RP3009

A low-cost instrument to measure total radiance from landscape elements

Overview

The loss of vegetation and the increased use of impervious surfaces has led to increased localised urban temperatures. Landscape elements in a residential suburban garden can affect the heat and light entering the house. A low-cost instrument was developed and tested to quantify the total radiant energy incident on the external fabric of a house. This will allow better guidance for landscaping professionals in order to reduce urban heat build-up and its impact on the thermal performance of housing.

Methodology

A low-cost temperature logger the size of a watch battery called an iButton was painted black on one side and mounted in a polystyrene block (Fig 1). This was a simple radiometer, able to detect the total amount of incident radiation.

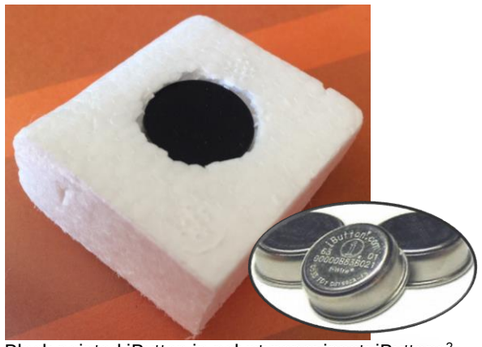

Fig 1: Black painted iButton in polystyrene; inset: iButtons[2].

Nine iButtons were placed around Josh's House[1] (Fig 2) in order to measure total radiant energy from different landscape areas e.g. driveway; vegetable garden.

Fig 2: Location of iButtons around Josh's House.

A thermal camera determined the average incident infrared radiation from the same field of view as the iButtons (Fig 3).

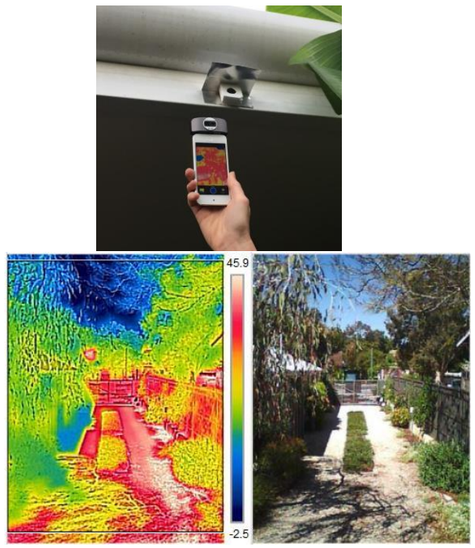

Fig 3: iButton comparison with thermal image.

Results

The data analysis is currently in progress, however intial results show there is a correlation between the temperatures from thermal images and iButtons (Fig 4).

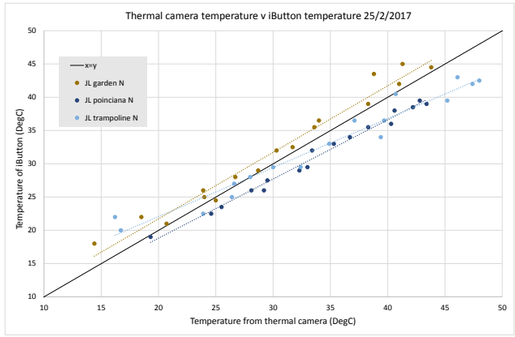

Fig 4: Example of thermal versus iButton.

There are clear differences in the data between different landscape areas (Fig 5).

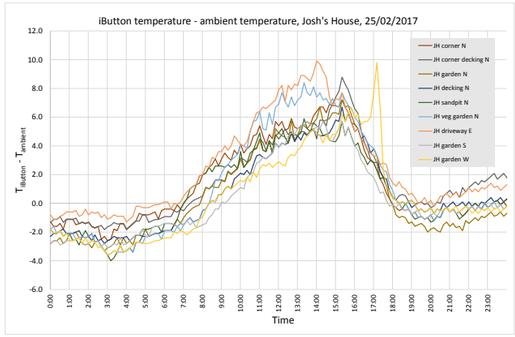

Fig 5: iButton – ambient temps, different landscape areas.

To analyse this data, an energy balance needs to be done between incoming and outgoing short and longwave radiation, taking into account emissivity of the iButtons, albedo of the landscape and convective losses.

Data from single landscape elements and areas has also been collected and will be used to assist with analysis.

Conclusions

Currently most landscape elements are studied for their potential to increase surface temperatures, whilst the reflected light is mostly ignored, especially in terms of its heating potential. iButtons measure the heating potential from all types of radiation, making it a universal indicator for incident radiation.

Anticipated impacts

This instrument can rapidly indicate the amount of radiation from a landscape, regardless of its complexity. Once established, this can be used to improve landscape designs to reduce unwanted heat gain.

Initial results show this low-cost instrument could provide information on just how our landscape affects both the heat and light entering our buildings

Further information

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