CRC for Water Sensitive Cities

Urban Heat, Heat Reduction and Public Health

Impacts of urban climate and microclimate on health

Researchers at the CRC for Water Sensitive Cities, in partnership with the National Climate Change Adaptation Research Facility (NCCARF), have identified threshold temperatures above which mortality and morbidity increase in all Australian capital cities, and have developed a mapping tool to identify areas of high vulnerability during extreme heat events.

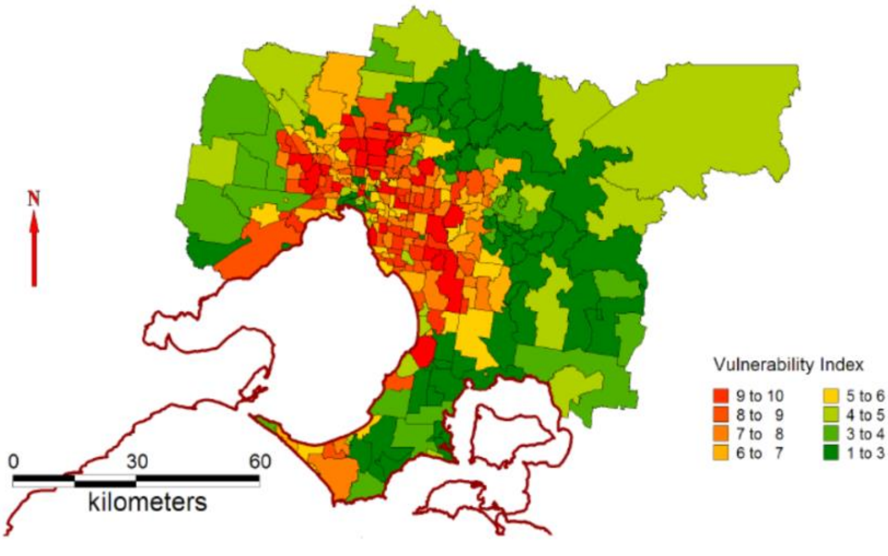
The maps show heat vulnerability by postcode for all Australian capital cities. The maps identify the areas that are most vulnerable to heatwave conditions based on risk-factors that include lack of tree cover, housing types, and the age, health, and social-economic status of the population. Researchers have found a clear association between extreme heat vulnerability and hospital emergency department presentations.

Urban warmth features strongly across all Australian cities, often associated with higher densities of vulnerable groups such as the elderly, the poor, or culturally and linguistically diverse communities. In areas that are covered by buildings, urban warming can increase local temperatures by around 4°C, which can take the temperature over the threshold where human health is threatened.

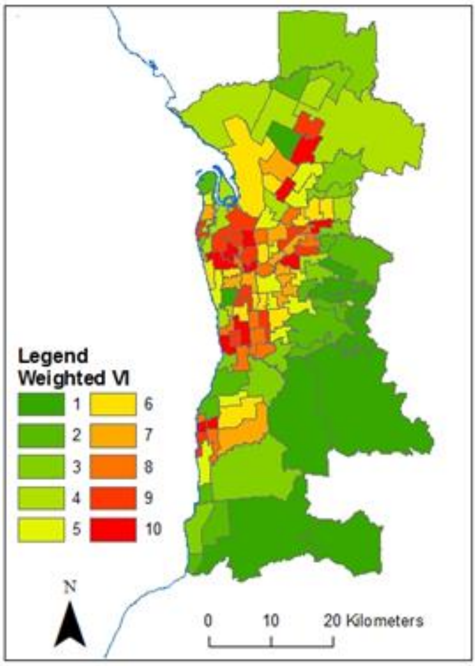
Heat extremes and the number of days exceeding the critical heat-health thresholds are projected to increase in all Australian capital cities in the coming decades. Highlighting the areas most affected by extreme heat allows a targeted response and a focus for urban planning and policy.

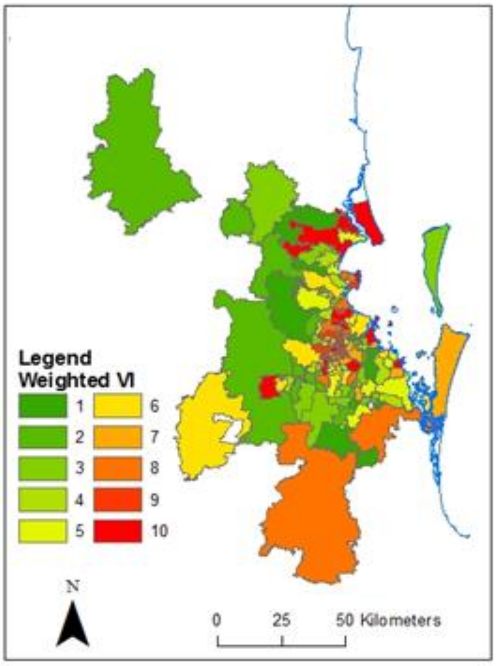
The vulnerability maps can be used for emergency response planning by hospitals, the ambulance service and local government to protect vulnerable residents and to plan for the future.

City planning and urban design should be guided by these heat vulnerability maps to plan more green spaces and plant more trees in the high vulnerability areas. Water planners and town planners need to work together to reduce local temperatures. This would provide long-term citywide resilience to predicted increases in the number and severity of heatwaves in Australian cities.



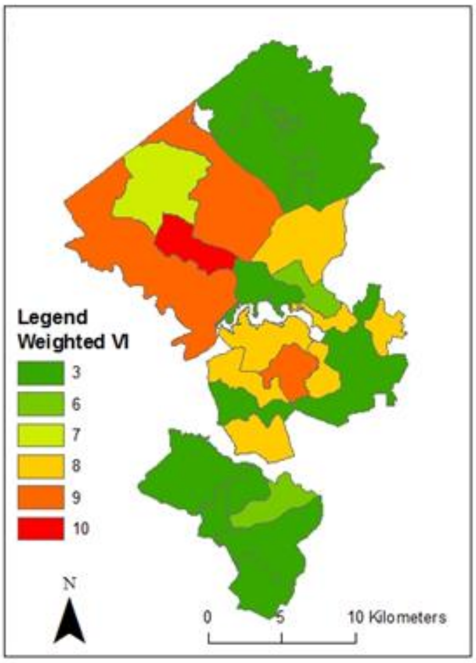
Melbourne: This heat vulnerability map for Melbourne identifies the city's most at-risk suburbs, which include Sunshine, St Albans, Glenroy, Coburg, Preston, Reservoir, Clayton and Dandenong.

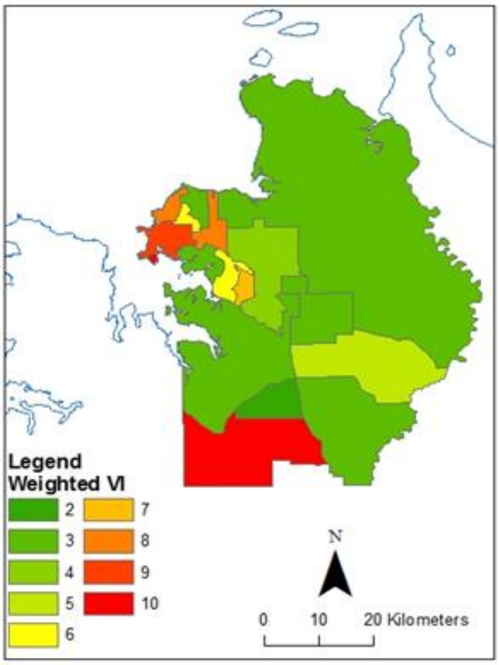




Adelaide: This heat vulnerability map for Adelaide identifies the city's most at-risk suburbs, which include Elizabeth, Parafield, Hope Valley, Regency park, St Clair, Woodville Sth, Woodville West, west Hindmarsh, City of Marion, Brighton, Brighton Sth, Brighton Nth, Glen Osmond, Urrbrae, Myrtle Bank, Dulwich, Glenside, Toorak Gardens, Tusmore, City of Norwood.

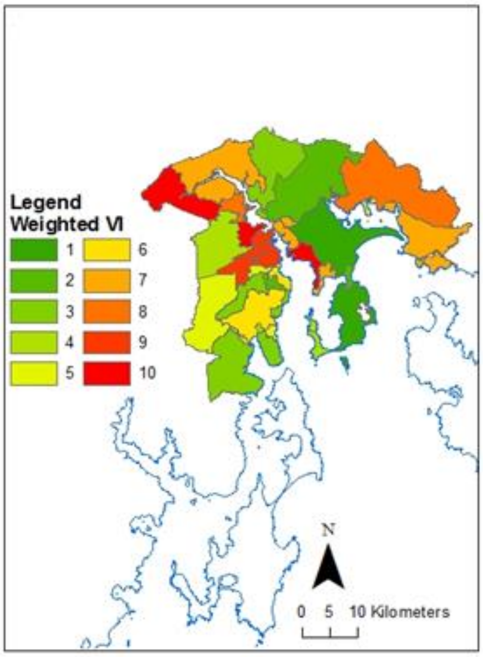
Brisbane: This heat vulnerability map for Brisbane identifies the city's most at-risk suburbs, which include Caboolture, Redcliffe, Geebung, South Coast, Cleveland, Chermside, Brisbane, Graceville, Corinda, Mansfield, Mt Gravatt, and Ipswich.



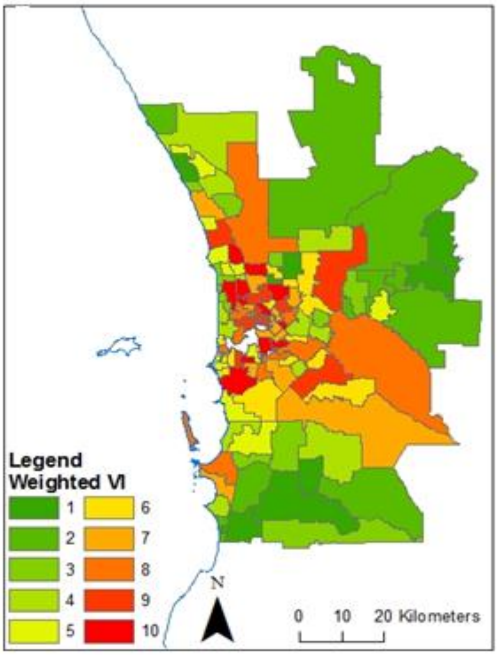


Canberra: This heat vulnerability map for Canberra identifies the city's most at-risk suburbs, which include Acton, Canberra (city), Curtin, Garran, Hughes.

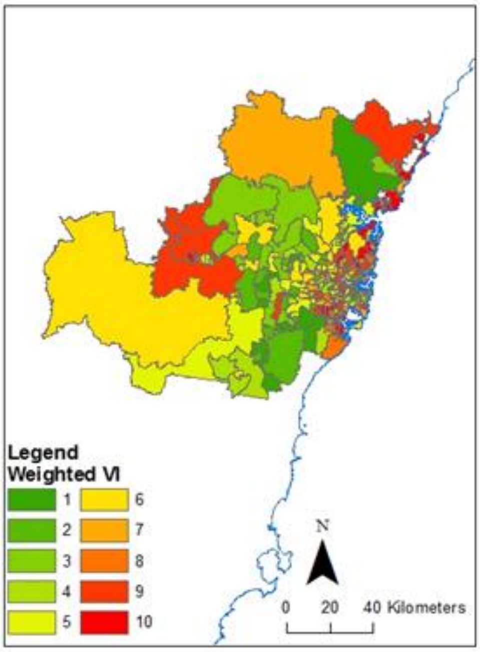
Darwin: This heat vulnerability map for Darwin identifies the city's most at-risk suburbs, which include Alawa, Brinkin, Casuarina, Coconut Grove, Tiwi, Jingili, Lee Point, Lyons, Millner, Moil, Muirhead, Nakara, Nightcliff, Rapid Creek, Wagama, Wanguri and Darwin River area.



Hobart This heat vulnerability map for Hobart identifies the city's most at-risk suburbs, which include Bellerive, Howrah, Montigu Bay, Mornington, Rosny, Rosny Park, Tranmere, Warrane, Dowsing Point, Glenorchy, Glenwood, Montrose, Rosetta, and the New Norfolk area.



Perth This heat vulnerability map for Perth identifies the city's most at-risk suburbs, which include Wangara, Stirling, Morely, Menora, Mt Lawley, Riverdale, Como, Booragoon, and Bibra Lake.



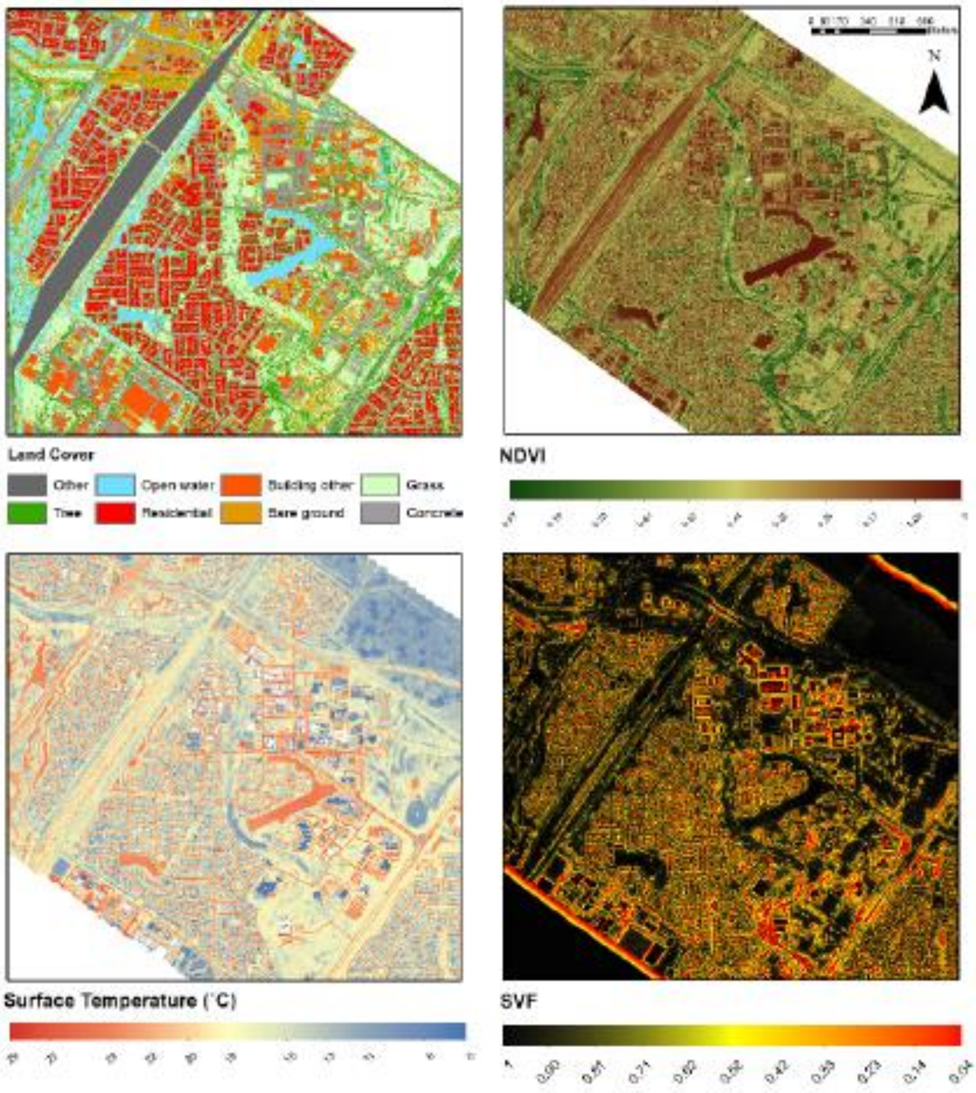
Sydney: This heat vulnerability map for Sydney identifies the city's most at-risk suburbs, which include Palm Beach, Budgewoi, The Entrance, Avoca area, Woy Woy, Ettalong beach, Narrabeen, Turramurra, Darling Point, Point Piper, Padstow, Sans Souci, Caringbah, Miranda, Sylvania, Wentworth Falls, Belrose, Forestville, and Killarney heights.

The influence of water sensitive urban design features on urban climate

Water sensitive urban design (WSUD) is a contemporary approach to the planning and design of urban environments that is sensitive to the issues of water sustainability, resilience and environmental protection. WSUD has evolved from its early association with stormwater management to focus on integrating the urban water cycle into built and natural urban landscapes to provide multiple benefits to society, including improving the urban climate. WSUD uses green infrastructure (trees and other plants) and water in urban environments to engineer a cooling effect to offset urban heat. Research by the CRC for Water Sensitive Cities has found that this approach is effective in mitigating urban heat, and could be used by local governments and city planners to help protect residents from dangerous urban temperatures.

In an 2011 intensive microclimate study of Mawson Lakes in Adelaide, CRC researchers found that land cover type (for example, trees, water, grass, buildings, or concrete) can have a heating or cooling effect, which can influence local temperature(see Figure below).

Trees and water bodies (lakes and wetlands) were found to have a significant cooling effect during the day.



Mawson Lakes, Adelaide: remote sensing data showing land cover, vegetation cover as measured by Normalized Difference Vegetation Index (NDVI), night land surface temperature (LST), and sky view factor (SVF).

Trees and water bodies (lakes and wetlands) have a significant cooling effect during the day. This cooling is apparent, independent of other influential factors.

CRC researchers examined relationships between vegetation cover, built area index and land surface temperature for three local government areas in Melbourne: the cities of Darebin, Melbourne and Monash. The found that for each 10% increase in tree cover there is a reduction in land surface temperature of between 0.5°C and 1°C. These results confirm the important role of green infrastructure in providing cooler urban environments.

For each 10% increase in tree cover, there is a reduction in land surface temperature of between 0.5°C and 1°C.

Researchers have also examined images of Dubbo, New South Wales taken by satellite during extreme summer temperature days whilst the city was in severe drought (between 2000-2011), and whilst it was experiencing flooding rains (2010-2011). The images showed that the use of irrigation water on the green infrastructure in Dubbo's urban landscape had a cooling effect. In one instance on 13 January 2005, when air temperatures reached nearly 40°C, Dubbo's urban landscape was 3-5°C cooler that the surrounding rural areas. As the drought wore on and irrigation use was restricted, this effect was lessened.

Promoting lush and well-irrigated vegetation can provide microclimate benefits by reducing excess urban heating through shading and cooling.

The provision of water to the green infrastructure in Dubbo's urban landscape had a remarkable cooling effect on land surface temperatures.

For more information, please access blueprint2013 (available at http://watersensitivecities.org.au/resource-library/publication-download/).

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Loughnan, M., Tapper, N., Phan, T., Lynch, K. and McInnes, J. (2013). A spatial vulnerability analysis of urban populations during extreme heat events in Australian capital cities, National Climate Change Adaptation Research Facility, Gold Coast pp.128. ISBN:978-1-921609-73-2. http://www.nccarf.edu.au/sites/default/files/attached_files_publications/Loughnan_2013_Spatial_vulnerability_analysis.pdf.

Nury, S., Coutts, A. Beringer, J. and Tapper, N. (2012) Spatial relation between urban vegetation and land surface temperature in Melbourne, Australia. 8th International Conference on Urban Climate, Dublin, Ireland.

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