

The Continuing Quest to Understand Urban Heat Islands

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Many people think the urban heat island (UHI)' is simple enough – after all temperature is one of the easiest environmental variables to measure so the characteristic warmth of cities should be a straightforward phenomenon to study. So why 200 years after it was discovered are we still working on this? Such warmth is easily shown using standard climate observations and thermal imagery of urban regions give an immediate visual impression of it. There are multitudes of papers reporting on UHIs and an increasing number of users who wish to use UHI data and address the consequences of its existence.

Unfortunately the apparent ease with which heat islands are seen has led many well-intentioned people, both within the urban climate community and in user groups, to assume that: a) there is a heat island, b) its causes are understood and c) its spatial form and magnitude are fairly static. None of these assumptions are well founded.

At the risk of making a simple issue complex I shall attempt in the talk to lay out some basic facts about UHIs, as I imperfectly understand them. The central messages are that:

- a) there is not one heat island in a city, but several that are linked,
- b) they are distinguished one from another mainly by scales imposed by the biophysical structure of a given city and the structure of the urban atmosphere,
- c) each requires measurement arrays appropriate to the scale,
- d) each is caused by its own set of scale-dependent processes,
- e) to model or simulate each requires a scale-dependent scheme that includes the relevant processes,
- f) it is incorrect to mix and match observed UHI features or processes or compare measured and modelled features at different scales,
- g) when using measured or modelled UHI features for applied purposes ensure the data depict the correct environmental temperature (air or surface) at the scale relevant to the focus of interest (e.g. a pedestrian, a building, a roof, airborne photochemicals).

Failure to understand UHIs clearly and be rigorous in their measurement; modelling; comparisons between data and models and between the UHI of different cities; UHI interpretations and application of UHI results has led to a seriously confused state of affairs. There is poor communication between scientists, management agencies, planners and the public in which people's time and resources are squandered and cities are poorly served. We can and must do better.