

# The Urban Heat Island effect during heatwaves in Melbourne, Australia

Cassandra Rogers, Ailie Gallant and Nigel Tapper



**MONASH**  
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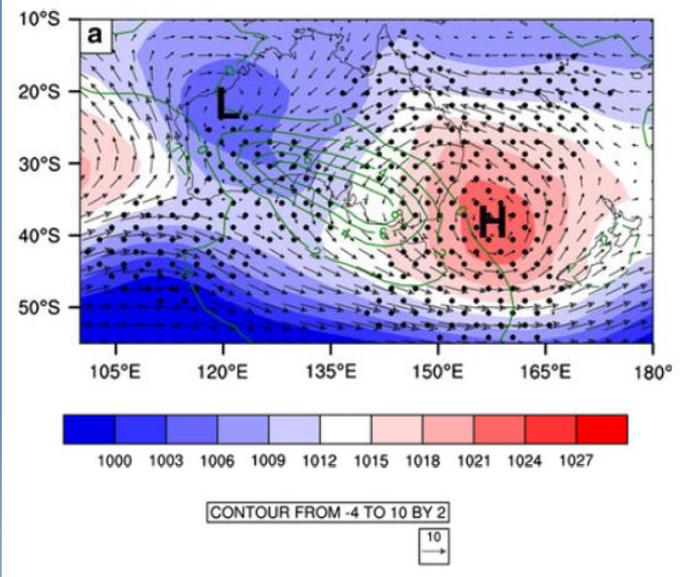


# Melbourne

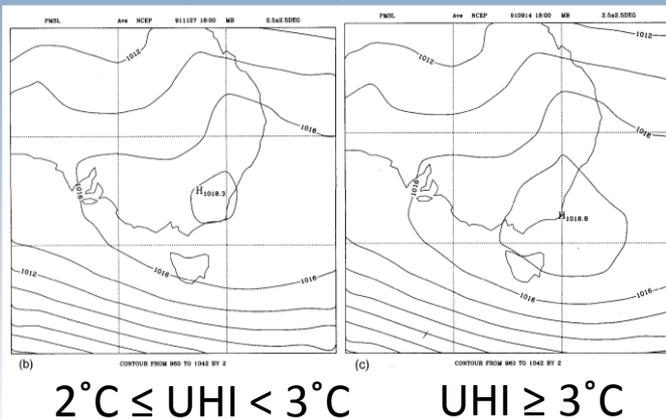
4.1 million people

Australia's second biggest city

# Similarities between heatwaves & urban heat islands



Source: Pezza et al., 2012



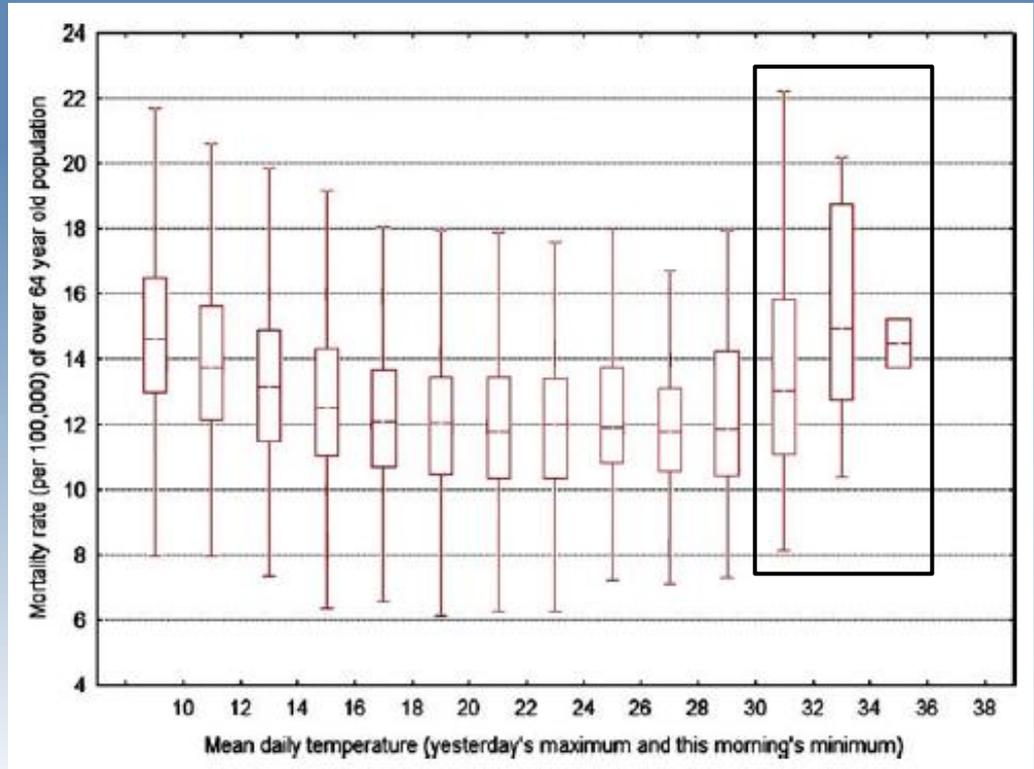
Source: Morris and Simmonds, 2000

In Melbourne:

- UHIs  $\geq 2^{\circ}\text{C}$  and heatwaves are both typically associated with high pressure systems to the south east of Australia
- Are heatwave events associated with stronger UHIs?

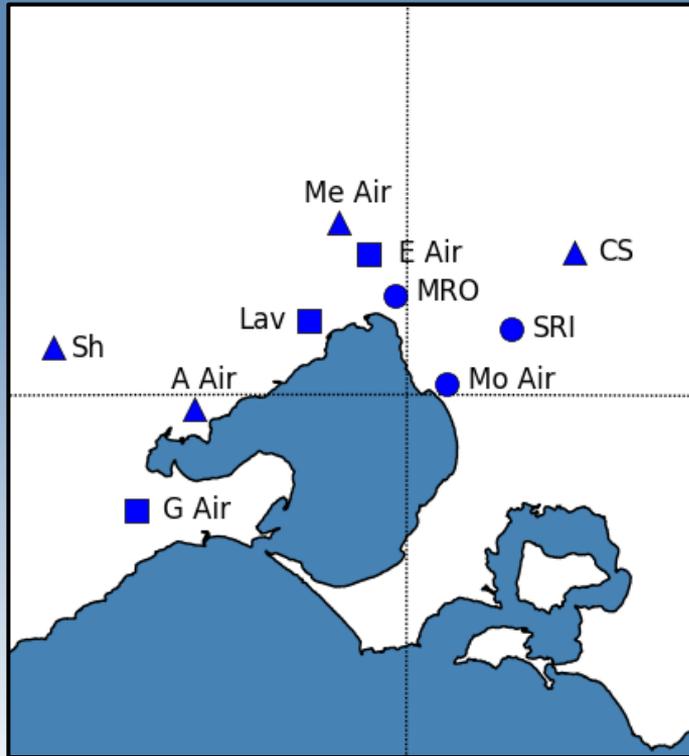
# Motivation: heat and health

- Small temperature increase = large increase in death rate (Nicholls et al. 2008)
- High nighttime temperatures are dangerous  
→ no recovery from daytime heat (Pascal et al., 2006)



Source: Nicholls et al., 2008

# Data: meteorological stations



Melbourne Station Location

Australian Bureau of  
Meteorology Automatic  
Weather Station data

3 hourly data

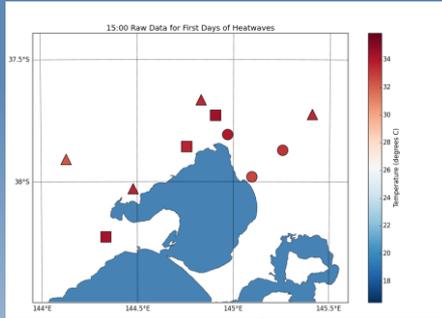
Circle = Urban  
Square = Urban Fringe  
Triangle = Rural

# Heatwaves and non-heatwaves

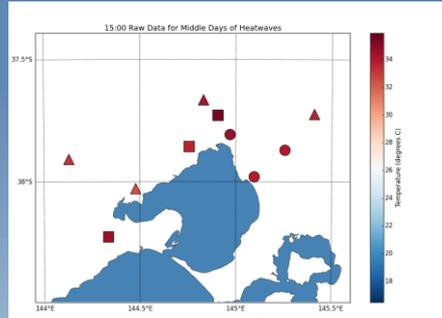
- ACORN-SAT data used to identify heatwaves
- Heatwave defined as:
  - Three or more consecutive days with maximum temperatures greater than the 90<sup>th</sup> percentile
  - Minimum temperatures of all days, except the first, is greater than the 90<sup>th</sup> percentile
- 31-day running mean used to calculate percentiles
- 19 heatwaves were identified from 1995 to 2014
- Monte Carlo simulations with bootstrapping for comparison of non-heatwave periods

# Temperatures during heatwaves

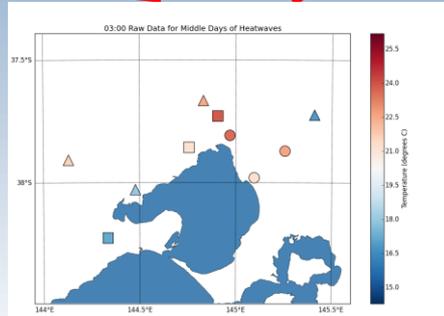
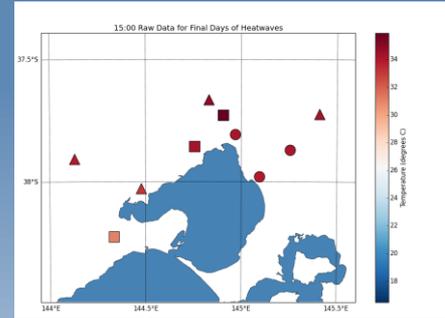
Start Day – 3 pm



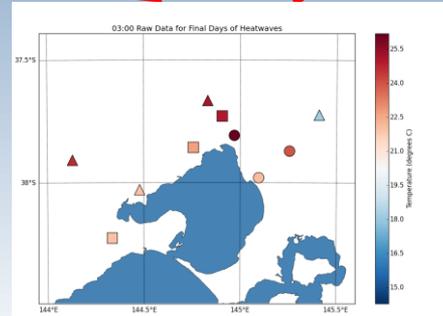
Middle Day – 3 pm



End Day – 3 pm

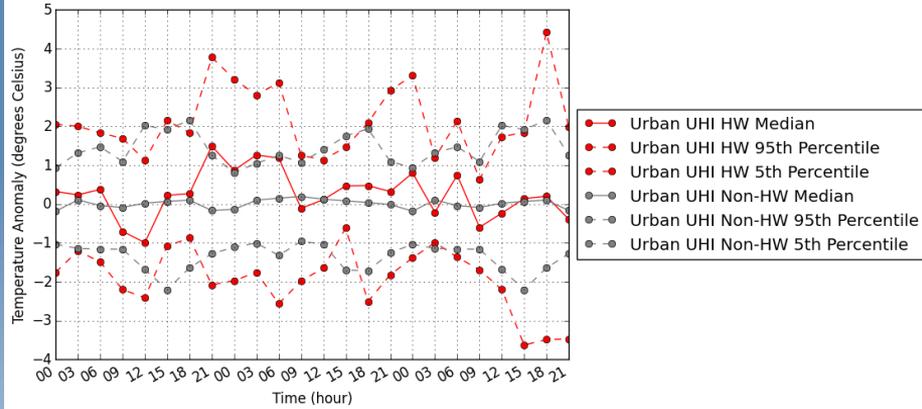


First Night – 3 am

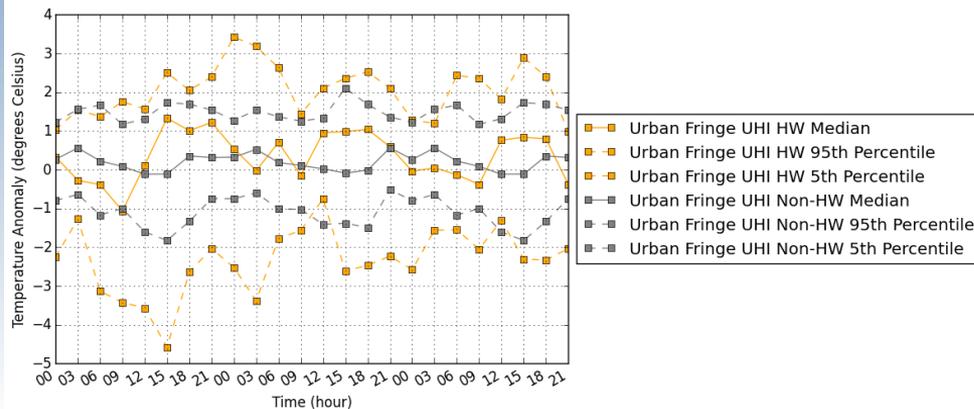


Second Night – 3 am

# UHI temperature anomaly progression



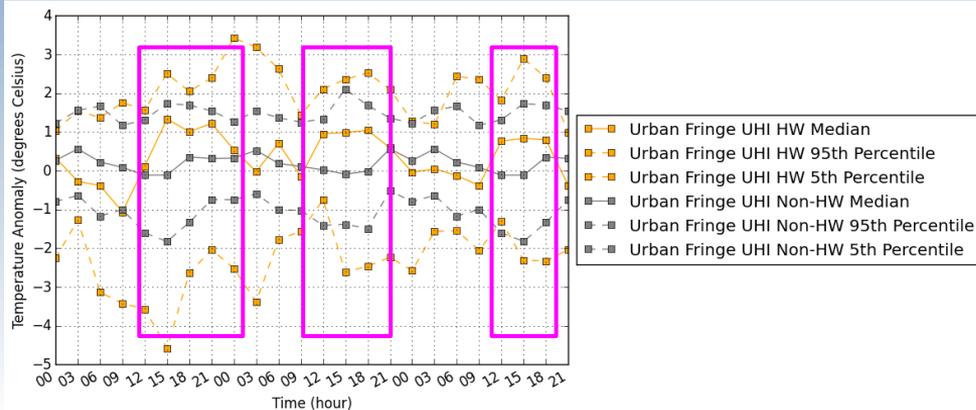
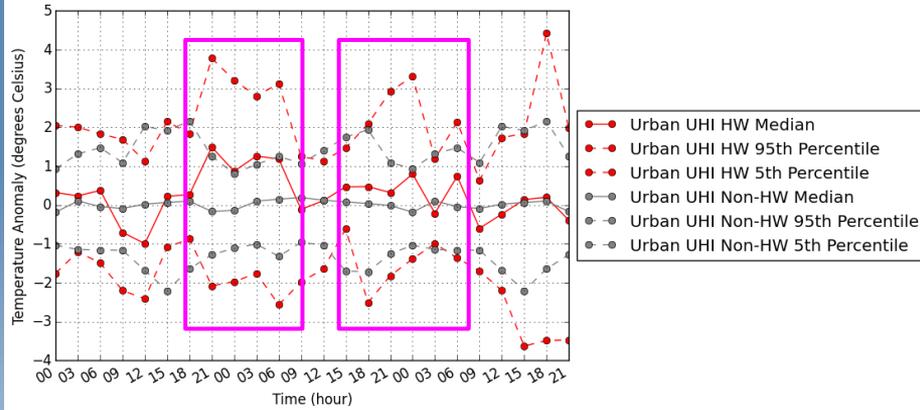
Urban sites minus rural sites



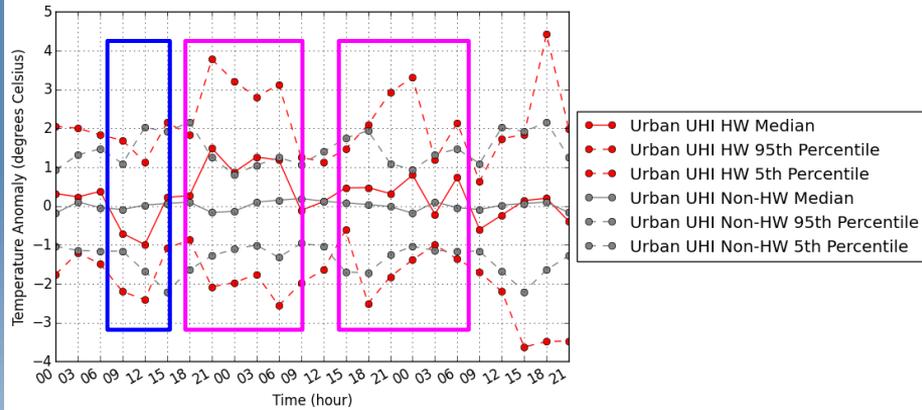
Urban fringe sites minus rural sites

# UHI temperature anomaly progression

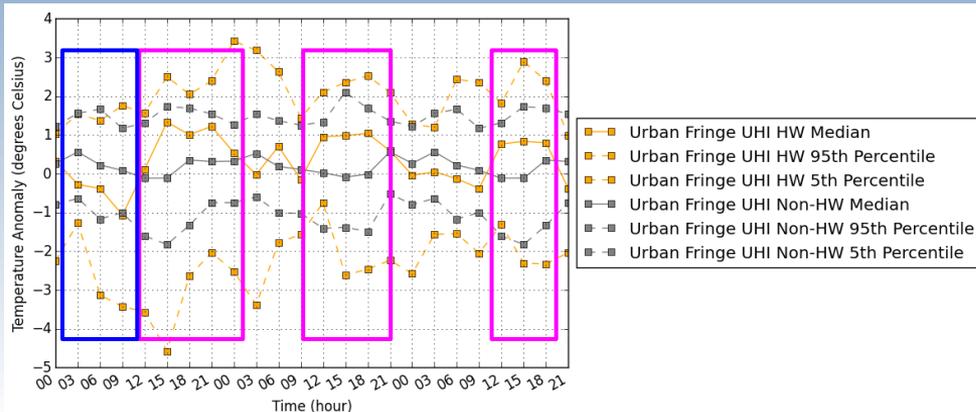
Pink areas show where the UHI is amplified during heatwaves compared to non-heatwave periods



# UHI temperature anomaly progression



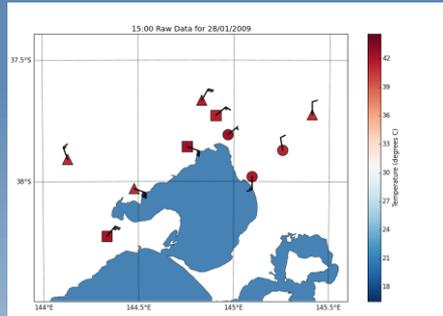
Pink areas show where the UHI is amplified during heatwaves compared to non-heatwave periods



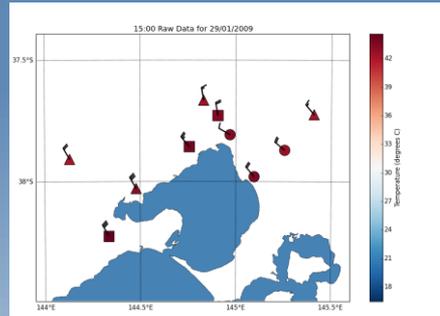
Blue areas show where the UHI is diminished during heatwaves

# Case study – January 2009 heatwave

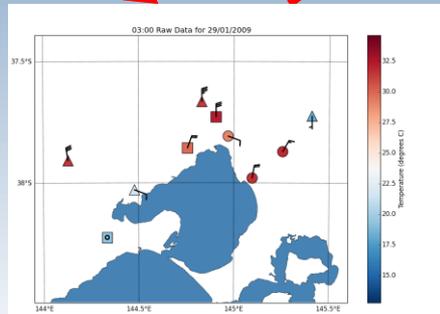
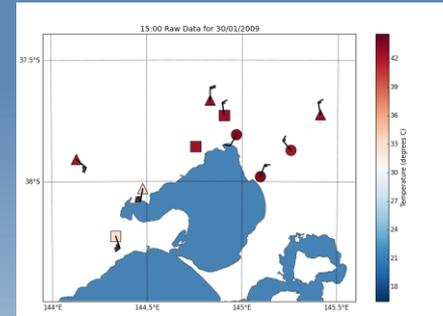
Start Day – 3 pm



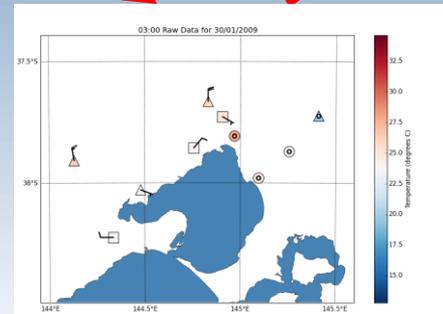
Middle Day – 3 pm



End Day – 3 pm



First Night – 3 am

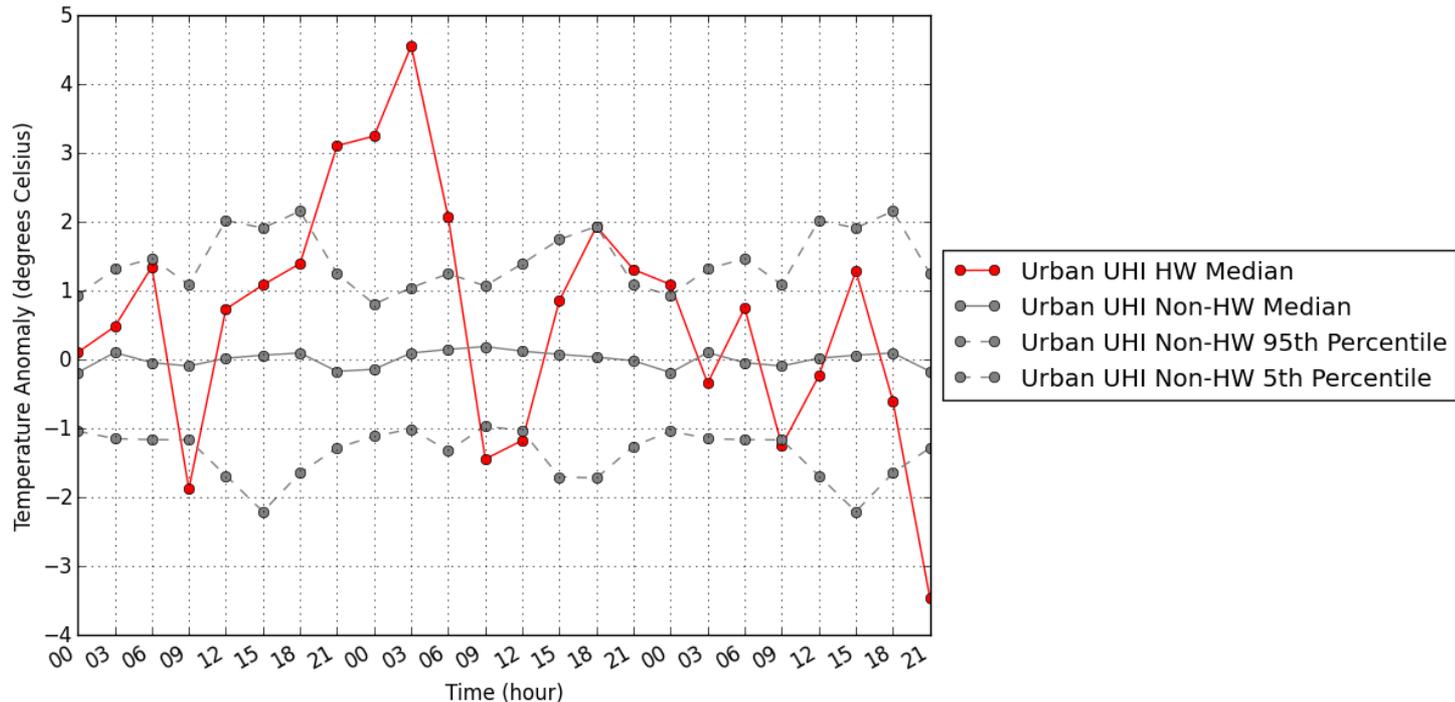


Second Night – 3 am



# Case study – January 2009 heatwave

UHI (urban – rural) anomaly progression during the pre-Black Saturday heatwave  
January 28 – January 30 2009



# Conclusions, limitations and future work

- Preliminary results show that the UHI is exacerbated during heatwaves in Melbourne
- The strength of the UHI is vulnerable to the characteristics of each site
- Future work – determine what influence the sea breeze is having on the results
- This research will be replicated to investigate the UHI effect during heatwaves in Adelaide and Perth

# Thank you

Thank you to Blair Trewin and the Bureau of Meteorology

## References

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