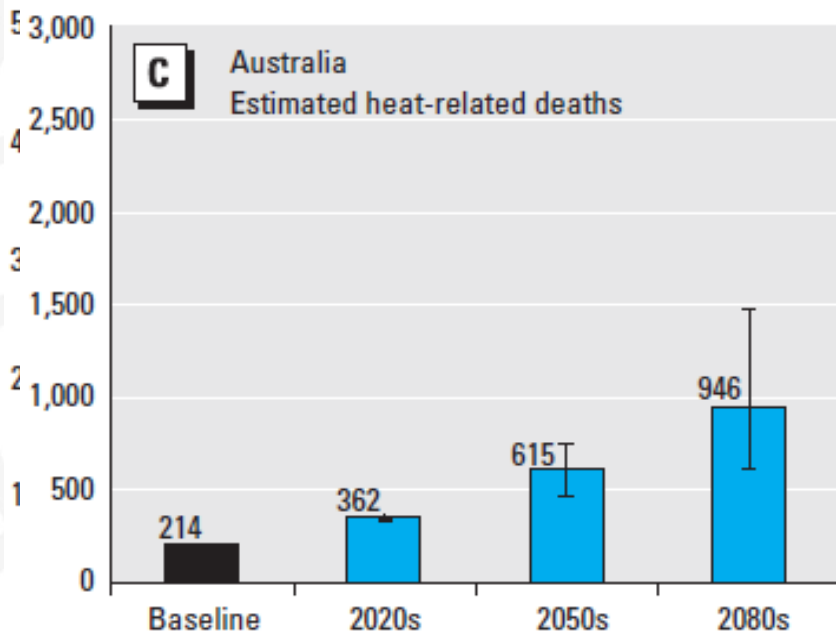
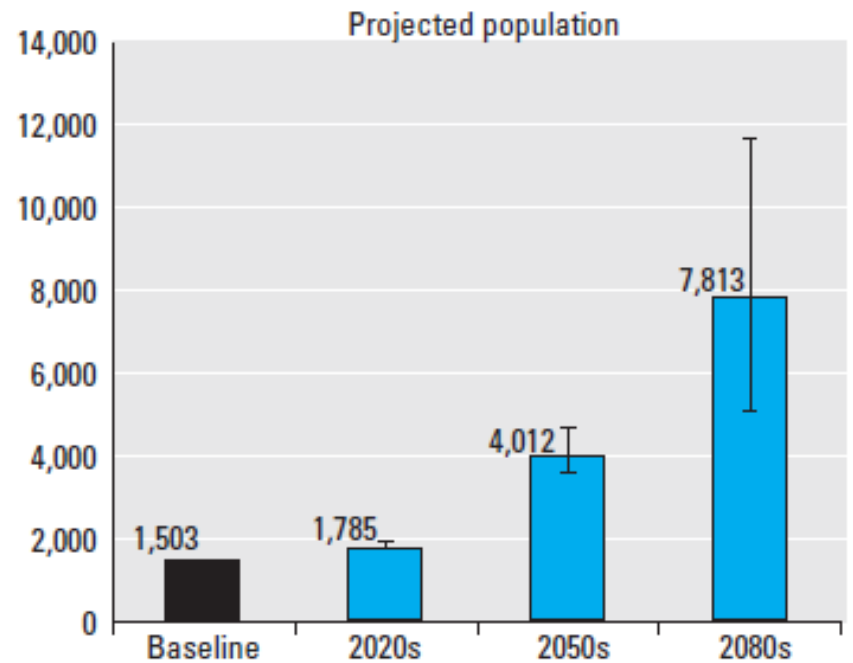
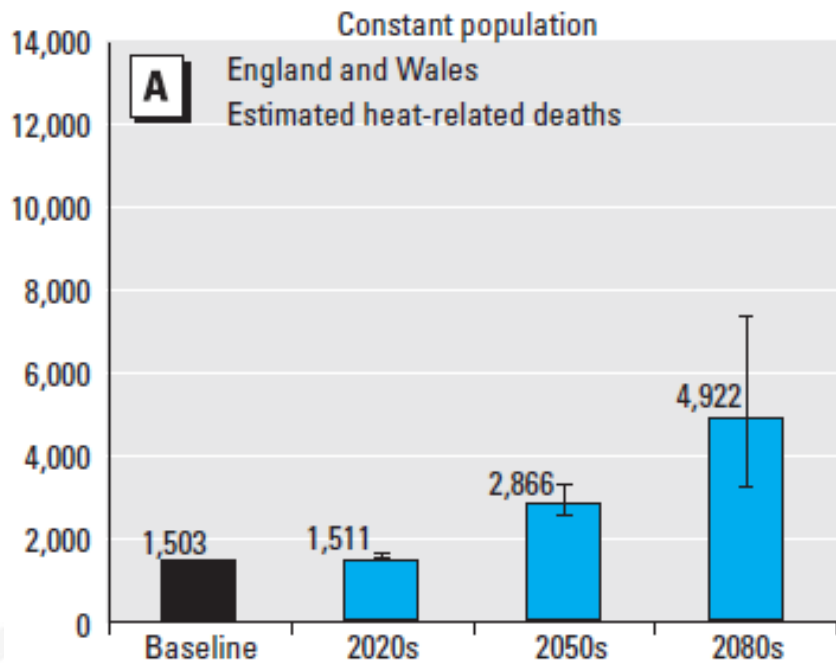
(Wilhelmi and Hayden 2010)

Relative risk of heat related mortality (per 1°C increase above temp threshold)



(Vardoulakis et al. 2014)

Relative risk is a ratio of the probability (or incidence) of the event occurring in the exposed group versus a non-exposed group.



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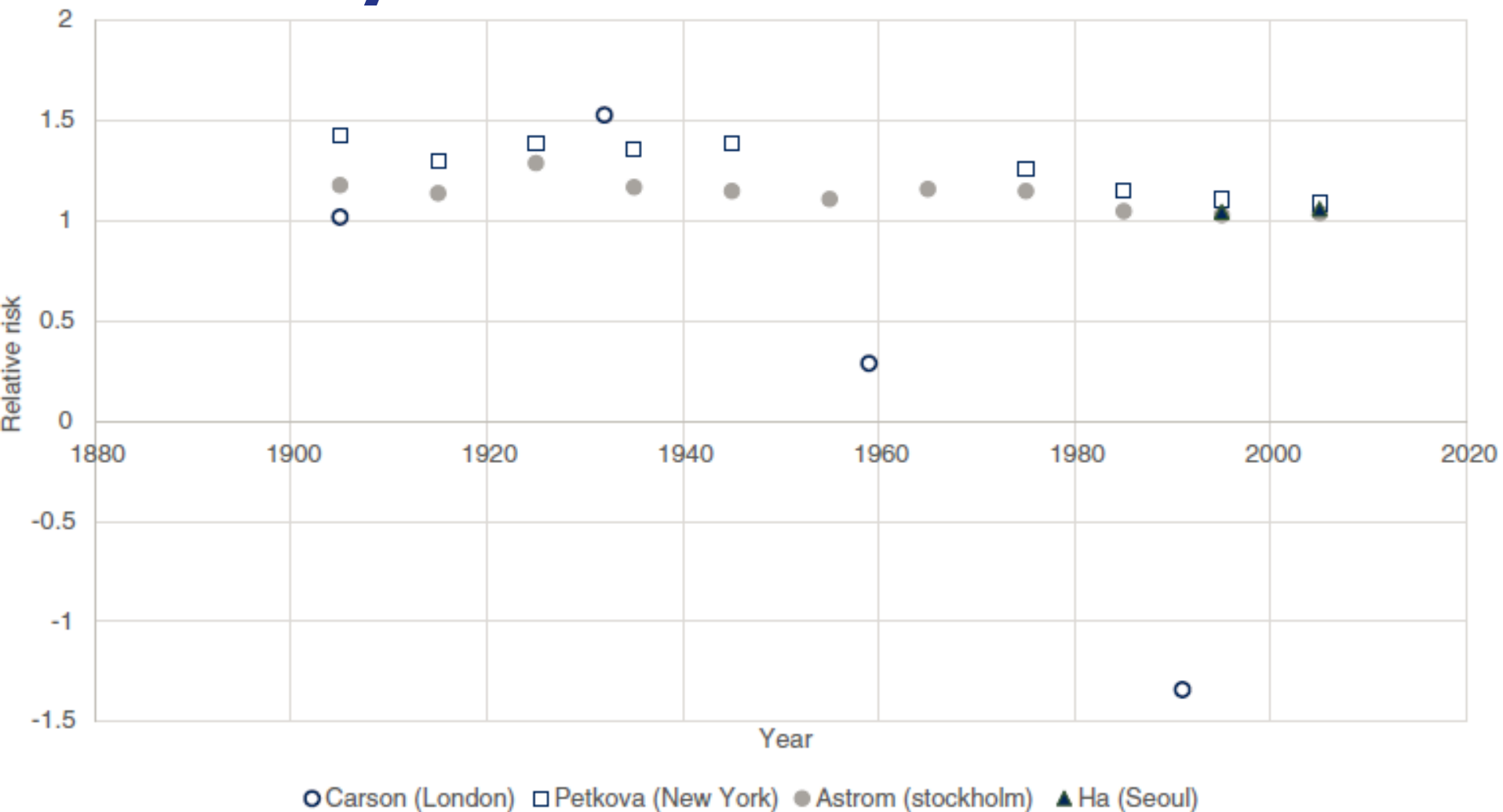


Changes in population susceptibility to heat and cold over time: assessing adaptation to climate change

Katherine Arbuthnott^{1,2*}, Shakoor Hajat¹, Clare Heaviside^{1,2} and Sotiris Vardoulakis^{1,2}

- 11 studies which quantified the risk of heat related mortality with changing ambient temperature in a specific location over time (time-series analysis);
- 6 studies which compared mortality outcomes between two different heatwaves in one location (episode analysis).

Relative risk of heat related mortality



Heat vulnerability over time



- 10 of 11 studies that quantified the risk of heat related mortality over time found a decrease in vulnerability (5 found this decrease to be significant).
- Only 2 studies attempted to quantitatively attribute changes in vulnerability to specific adaptive measures.
- 4 of the 6 papers examining effects of heatwaves found a decrease in excess mortality in later years.
- Results of studies examining temperature related health risks are aggregated to at least city level.
- The UHI is likely to alter heat related risk and with increasing urbanisation.



Contents lists available at ScienceDirect

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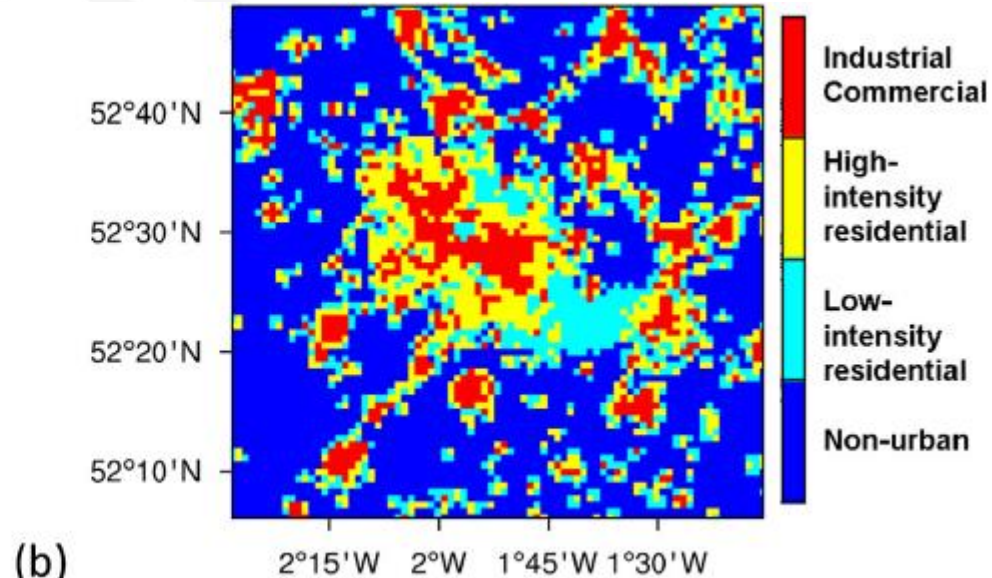
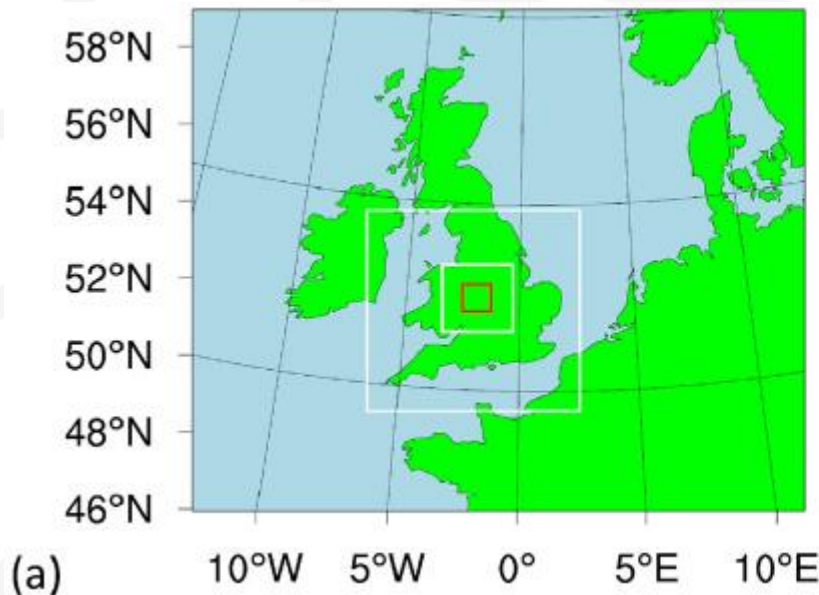
journal homepage: www.elsevier.com/locate/scitotenv



Assessing urban population vulnerability and environmental risks across an urban area during heatwaves – Implications for health protection

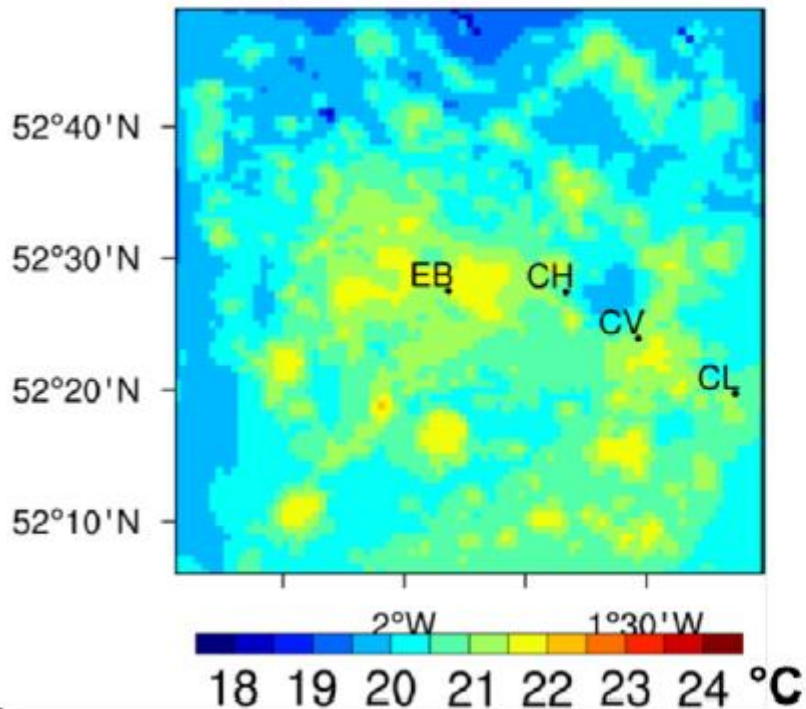


H.L. Macintyre ^{a,*}, C. Heaviside ^{a,b,c}, J. Taylor ^d, R. Picetti ^b, P. Symonds ^d, X.-M. Cai ^c, S. Vardoulakis ^{b,c,e}



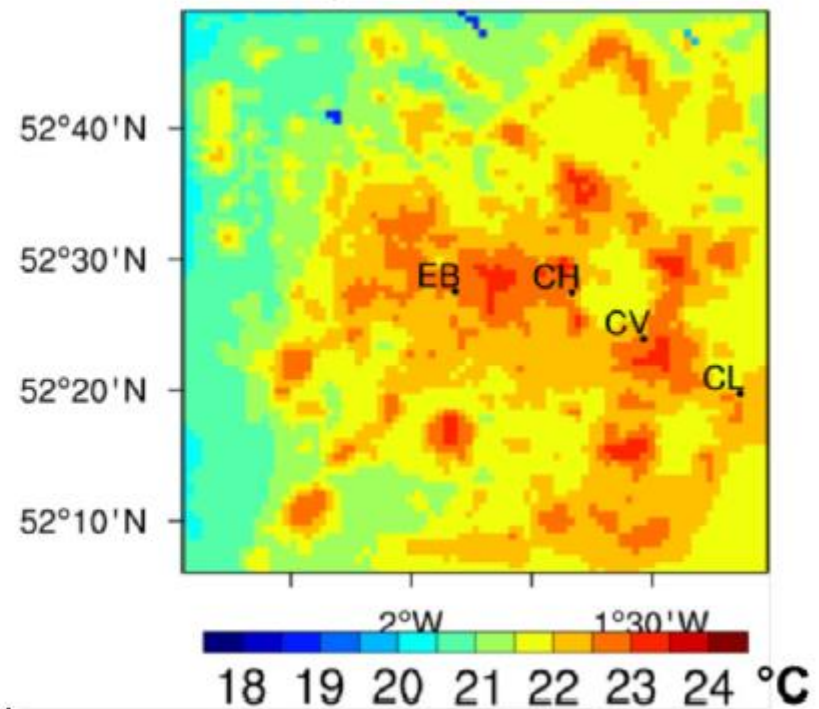
Air temperatures across the West Midlands

August 2003 heatwave



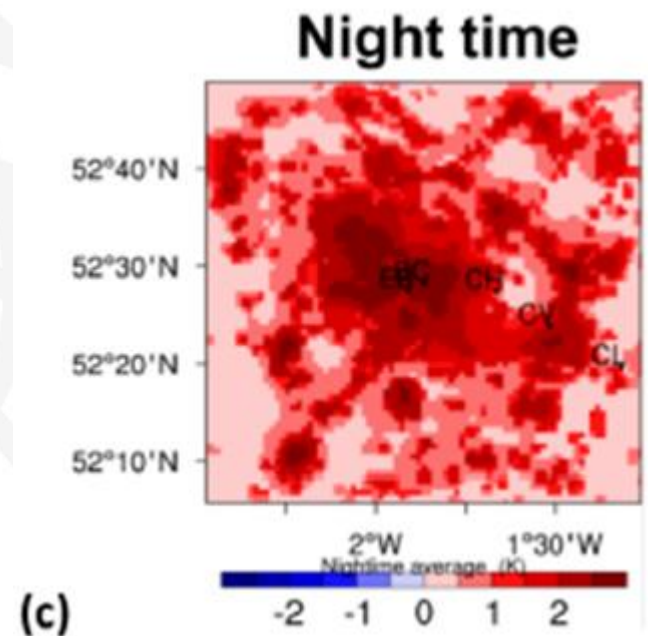
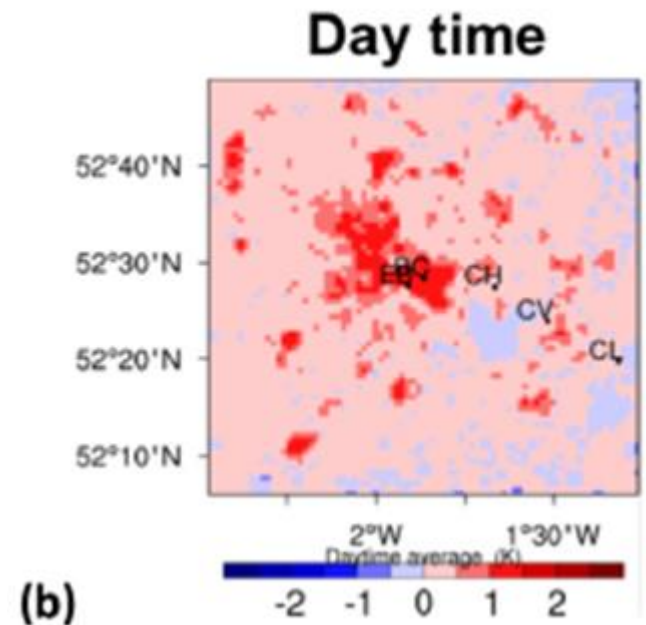
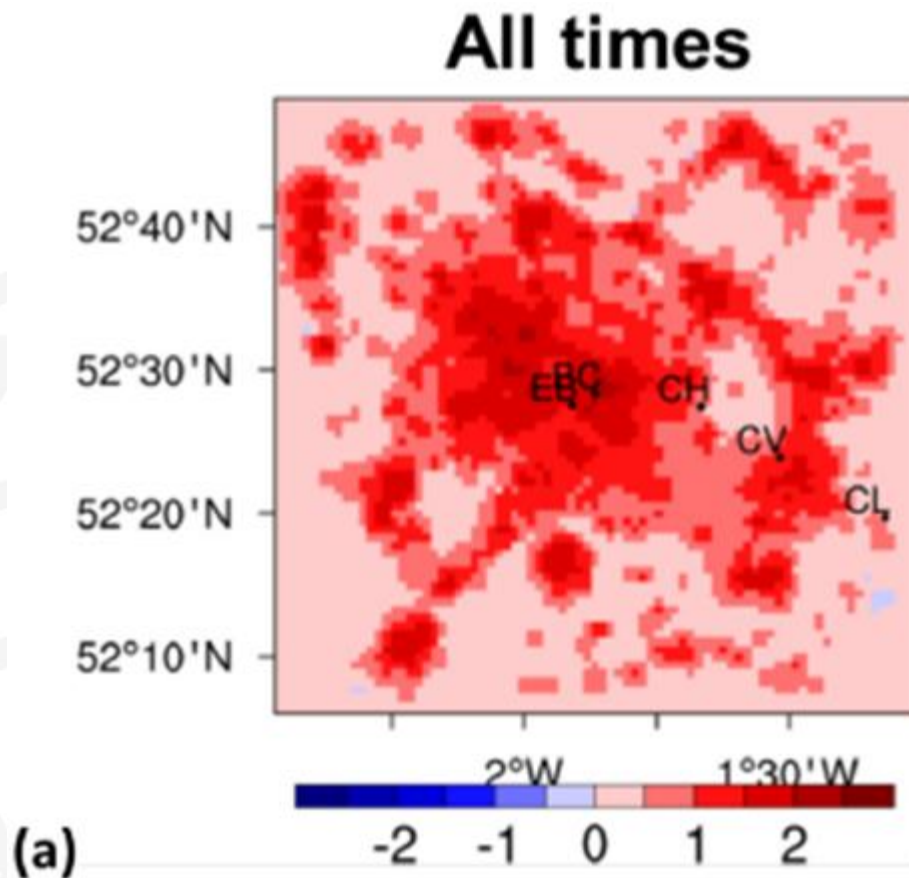
(a)

July 2006 heatwave



(b)

UHI Intensity

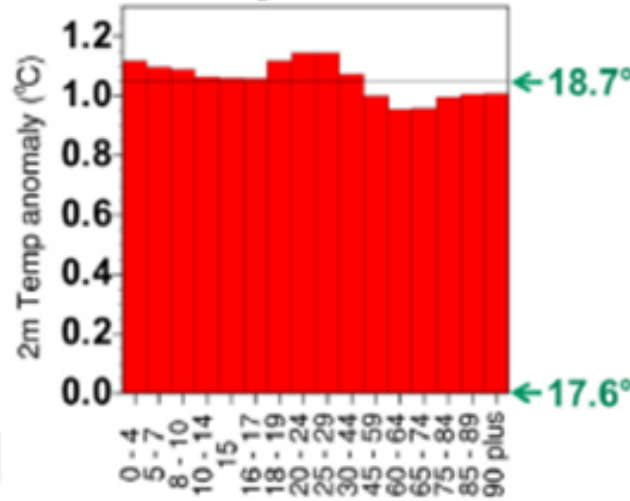


Age group

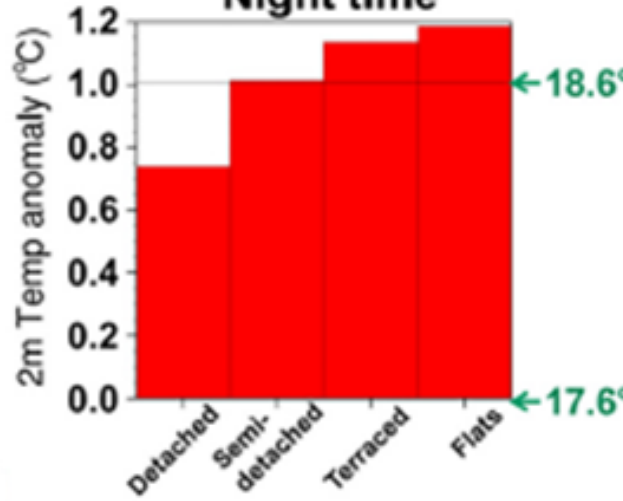
Housing

Deprivation

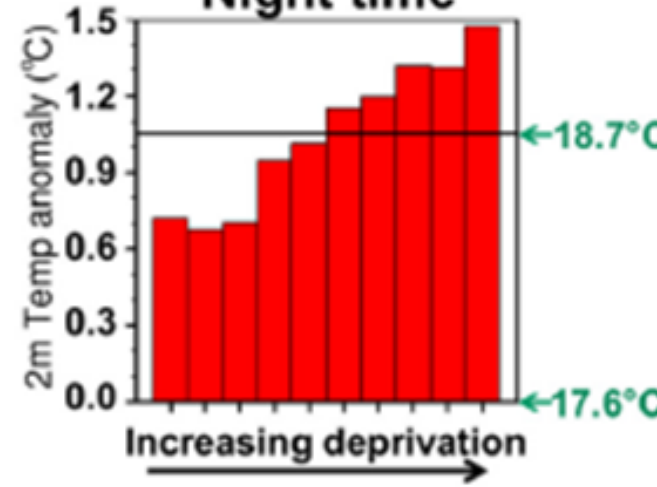
Night time



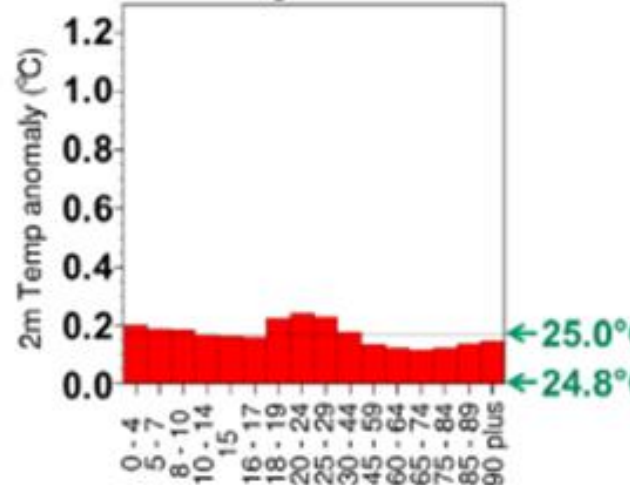
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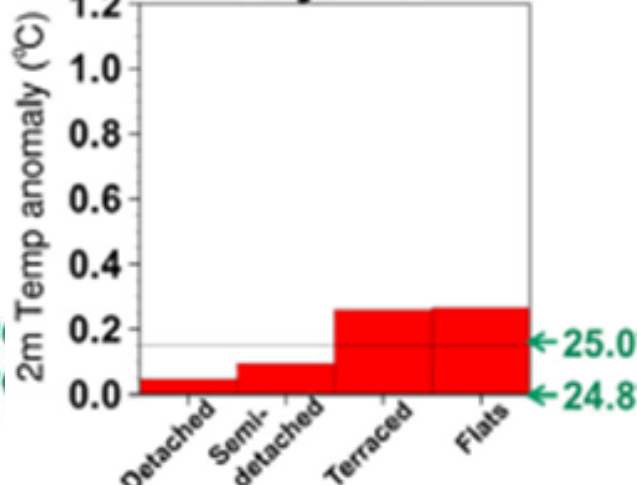
Night time



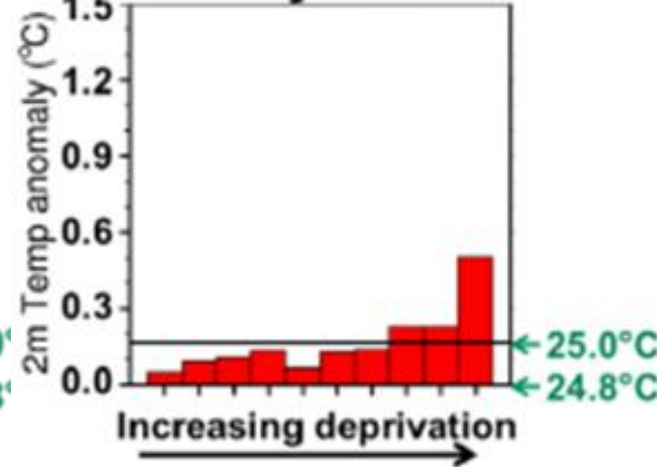
Day time



Day time

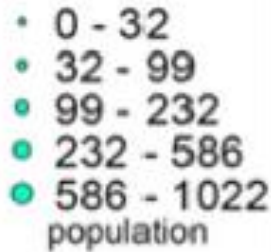
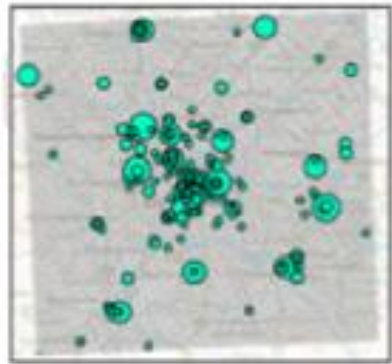


Day time

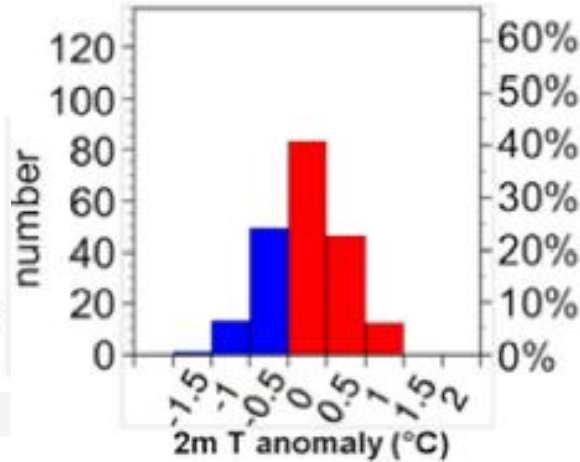


Sensitive locations - 1

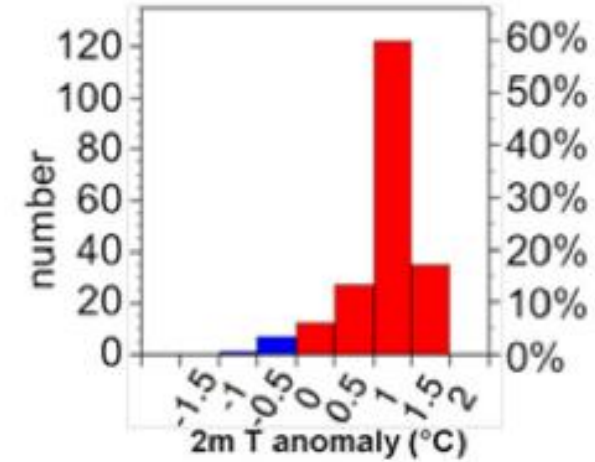
(a) Hospitals



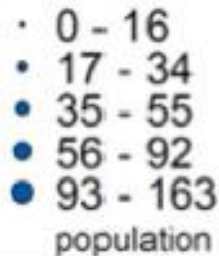
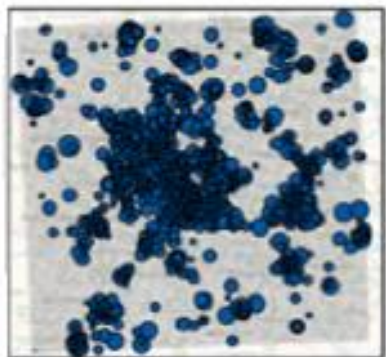
Day Time



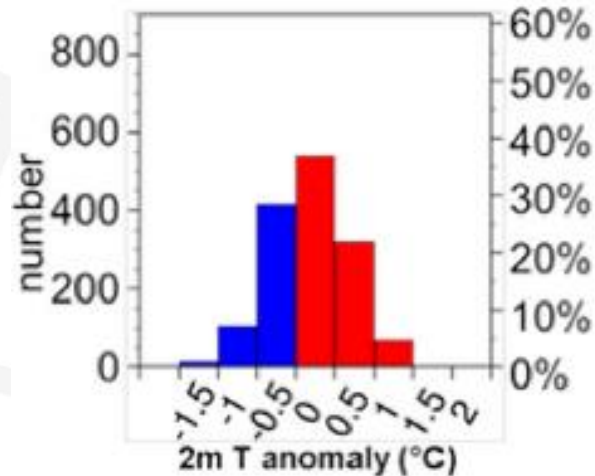
Night Time



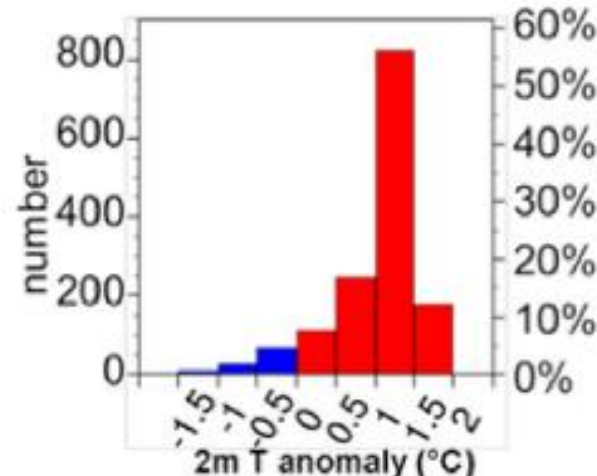
(b) Care homes



Day Time

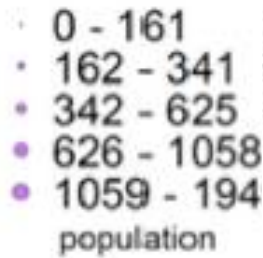
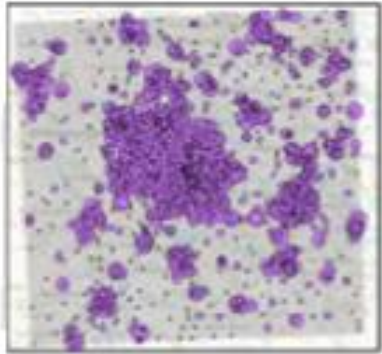


Night Time

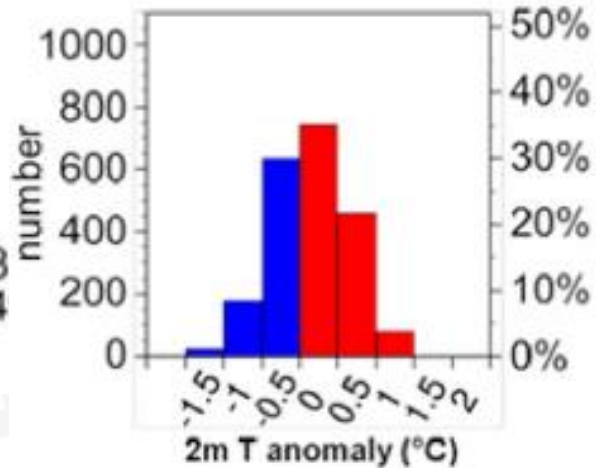


Sensitive locations - 2

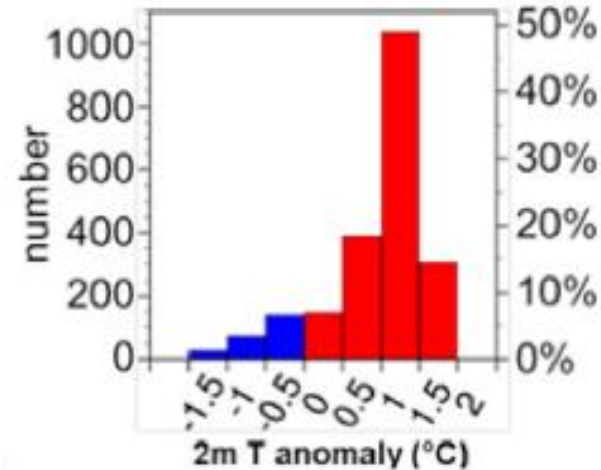
(c) Schools



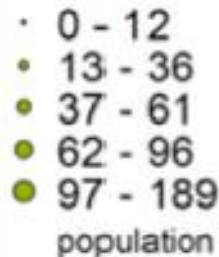
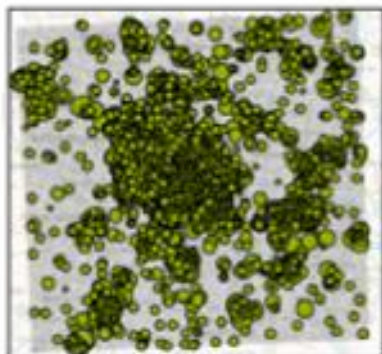
Day Time



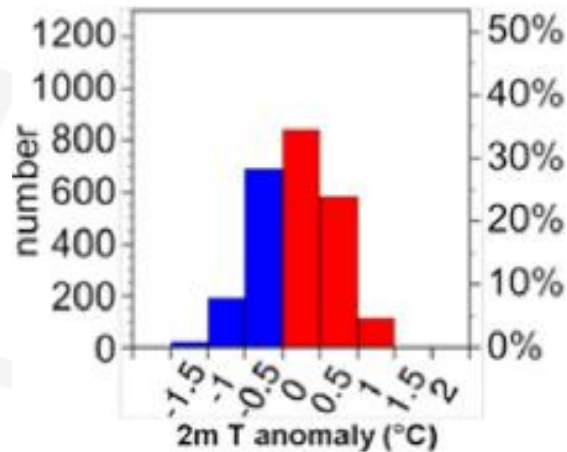
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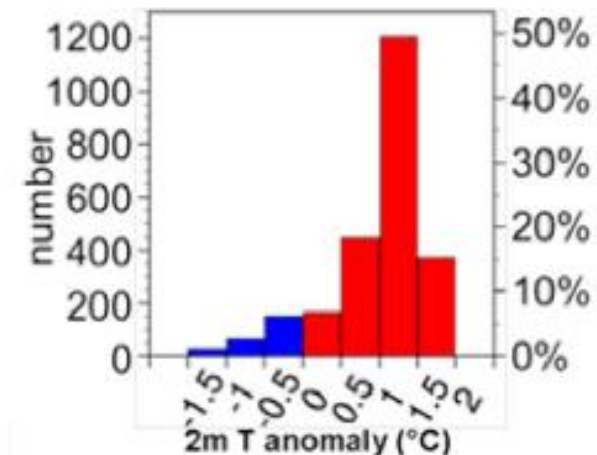
(d) Child care centres



Day Time



Night Time



Conclusions

- Climate change, population change, and the urban heat island are likely to alter heat related risk.
- There is evidence that across a number of different settings, population vulnerability to heat and heatwaves has been decreasing.
- The UHI intensity, housing types, and population characteristics are not evenly distributed, which may create areas of high risk of health effects from heat.
- Understanding how urban populations have adapted to heat over time, and identifying high risk urban areas, can inform future adaptation measures.



Public Health
England

The Heatwave Plan for England



Public Health
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Protecting and improving the nation's health



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

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Thank you!

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