National Cool Cities Initiative

Creating the Evidence-base for Heat Resilient Urban Design and Planning

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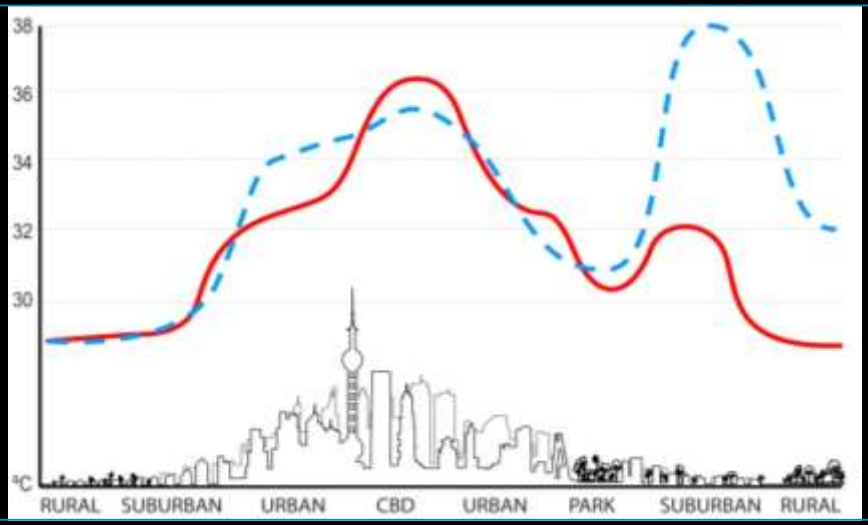
UNSW THE UNIVERSITY OF NEW SOUTH WALES | LOW CARBON LIVING CRC

NCCI - Significance

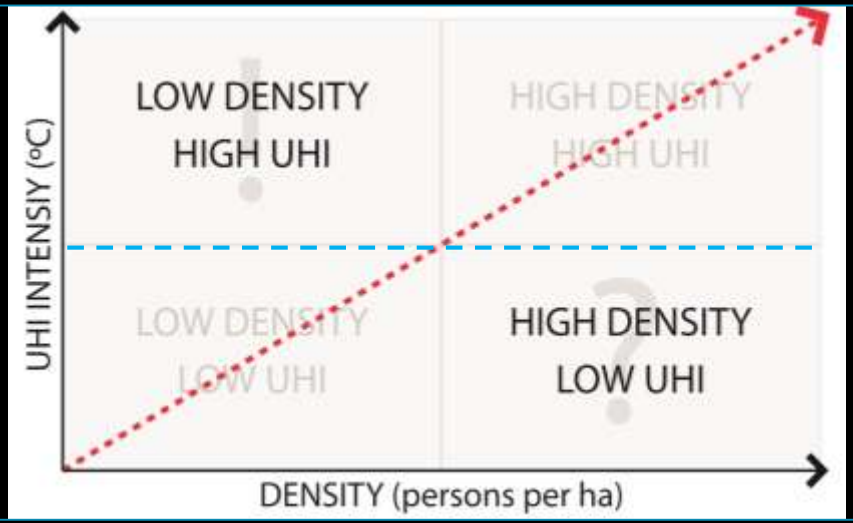
- New extremes: Cities now experience 45°C during prolonged heat waves
- Urban temperatures at street scale vary greatly due to urban form
- Positive relationship between urban density and Urban Heat Island Effect
- Climate change further amplifies Urban Heat Island Effect
- Current policy disregards urban microclimate and heat vulnerability
- Lack of understanding, information and tools



Canopy Layer Urban Heat Islands: The hottest neighbourhoods in Australia have low urban densities.

NCCI - Aims and Objectives

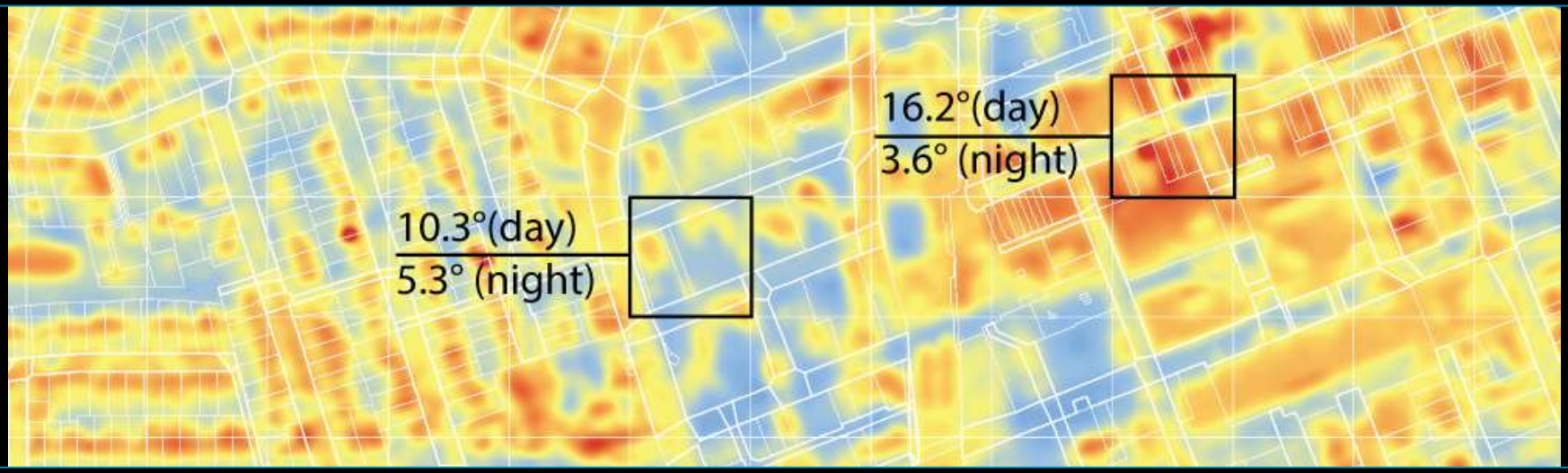
- **Creating the evidence-base** for heat resilient urban design, planning and policy;
- **Quantifying how the design of neighbourhoods influences urban temperatures at precinct and street scales** and thus the liveability and carbon footprint of our cities;
- Addressing the vital need for a **risk assessment and mitigation framework** to extreme heat events across the study area and other cities globally.



How can urban heat be mitigated while creating healthy, low carbon cities with higher urban densities?

NCCI - Outcomes

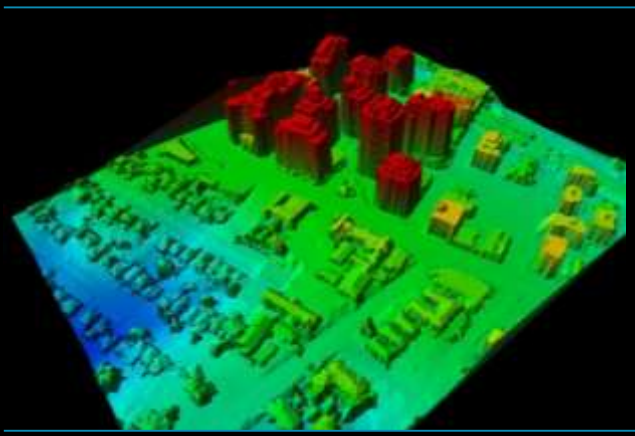
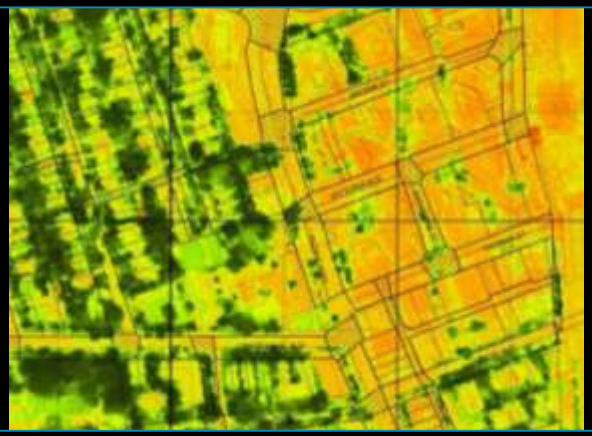
- **Providing easily accessible information and tools** to assess and avoid embedded vulnerability to extreme heat events;
- **Identifying high risk areas** to prioritize localized urban design interventions and **educate the community**;
- Developing nationwide **climate-sensitive urban design and planning guidelines** towards an **Australian Standard for urban heat resilience**.



Urban Heat Island intensity at pedestrian level can vary greatly across a city.

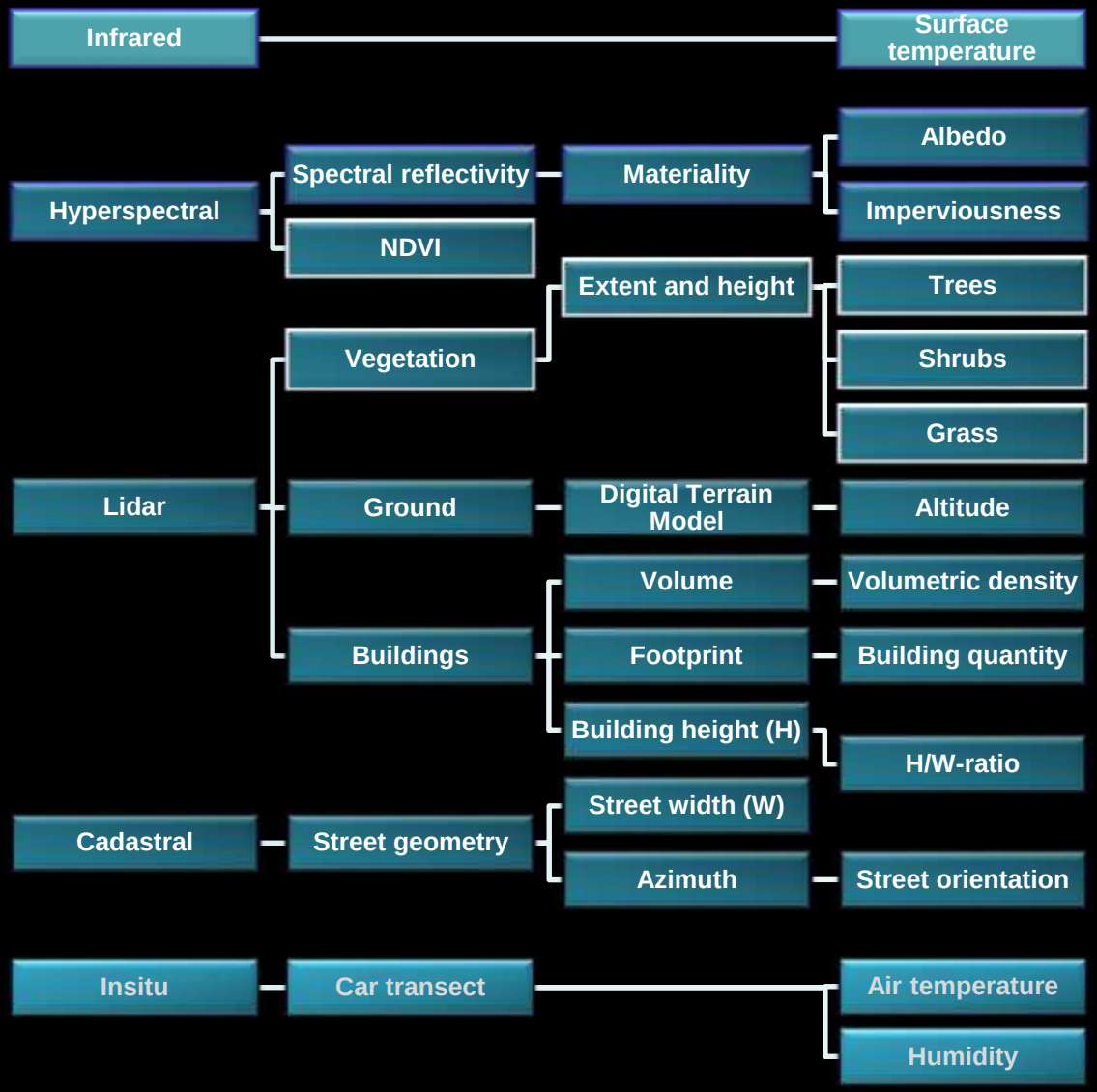
NCCI - IMPACT

- **Improving comfort, health and productivity of the community;**
- **Reducing the carbon footprint of the built environment**;
- Raising **community awareness**;
- Enabling a **review of** local design and planning **regulations**;
- Providing an **urban heat vulnerability assessment tool**;
- **Facilitating cost-benefit analysis** of targeted urban interventions for long-term risk reduction and immediate adaptation actions.

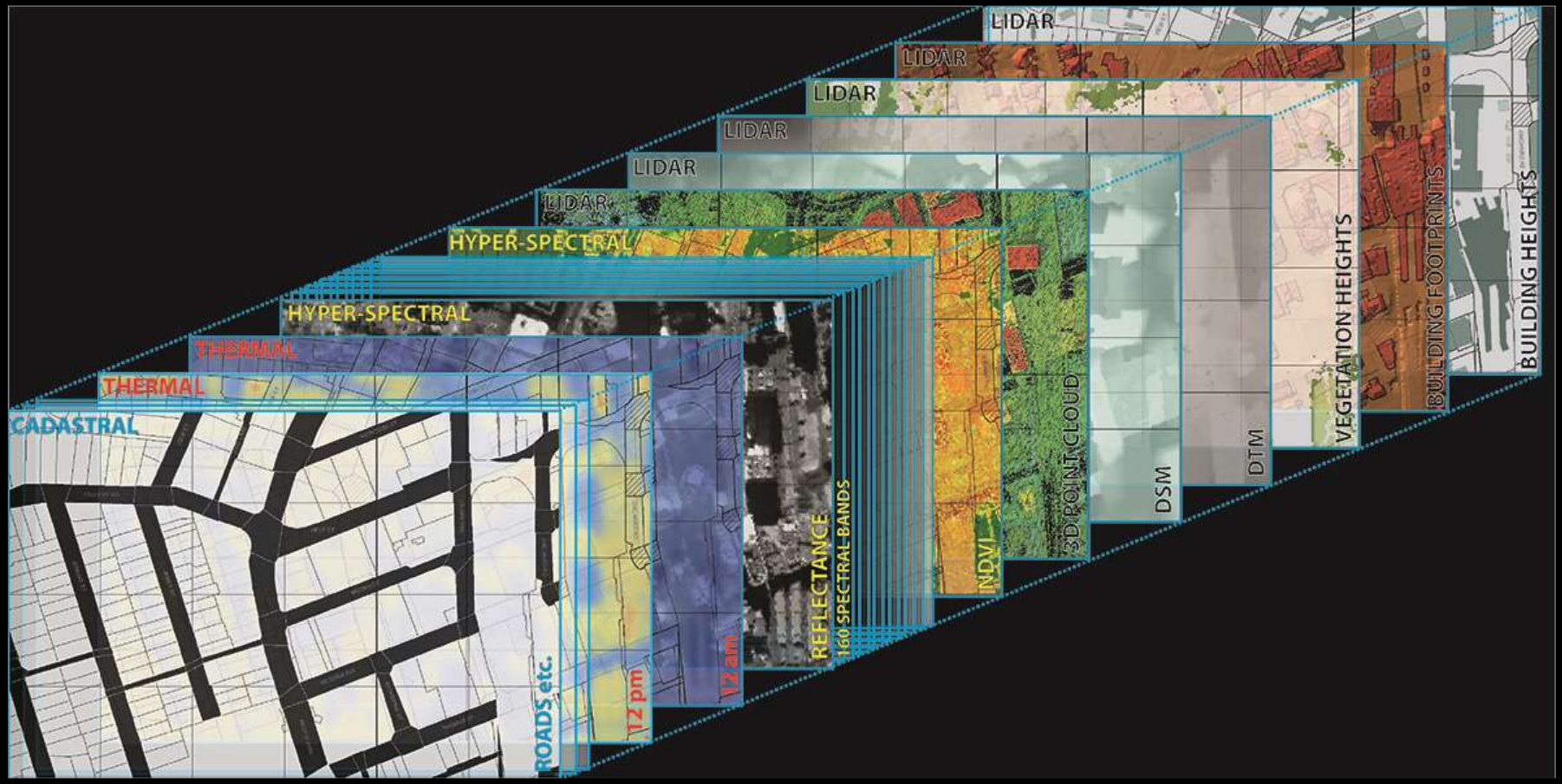



Providing easily accessible information for decision makers at unprecedented scale and accuracy.

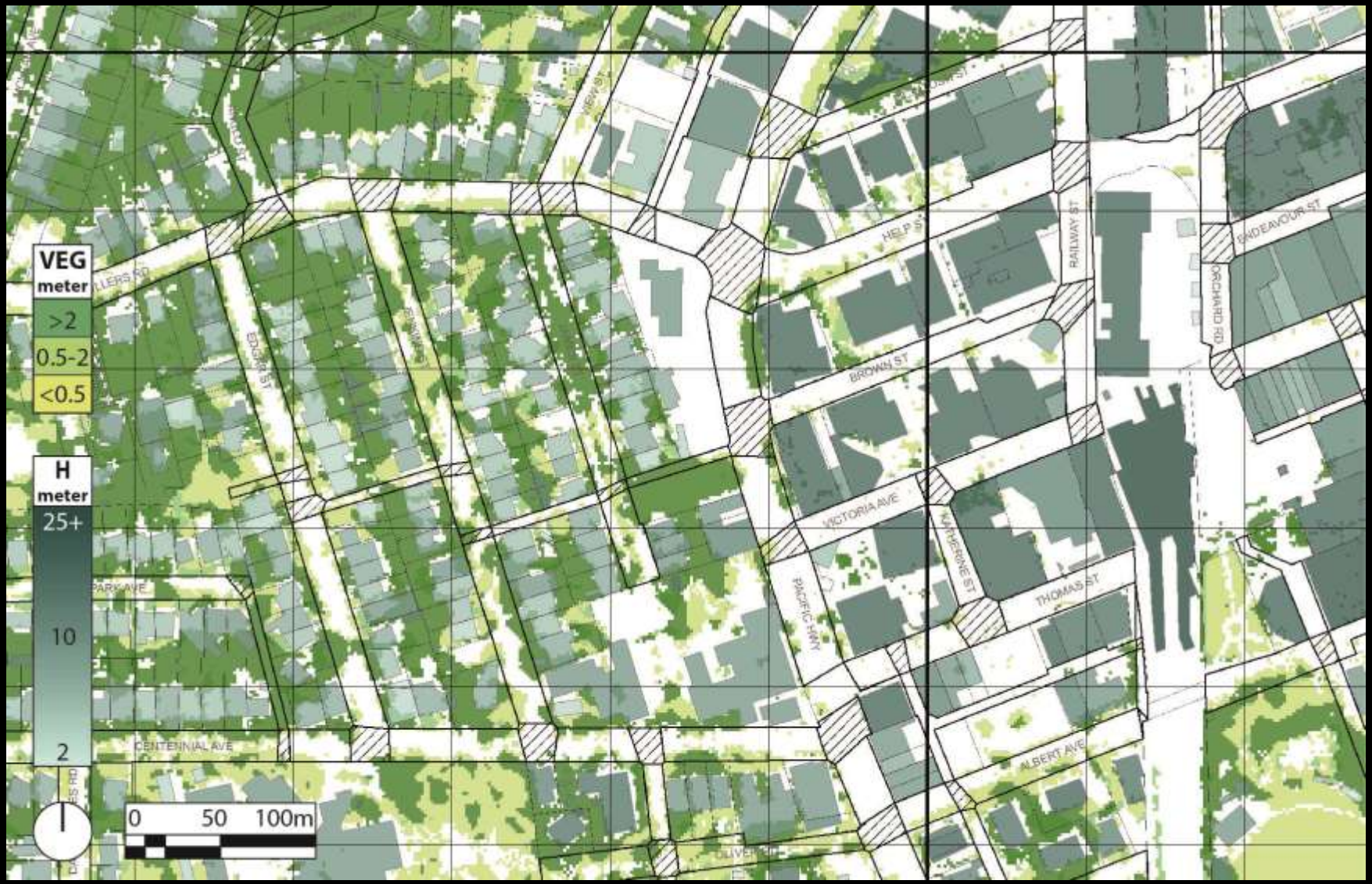
NCCI – Methodology and Variables



DATA FUSION IN GIS

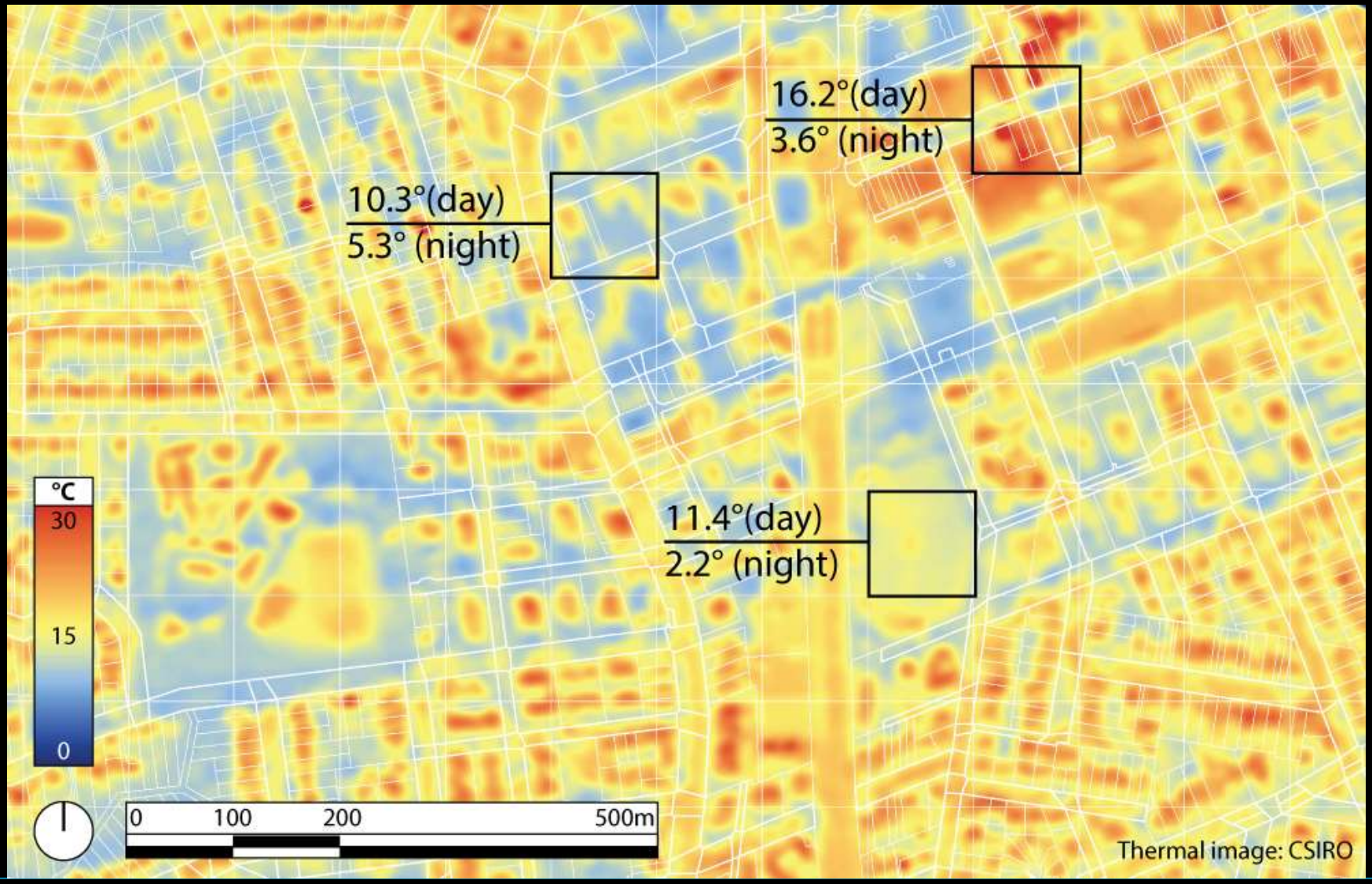


Airborne Remote Sensing – 3D Data



Building volumes and low, medium and high vegetation coverage based on Lidar and Hyperspectral data

Airborne Remote Data – Thermal Infrared



Surface Temperature at 2 pm in Winter (04/06-08-2012)

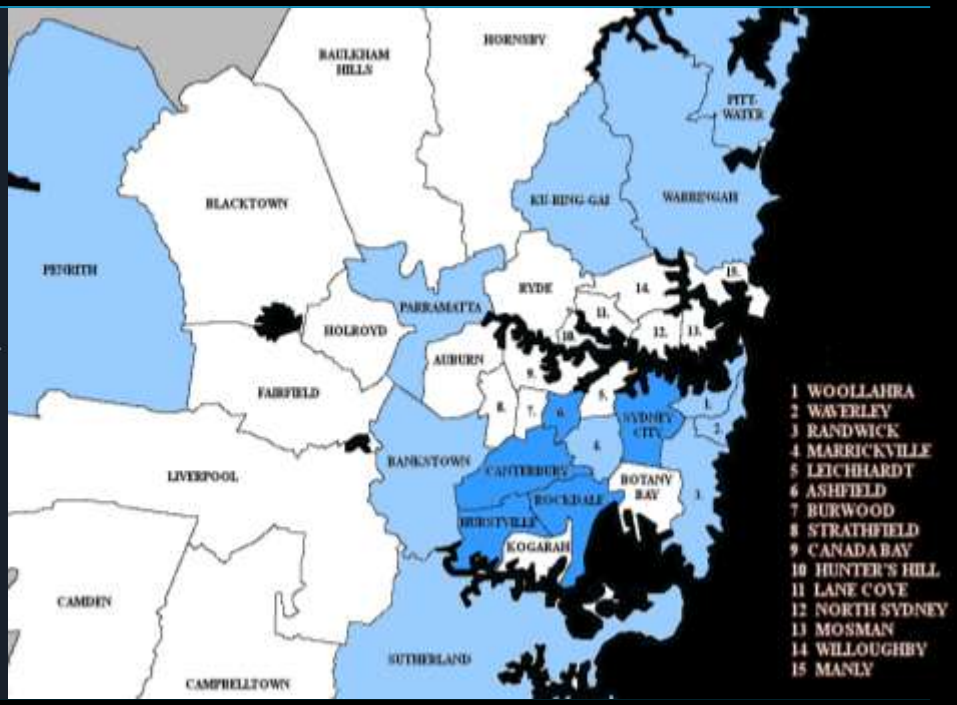
Spatial Analysis at Precinct and Street Scale

- **Spatial Error model -** Multiple Linear Regression with spatial dependency

$$y_i = \beta_0 + \sum_p \beta_p \, x_{ip} + \lambda w_i \xi_i + \varepsilon_i$$

Urban form parameter	*Change*	*Effect on*	
		Mean nigh-time surface temperature	*Mean daytime surface temperature*
Area of high vegetation	+10 %	↑ **+ 0.13 K**	↓ **- 0.15 K**
Area of impervious ground surface	+ 10 %	↑ **+ 0.15 K**	↑ **+ 0.32 K**
Area of buildings (roofs)	+ 10 %	↓ - 0.04 K	↑ **+ 0.57 K**
Albedo of impervious ground surfaces	+ 0.1	↓ **- 0.22 K**	↑ + 0.18 K
Albedo of roofs	+ 0.1	↑ + 0.02 K	insignificant
Building density (Height/Distance-ratio)	+ 0.1	↑ + 0.05 K	↑ + 0.15 K
Altitude	+ 10 m	↑ + 0.16 K	insignificant
Distance to coast	insignificant		

Contribution to urban heat generation by urban form parameter.

NCCI – Nationwide Heat Resilience Benchmarking

- Strong nationwide interest with **over 60 LGAs to date** in Sydney, Brisbane, Gold Coast, Townsville, Cairns, Darwin, Perth, Adelaide and Melbourne;
- **First stage to begin in Sydney** in 2015 supported by SSROC, NSW OEH and CRC for Low Carbon Living.