RP3009

RATING THE THERMAL PERFORMANCE OF A RESIDENTIAL LANDSCAPE

Research Question

Current schemes such as NatHERS[1] measure and regulate the thermal performance of residential house structures only. The radiative property of the landscape around that house is not fully considered.

This research aims to develop a rating system which quantifies the thermal performance of various landscape elements and provides the tools to better design a residential landscape that increases resilience and improves our microclimate.

Figure 1: Well-designed garden at Joshs house.

Methodology

A two-pronged experimental approach is being taken. The first is to use small temperature sensors called iButtons to determine the amount of radiation incident on the walls of a house specifically from the garden. Josh's House* will be used for a pilot study as its landscape has been designed with thermal performance in mind (Fig 1). The second is to quantify the amount of radiation from a number of different landscape elements using a thermal camera. Both methods are being performed over a year to capture seasonal effects. The test work for both phases is still in progress.

Results

Initial fieldwork with iButtons has been completed in order to calibrate temperature readings with actual incident radiation (Fig 2). The ability to detect and quantify the reduction in radiation due to cloud cover and to tree shade has been demonstrated. The next stage is to locate iButtons around Josh's House and another house with a "hotter" garden.

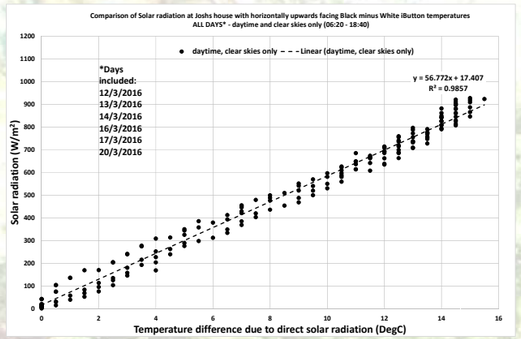

Figure 2: Calibration curve for iButton temperatures versus incident radiation.

Thermal images have been captured of 22 landscape elements over two seasons.

Samples of various landscape elements e.g. different coloured pavers, concrete slabs, mulch, shrubs and decking, were set up on an open field. Half hourly images were taken from 6am to 8:30pm on a no-cloud day.

Solar radiation was measured using iButtons, and a portable weather station monitored ambient temperature, relative humidity and wind speed and direction.

The reflected temperature was measured to be below -20°C during the experiment and the emissivity of each element was determined to be above 0.84 (SD 0.02) in a further experiment. A graph of the radiation from some of these elements in winter is shown in Figure 3.

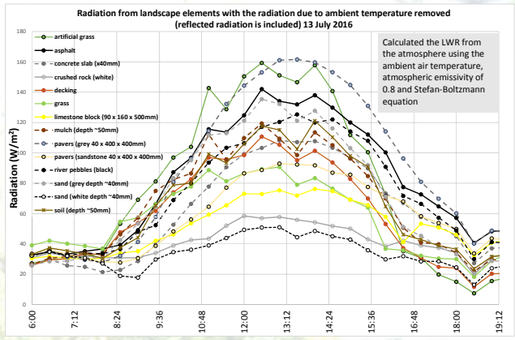

Figure 3: Radiation from some landscape elements over one sunny day in winter. The radiation from ambient temperature has been removed but reflected radiation is included.

Conclusions

iButtons are a suitable instrument for longer term monitoring of the incident radiation onto all walls of a house concurrently. They determine the quantity of solar shading as well as the amount of landscape re-radiation if shielded from the sun.

Thermal imaging is enabling quantification of radiation from landscape elements over different times of day and season of the year. When aggregated, this information will be used to quantify radiation from the whole garden based on its individual elements.

Anticipated Impacts

The results from this study will produce a tool to allow an assessment of the radiation generated by different residential landscapes. This could be used to both inform landscape designers and residents, and/or regulate design rules by councils or other government agencies as a way of mitigating increased residential and suburban heat.

Key Statement

Increasing our personal resilience to climate change depends on us having the right tools to enable constructive localised changes. Cooling our microclimate increases human thermal comfort in our garden, reduces home energy use and, when considered on a suburban scale, will assist to reduce the Urban Heat Island effect.

Further Information

*information on Joshs house can be found at http://joshshouse.com.au/

Information on the CRC for Low Carbon Living can be found at http://www.lowcarbonlivingcrc.com.au/

Contact

Jane Loveday

Curtin University Sustainability Policy Institute

Jane.loveday@student.curtin.edu.au

[1] The Nationwide House Energy Rating Scheme (NatHERS) is a star rating system (out of ten) that rates the energy efficiency of a home, based on its design.