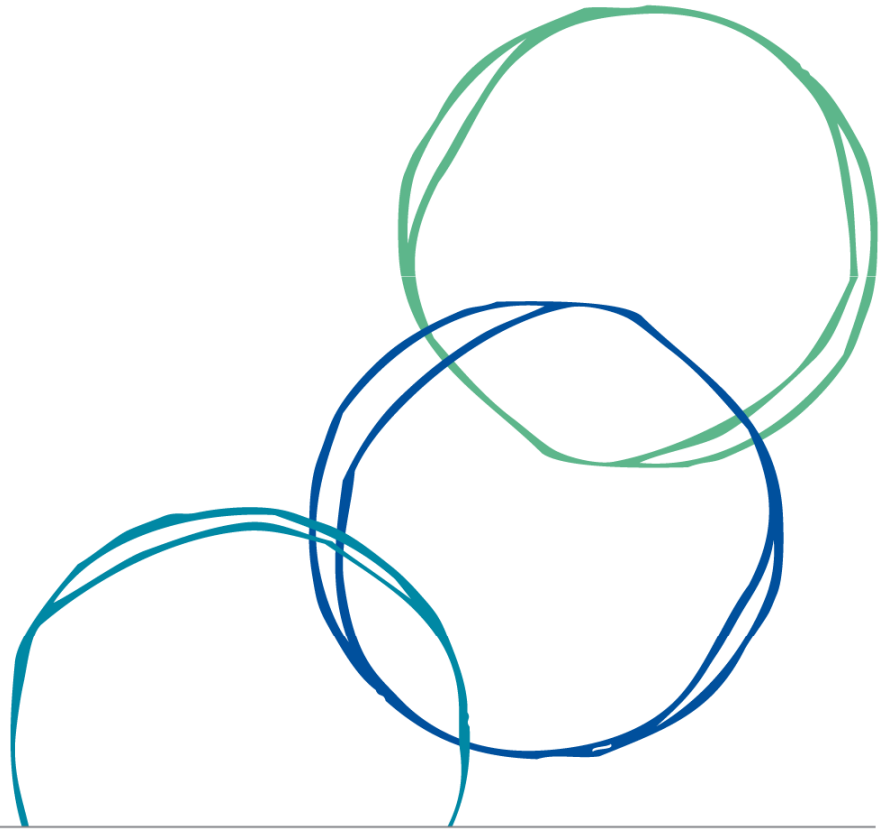
CRCLCL exemplar 4: Urban Microclimates - Evidence for Policy and Product Development

Dr Conrad H. Philipp
Postdoctoral Research Fellow
University of South Australia (UniSA)

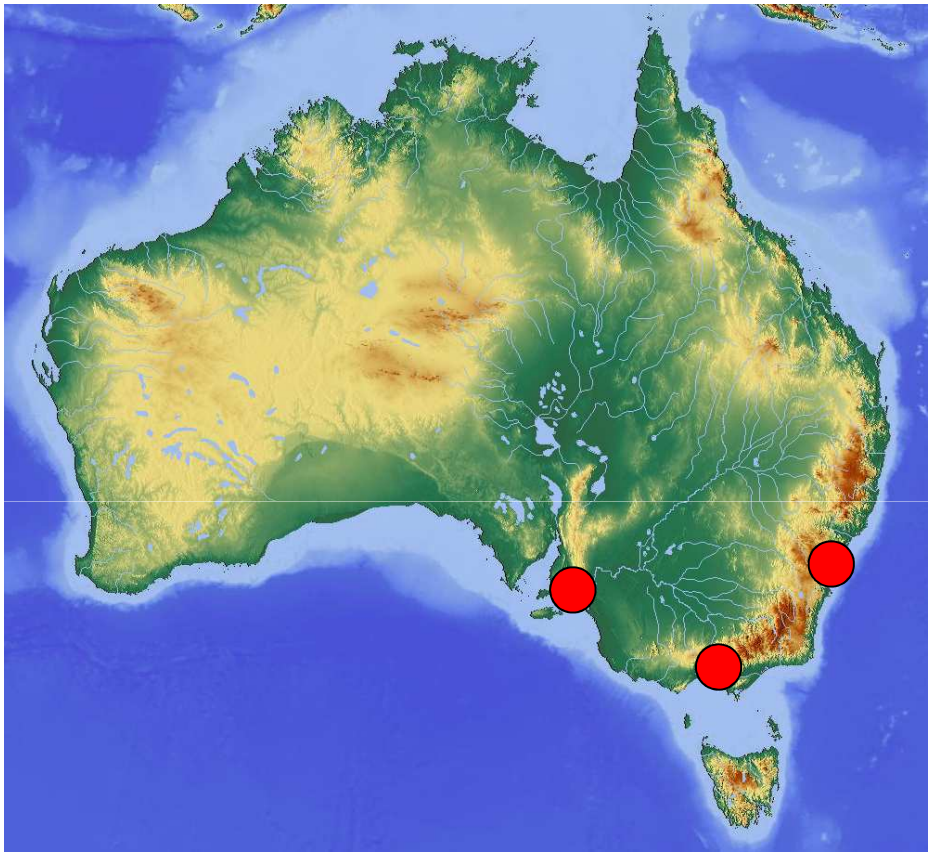
13 November 2014



URBAN CLIMATES RESEARCH

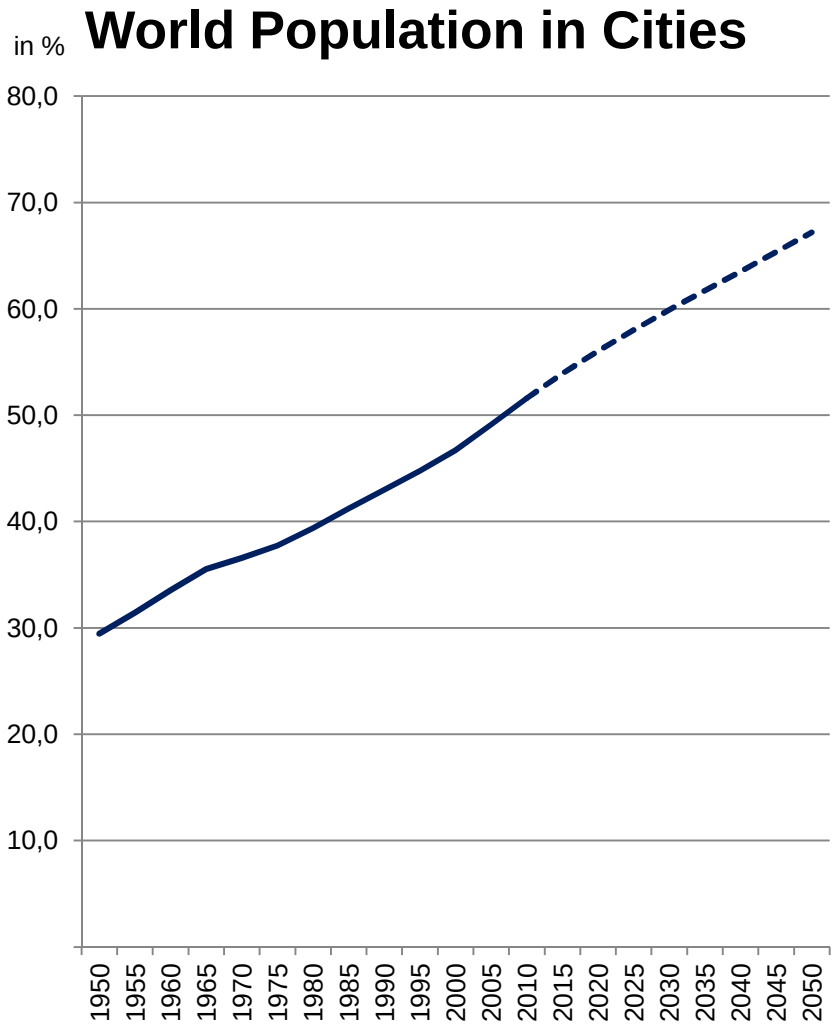
RP2005 Urban micro climates

- Urban microclimates is a study applying knowledge about urban microclimates in Sydney, Melbourne and Adelaide.
- The project aims for a sharing of information about urban micro climates between cities.
- The project outlines characteristics of urban microclimates, and aims to produce an effective way to monitor and record information about microclimates for use by planning agencies, service providers and developers.



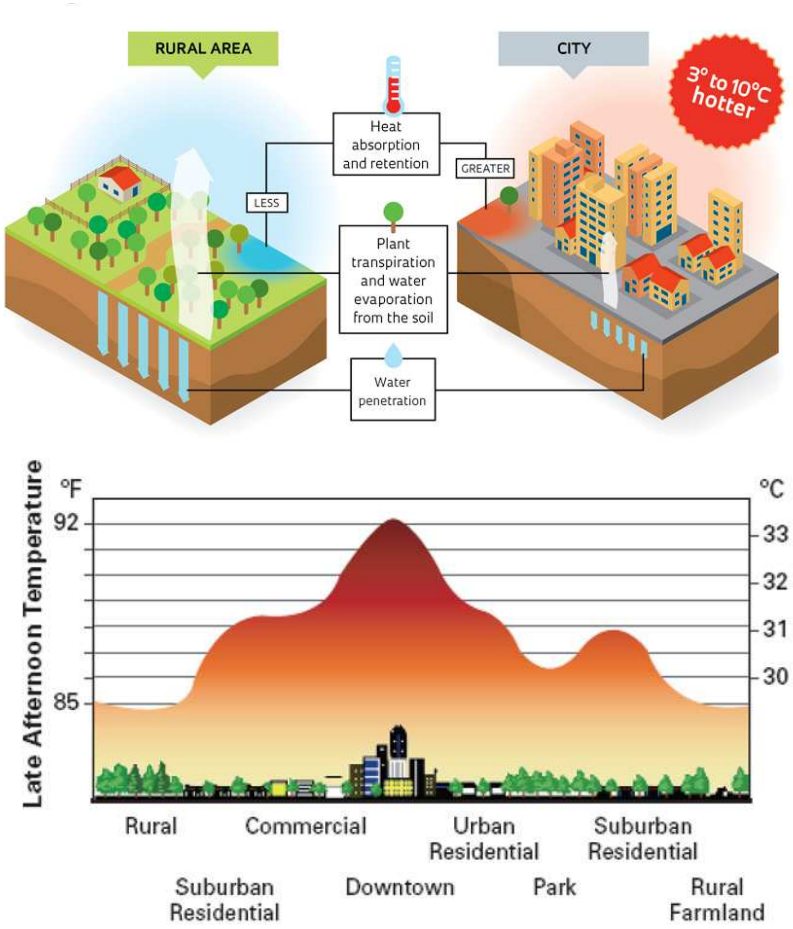
World Population

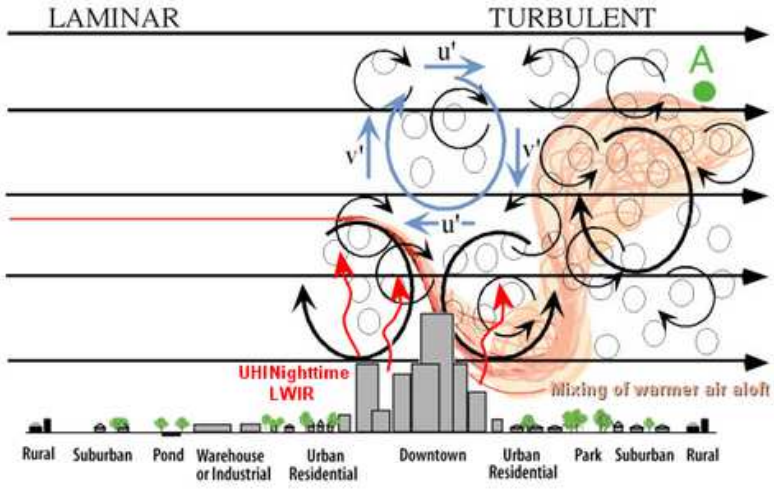
- Since 2007 more that 50% of global population now live in cities
- By 2050 in excess of 90% of Australia will be urban
- In 1970 only 2 “megacities” by 2027 there will be 37

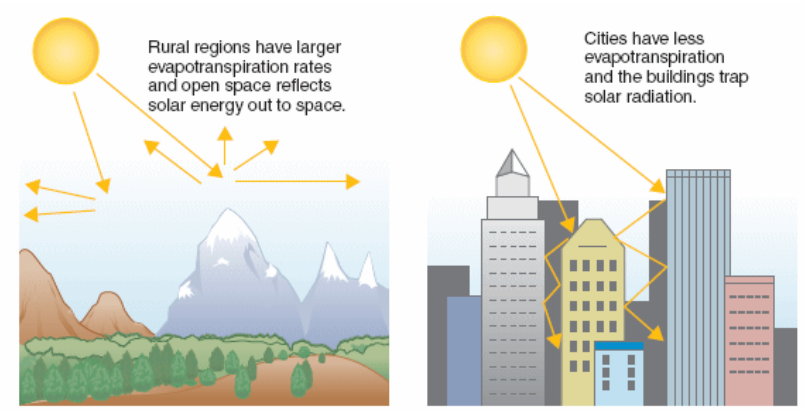


Source: World Bank 2014

Urban heat effect







URBAN CLIMATES RESEARCH

LOW CARBON LIVING CRC

Project Partners

BLUESCOPE

HASSELL

CITY OF SYDNEY

CITY OF MELBOURNE

Government of South Australia
Department of Environment, Water and Natural Resources

NSW GOVERNMENT
Office of Environment & Heritage

ADELAIDE CITY COUNCIL

Nursery & Garden Industry Australia

THE UNIVERSITY OF MELBOURNE

UNSW AUSTRALIA
Built Environment

University of South Australia

RP2005: Urban Micro Climates. Comparative study of major contributors to the Urban Heat Island effect in three Australian cities: Sydney, Melbourne and Adelaide

Theme (i)	Theme (ii)	Theme (iii)	Theme (iv)
Mapping of key contributors in different scales	Linking Quantities with Qualities in urban context	Comparative analysis of different strategies based on Australian context	Design framework for urban planners, designers and architects

URBAN CLIMATES RESEARCH

CRC for Low Carbon Living

CRC for Water Sensitive Cities (Monash U)

Post-Doc Research Fellow (UniSA): *Conrad H. Philipp*
Overall synthesis and coordination (0.6 FTE)

CI ... Tapper / Coutts (CRC-WSC)	CI ... Thompson (UNSW)	CI ... Osmond (UNSW)	CI ... Crocker (UniSA)	CI ... Boland (UniSA) *project leader*	CI ... Aye (UniMelb)	CI ... Fryd (UniMelb)
Vegetation, evaporation and comfort	Health impacts of urban microclimates	Green roofs, walls, materials and surfaces	Integration of strategies, qualities and social impacts	Climate change risk analysis and heat transfer	Urban Systems and metro-scale heat islands	Urban greenery and heat exchange

G. Hopkins (UniSA)
Research Fellow
'Green Walls'

G. Smith (UTS)
Research Fellow
'Materials'

CRC PhD #1 (UNSW)
Urban microclimates and surface materials
Jonathan Fox

CRC PhD #2 (UniSA)
Urban microclimate: Retrofitting precincts for heatwave resilience
Gertrud Hatvani-Kovacs

CRC PhD #3 (UniMelb)
Urban microclimate modeling systems in city scale
under decision

PhD #4 (funded by UniSA)
Urban microclimates and public life/public space,
Ehsan Sharifi

PhD #5 (funded by UniMelb)
Urban policy and micro climates
Judy Bush

Interaction between the main research strands

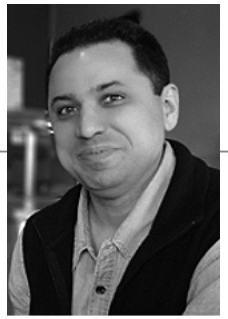
CRC Partners
City of Sydney: L. Sharman
City of Melbourne: G. Hall
NSW Gov: Office of Environment and Heritage: S. Dunford, M. Riley
SA Gov: DEWNR; Renewal SA; Zero Waste SA; DMITRE
HASSELL: K. Maher, B. Pollard
BlueScope Steel: J. Adams

3rd Party Project Partners
City of Adelaide: A. Stokes, P. Smith
Nursery & Garden Industry Australia: R. Prince

End-User Reference Group
Major Cities Unit, Commonwealth Gov
ASBEC and PIA
Local Government Association
City of Perth
City of Brisbane
City of Parramatta
CSIRO

Gertrud H.-Kovacs

Ehsan Sharifi



Judy Bush

Jonathan Fox

LOW CARBON LIVING CRC

Design: C. Thorton

Comparative Study of Urban Heat Islands*

A five scale methodology across three Australian cities on macro & micro levels.

Jonathan Fox: PhD Researcher - UNSW.

Thermal analysis, facades & walls.

Aims to establish predictive relations between façade design and their thermal characteristics (i.e. surface and air temperatures) by developing a vertical surface thermal classification tool.

- Individual buildings
- Relationship between vertical surfaces, material and outdoor
- Micrometeorology and thermodynamics

Development of a classification tool will enable architects, planners and decision-makers to make informed choices about the microclimatic effects of building design. Surface, air and mean radiant temperature information will be derived from material selection and façade composition options.

Ehsan Sharifi: PhD Researcher - UniSA.

Socio-behavioural analysis.

Heat stress in higher densities affects the usability of public space and quality of public life. This research investigates correlations between urban microclimate variables of temperature, humidity and shade with the activity patterns of public life in five public spaces of Adelaide, Sydney and Melbourne, with the aim of:

- Highlighing the importance of microclimate modification.
- Underline the need for climate responsive public spaces.
- Identify links across quantities/quality in heat resilient space.
- Explore opportunities for public space adaptation to heat.

Outcomes will include the development of a heat resilient assessment tool and an index system to analyse and mitigate the heat stress in public spaces.

Conrad Philipp: UCR Coordinator & Research Fellow - UniSA.

Satellite thermal imaging.

City-scale calculations are possible using remote thermal images. The Landsat 7 satellite allows the use of data across a timeframe since 1999. Around 90 thermal images will be investigated for each region of Melbourne, Sydney and Adelaide. In relation to the land use types the land surface temperature will be calculated to identify urban heat spots in the CBD and the suburbs for each of these cities.

- Heat studies (CBD and suburbs) in Adel' , Melb' & Syd'.
- Urban remote sensing calculation's (Landsat 7/8)
- Land surface calculations according to varying land use types.

Judy Bush: Phd Researcher - UoM.

Urban greenery & policy.

Examining policy, regulatory and communications approaches and strategies to support strengthened retention, expansion and efficacy of urban greenery in Australian cities, in relation to the urban heat island effect. This research will inform policy development and implementation, as well as improved practices and processes for knowledge translation between distinct communities and disciplines, contributing to trans-disciplinary and 'trans-cultural' endeavours to retain and expand urban greenery.

- City and nationwide research.
- Effective policy to maximise urban greenery.
- Implement science findings in policy.

PhD Researcher - UoM.

Thermal modelling of roof types.

Aims to identify Urban Hot Spots and capture diurnal variation in UHI intensity and spatial distribution of UHI on city-scale (including the urban heat effect in suburbs); To model impact of mitigation scenarios as a percentage increase in Green Roofs & Reflective Surfaces; And, discuss what temperature decreases (spatial and temporal) can be expected. Develop guidance for UHI planning (Building regs, location based mitigation) and comparison of mitigation costs / benefits.

- Heat island at urban scale (CBD and suburbs).
- City-scale modelling of diurnal variation and spatial distribution of UHI.
- Find best mitigation for expected drop in outdoor temp'.

Gertrud Hatvani-Kovacs: PhD Researcher - UniSA.

Urban precinct resilience & potential retrofitting.

Using precinct-scale case studies of metropolitan regions of Adelaide and Sydney to define the resilience of each precinct to urban heat waves. Analysis of the most significant factors of precinct resilience will be carried out to determine the best retrofitting techniques for existing precincts. Strategies will be evaluated in terms of energy and carbon efficiency, financial affordability and perceived acceptability by population.

- Precinct scale research on HW resilience in CBD & suburbs.
- Identify best precinct mitigation & adaptation techniques.
- Include population vulnerability in evaluation of potential mitigation adaptation techniques.

Scales of Observation Across All Three Metropolitain Areas:

		Adelaide		Melbourne		Sydney	
	Scale:	CBD	Suburb	CBD	Suburb	CBD	Suburb
Pip	medium			•	•		
Gertrud	medium	•	•				•
Ehsan	medium	•		•		•	
Judy	large			•	•		
Jonathan	fine	•	•	•	•	•	•
Conrad	large	•	•	•	•	•	•

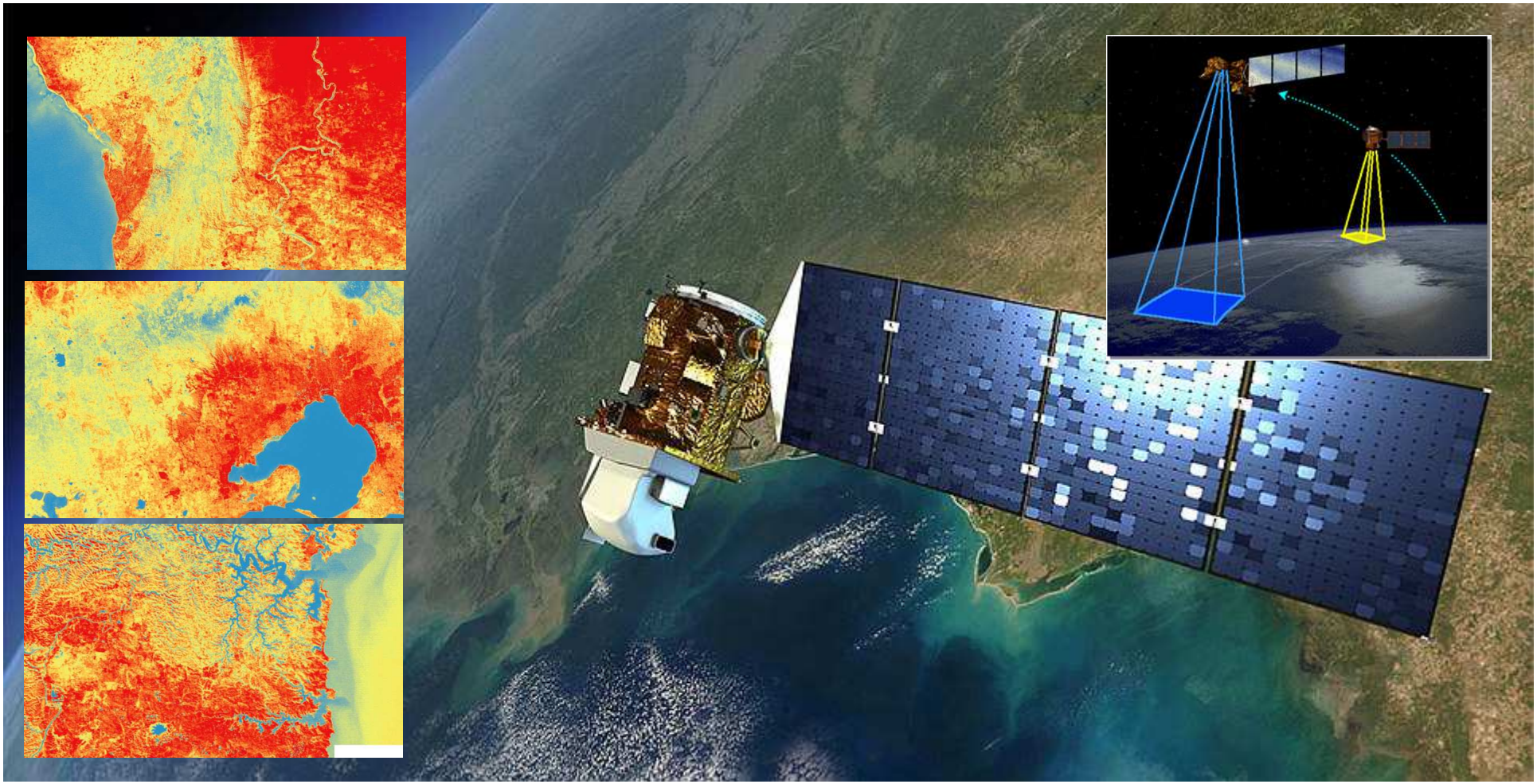
In partnership with:

LOW CARBON LIVING CRC

Measurements of the land surface temperature

Remote sensing technique

Source: C. Philipp

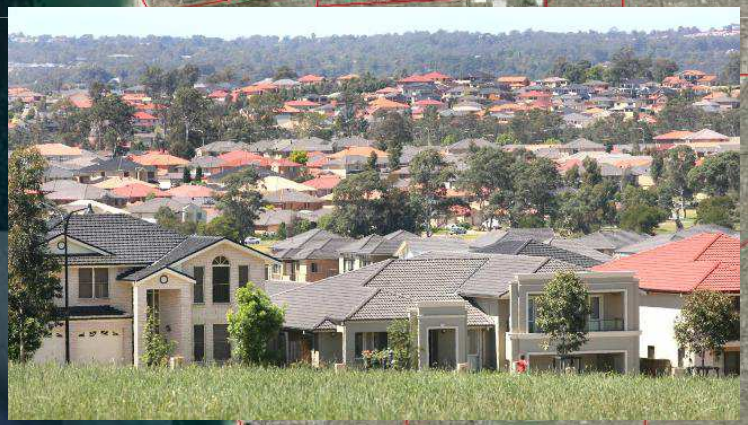


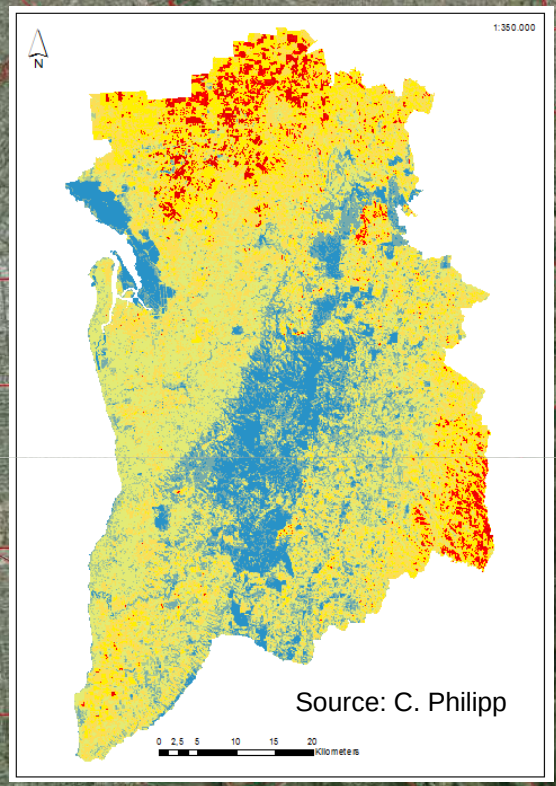
URBAN CLIMATES RESEARCH

LOW CARBON LIVING CRC

Measurements of the land surface temperature

Thermal conditions of the CBD of Adelaide compared to the suburbs?





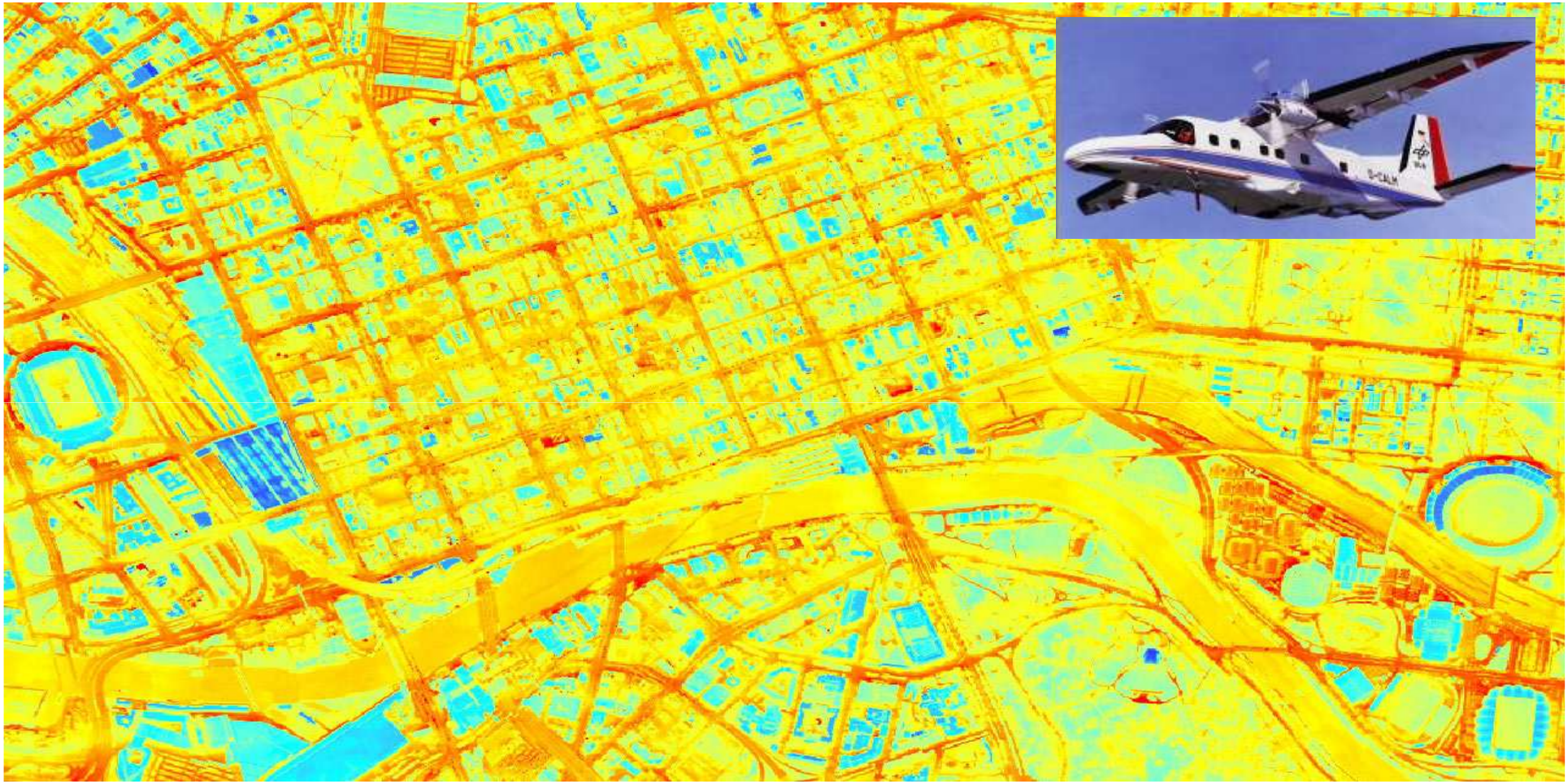
URBAN CLIMATES RESEARCH

LOW CARBON LIVING CRC

Measurements of the land surface temperature

Aerial flyovers with thermal sensory equipment

Source: CC Melbourne

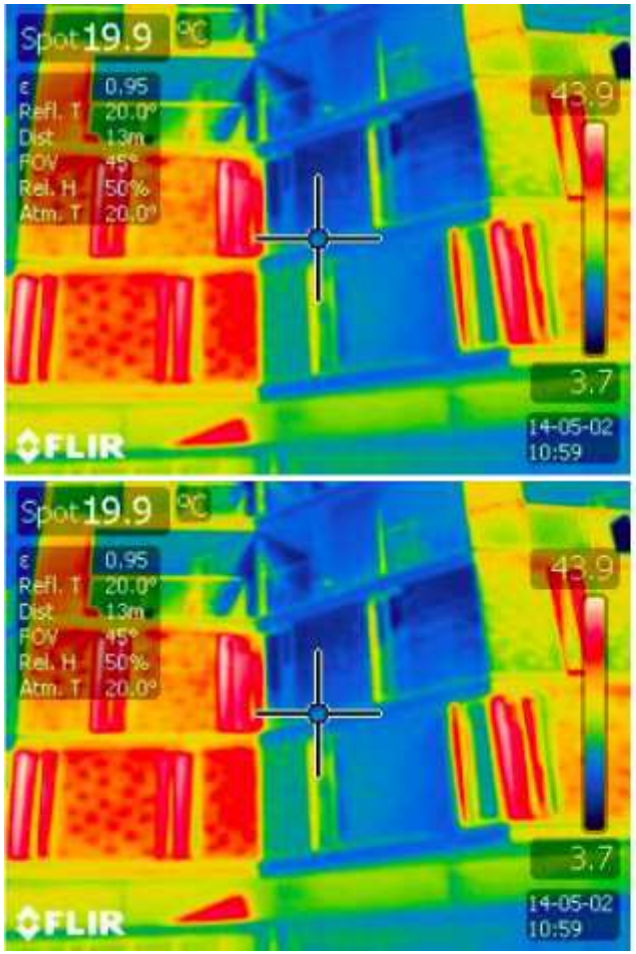


URBAN CLIMATES RESEARCH

LOW CARBON LIVING CRC

Measurements of the land surface temperature

Thermal hand cameras (for example FLIR camera)



Source: BatesSmart Pty Ltd

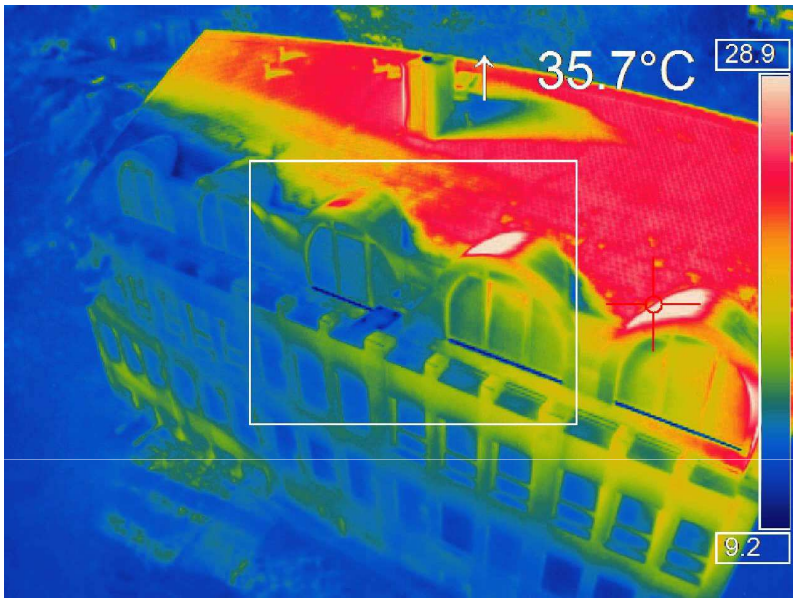
Source: Jonathan Fox

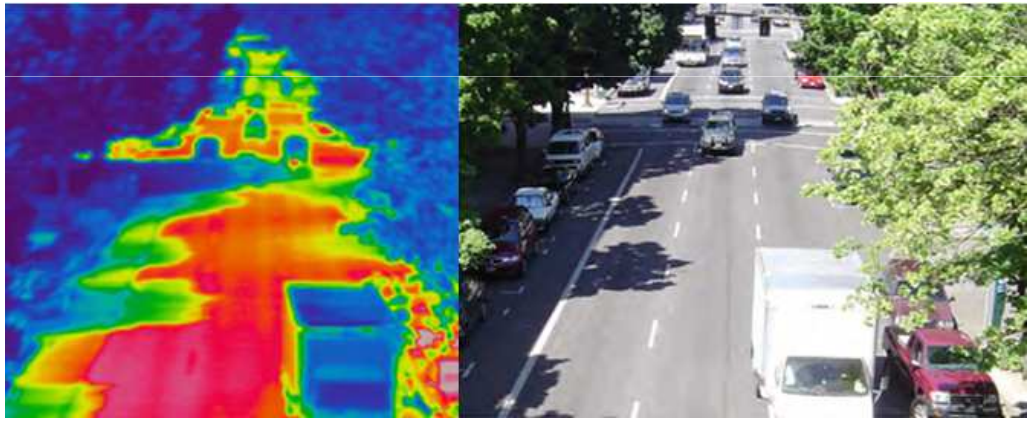
URBAN CLIMATES RESEARCH

LOW CARBON LIVING CRC

Measurements of the land surface temperature

Aerial flyovers using drones with thermal cameras attached



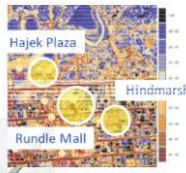


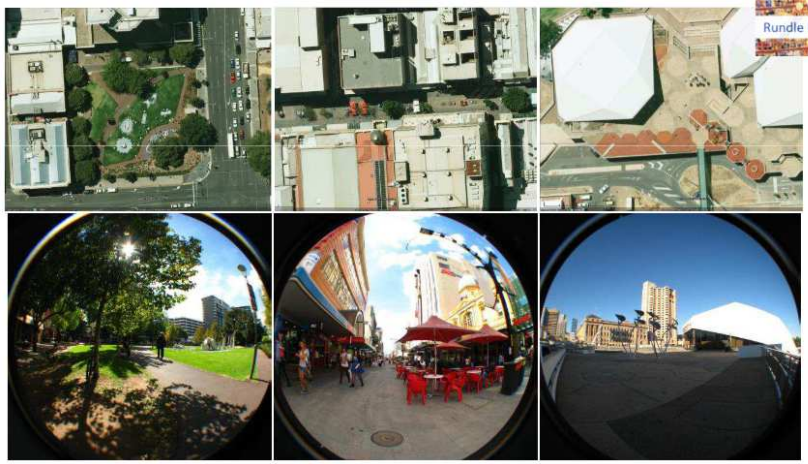
URBAN CLIMATES RESEARCH

LOW CARBON LIVING CRC

Activity thermal resilience and Urban Greenery

Source: Ehsan Sharifi





Source: Ehsan Sharifi

URBAN CLIMATES RESEARCH

LOW CARBON LIVING CRC

RP2005 Urban micro climates

Research topics:

- impact of LUT
- different climate
- rooftop colour
- seasonal effect
- building density
- urban hot spots
- change of land use type
- interaction between different land use types

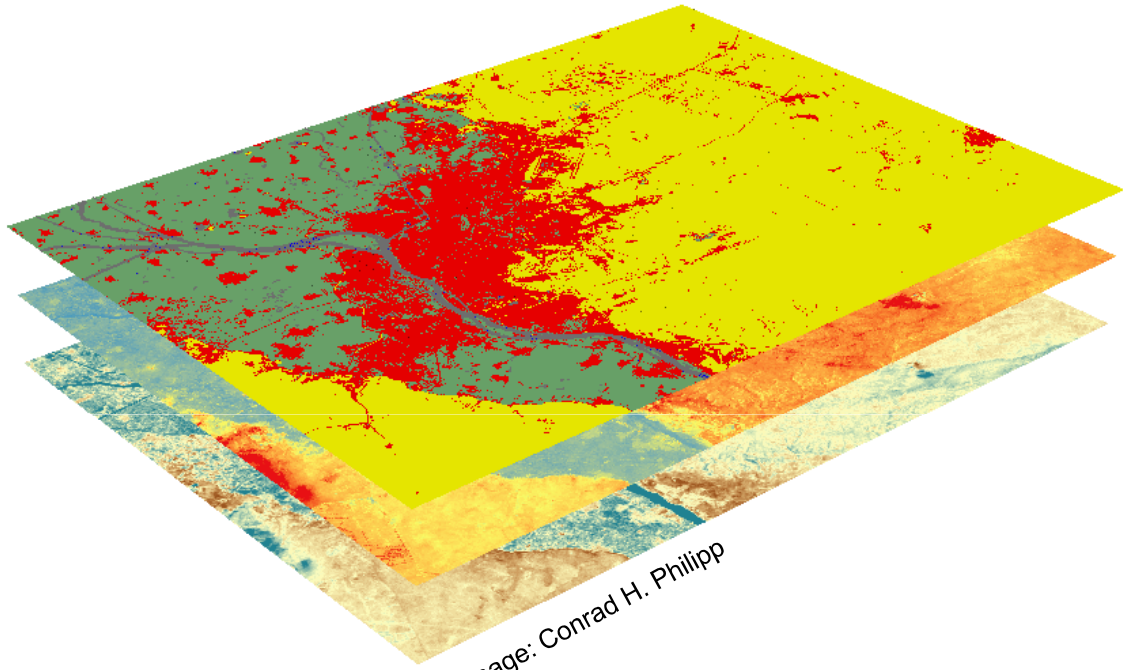
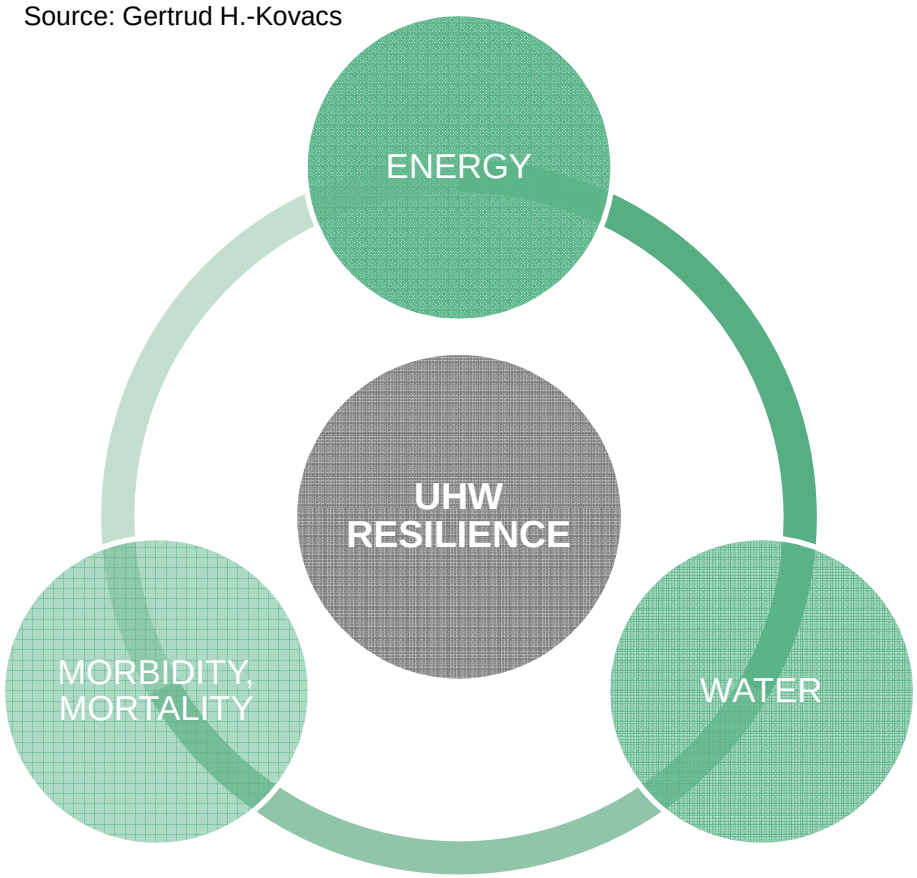


Image: Conrad H. Philipp

Urban microclimates: retrofitting Australian precincts for heat wave resilience

Source: Gertrud H.-Kovacs



1. Better knowledge about the heatwave resilience (CBD+suburbs)
2. Save energy, water, human life during heatwaves
3. Enhance indoor and outdoor thermal comfort
4. Name the best (and worst) urban design and architectural practises related to heatwave mitigation and adaptation
5. Supply a guide for practitioners and for building industry

Urban greenery and the urban heat island effect in Australian cities: policy and communication

Source: Judy Bush

- Investigate the sustainability transitions in mitigation of urban heat island effect, with policies for urban greenery as socio-technical transitions
- How theories of sustainability transitions can be applied in practice
- Working with local government, businesses and households to take action on climate change: energy efficiency and renewable energy
- Qualitative research in a case study with the Moreland Energy Foundation via data collection using policy documents and semi-structured interviews

Image: Gertrud H.-Kovacs

Conference participation & Workshops

Australia

The 2014 World Green Infrastructure Congress,
Sydney on 07 - 10 October

Climate Adaptation 2014 Future Challenges,
30 September - 02 October 2014

7th Making Cities Livable Conference,
9 - 11 July 2014

International

Bauhaus Summer School Weimar,
Weimar (Germany), 15 - 29 August 2014

Third International Conference on Countermeasures to Urban Heat Island,
Venice (Italy), 13 - 15 October 2014

ARUS advanced research in urban studies,
Essen (Germany), 20 - 21 October 2014

CRC RP2005 Workshops:

1st - 11 October 2013 - UniSA

2nd - 21 February 2014- UNSW

3rd - 26 September 2014 - UoM

4th - April 2015 - UniSA

5th - November 2015 - UNSW

6th - June 2016 - UoM

Project website - Article in Newspapers - Booklet


Subscribe to The Fifth Estate

THEFIFTHESTATE OUR PLANET OUR REAL ESTATE

▼ Sections Jobs Business Property Sectors Politics Design & Tech Habitat eBooks

Urban heat island effect felt more strongly in humid cities

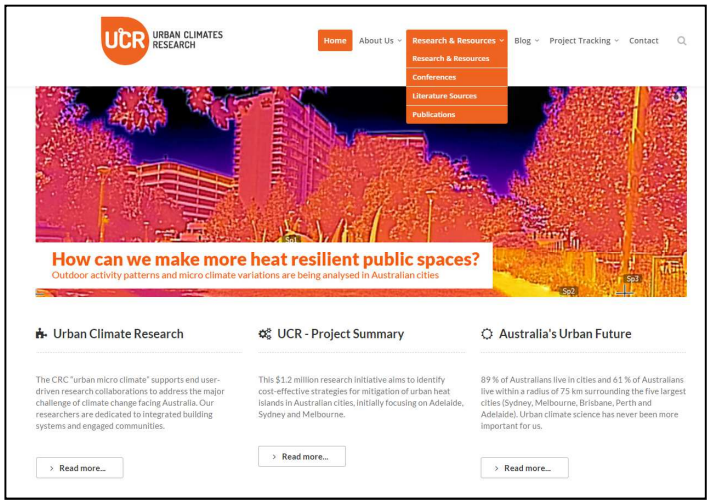
10 July 2014

10 July 2014 — BRIEF: A city's local background climate may have a greater role than previously thought in variations in the urban heat island effect — a phenomenon that causes many cities to be warmer than their rural surroundings.

The UHI effect has long been thought to be controlled by the lower rates of evaporative cooling in urban areas, which should tend to increase temperatures, but in a report published in Nature this week, Xuhui Lee and colleagues show that UHI variations can instead be explained by changes in the efficiency of convection between the land surface and the lower atmosphere.

If an urban area is aerodynamically smoother than surrounding rural areas it is harder for heat to disperse into the broader atmosphere and urban warming occurs; conversely, cooling tends to occur in urban areas that are aerodynamically rougher.

"The 'rougher' surfaces of the vegetation triggers turbulence, and turbulence removes heat from the surface to the atmosphere," lead author Lei Zhao said. "But where there is a smoother surface, there is less convection and the heat will be trapped in the surface."


URBAN CLIMATES RESEARCH

Home About Us Research & Resources Blog Project Tracking Contact

Research & Resources
Conferences
Literature Sources
Publications

How can we make more heat resilient public spaces?

Outdoor activity patterns and micro climate variations are being analysed in Australian cities

Urban Climate Research

The CRC "urban micro climate" supports end user-driven research collaborations to address the major challenge of climate change facing Australia. Our researchers are dedicated to integrated building systems and engaged communities.

› Read more...

UCR - Project Summary

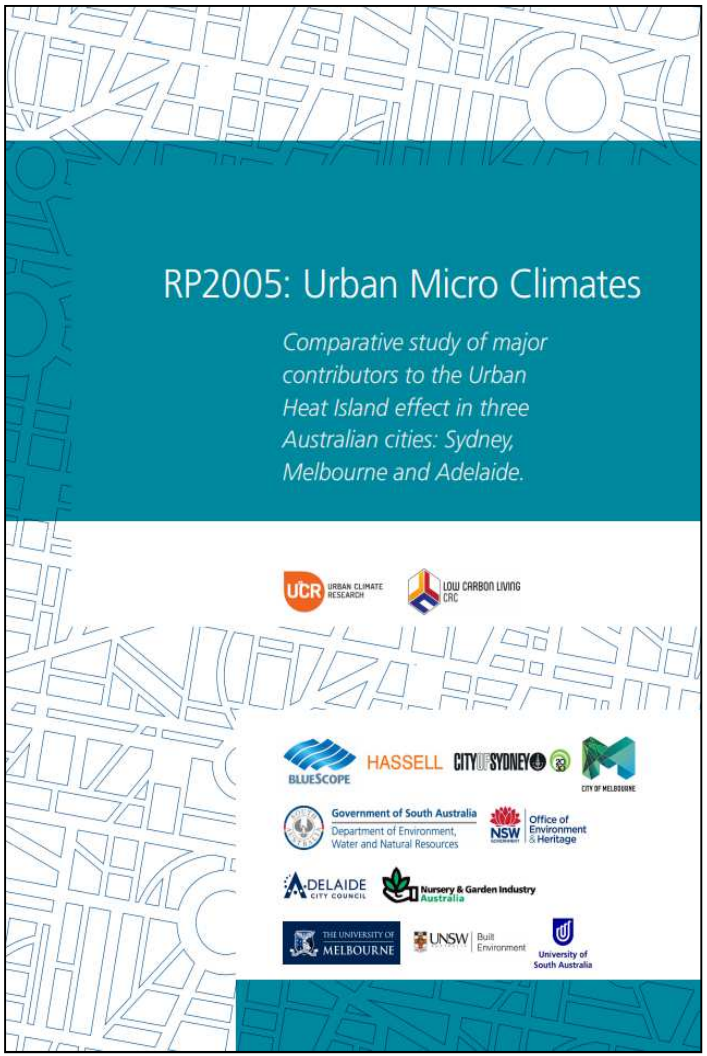
This $1.2 million research initiative aims to identify cost-effective strategies for mitigation of urban heat islands in Australian cities, initially focusing on Adelaide, Sydney and Melbourne.

› Read more...

Australia's Urban Future

89 % of Australians live in cities and 61 % of Australians live within a radius of 75 km surrounding the five largest cities (Sydney, Melbourne, Brisbane, Perth and Adelaide). Urban climate science has never been more important for us.

› Read more...



URBAN CLIMATES RESEARCH

LOW CARBON LIVING CRC

Thank you

To find out more, contact:

CRC for Low Carbon Living Ltd
www.lowcarbonlivingcrc.com.au

Room 202-207, Level 2
Tyree Energy Technologies Building
UNSW Sydney NSW 2052 Australia

Twitter: @CRC_LCL
info@lowcarbonlivingcrc.com.au
P: +61 2 9385 5402
F: +61 2 9385 5530

Extra contact details if required:

Dr Conrad H. Philipp

Postdoctoral Research Fellow
University of South Australia (UniSA)

conrad.philipp@unisa.edu.au