RP2005

URBAN MICROCLIMATES AND OUTDOOR THERMAL COMFORT

Research Question

To explore outdoor heat-activity patterns in low carbon cities, key research questions are:

- To what extent do outdoor activities correlate with urban microclimate parameters of air, radiant and apparent temperature?
- When do changes start and how do changes fluctuate?
- What attributes of public space can facilitate resilience to heat stress?
- To what extent can heat resilient public spaces contribute to low carbon living in Australian cities?

Figure 1: Some hard urban surfaces such as asphalt, concrete and paving store heat in their thermal mass and make the public space a dangerous place to attend during heatwaves (Riverbank Plaza, Adeladie, FLIR 6 thermal image taken by E. Sharifi).

Methodology

Two intertwined concepts of spatial heat resilience – indicating physical ability to maintain thermal environment close to humans' thermal comfort – and activity heat resilience – indicating ability to maintain normal activities in the thermal discomfort conditions – are proposed to evaluate the state of heat resilience in Australian cities.

Thermal neutrality and heat adaptation thresholds are measured in 10 case studies in Frendship Plaza, Darling Quarter, Darling Harbourside (Sydney), St Paul's Court, Federation Square, Federation Wharf (Melbourne), Hajek Plaza, Blue hive Plaza, Art Centre Plaza, Torrens Riverbank and Hindmarsh Square, (Adelaide). Data collection includes micorclimate measurement, activity observation and thermal photography ($16°C < T_{air} < 42°C$; $10°C < T_{surface} < 65°C$). Findings are triangulated via a closed questionnaire survey.

Results

Public spaces with soft landscapes (including urban greenery and surface water) and smart shadow coverage have higher spatial and activity heat resilience. Optional activities (including preferred and adjustable activities) are declined after the apparent temperature reaches the threshold of 28-32°C. However, necessary activities (including vital and habitual) and social activities (including simultaneous, managed and cultural) have a higher neutral thermal threshold of 36°C. Every 10% increase in the urban greenery can effectively decrease the precinct temperature by 0.6°C and enables local communities to have extended public life outdoors.

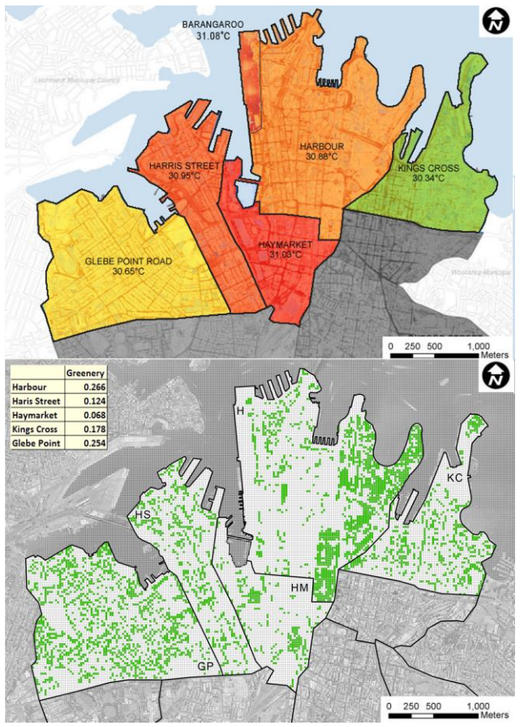

Figure 2: Higher ratio of urban greenery correlates with lower precinct average temperatures and extend outdoor activities in more inhabitable urban settings (Aerial thermal imagery, City of Sydney 2009; Greenery distribution via ENVI by E. Sharifi).

Conclusions

Every 1°C increase in the ambient temperature increases cooling electricity demand by 2.6% in Australian cities. Higher urban heat resilience correlates with the increase in tree canopies, softer landscapes and shadow coverage. Urban cooling strategies decrease thermal load on outdoor participants in heat resilient public spaces.

Heat resilience is a quality indicator for public space which supports the application of natural elements including tree canopies in low carbon cities.

Anticipated impacts

In the context of climate change, heat resilient public spaces can support more vibrant, healthy and low carbon urban environments in existing and future cities. Local city councils, major urban design and development firms benefit from heat resilience principles to enhance public life in urban regeneration and transformation projects.

Heat resilient public spaces can be up to 4°C cooler than BAU and facilitate low carbon life in Australian cities

For more information visit:

http://www.urbanclimates.org

http://www.lowcarbonlivingcrc.com.au/research/program-2-low-carbon-precincts/rp2005-urban-micro-climates

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