The Urban Heat Island effect during heatwaves in Melbourne, Australia

Cassandra Rogers, Ailie Gallant and Nigel Tapper
Melbourne
4.1 million people
Australia’s second biggest city
Similarities between heatwaves & urban heat islands

In Melbourne:

• UHIs ≥ 2°C and heatwaves are both typically associated with high pressure systems to the south east of Australia.

• Are heatwave events associated with stronger UHIs?

Source: Morris and Simmonds, 2000
Source: Pezza et al., 2012
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

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 90th percentile
  – Minimum temperatures of all days, except the first, is greater than the 90th 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
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

Temperature anomaly progression during the pre-Black Saturday heatwave
January 28 – January 30 2009
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.
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References


