Sweats and the City - why is city life hotting up and what are the new urban heat island effects?

In the minds of young country folk, city life is often perceived to be a 24-hour, year-long party (or so the migration text-books tell us). Now, it appears that the plants and animals in our town and city centres are also leading more active lives than their rural cousins!

Scientists researching the effects of the **urban heat island** have discovered that spring comes at least seven days earlier in large settlements, while autumn departs around 8 or 9 days later. As a result, our urban flora and fauna are waking up sooner and bedding down for winter later than their countryside counterparts.

The heat island is a phenomenon that involves air temperatures becoming warmed beyond those found in surrounding rural areas. This is due to a number of reasons, such as the widespread use of heat-absorbing building materials in urban areas that slowly release stored daytime heat throughout the night (see inset 1).

Heat island processes

Urban heat islands are the product of several inter-related sets of processes:

- *Radiation heating of concrete, brick and tarmac* Building materials have a higher thermal capacity than soil, allowing the sun's heat to be stored for longer and emitted gradually during the night. The city thus acts as a giant storage heater.
- *Industrial and domestic heat emissions* Low-level radiant heat is given off by car engines and other motors, fridges, air conditioners and central-heating systems.
- *Smoke blanket* Pollutants, while reducing incoming sunlight, trap re-radiated heat, especially at night time [This human impact is less important than in the past in many MEDC cities, such as London, where air quality has improved considerably since legislation was first introduced in 1956].
- *Less vegetation and areas of open water* This means that less energy is used up in the evaporation and transpiration of water.

The scientists from Boston University have found that urban temperatures are up to 2.5 C higher than in surrounding rural areas (*The Guardian*, 13 July 2004). This is a greater difference than many early heat island studies showed. For instance, in one classic study of London conducted in the 1950s, temperatures were only around 1C higher than in surrounding areas*. This increase in heating may be attributable to rising affluence amongst tertiary sector (office) workers, allowing far more people to own cars and fridges, or to install expensive air conditioning systems, than in the past. All of these devices are driven by motors that generate heat. Well-paid city workers are also less likely to worry about the financial costs of extensive central heating use than previous generations (see oil crisis article). In addition, the recent craze for patio heaters and outdoor garden lighting is contributing to further urban heating, even in the middle of the night!

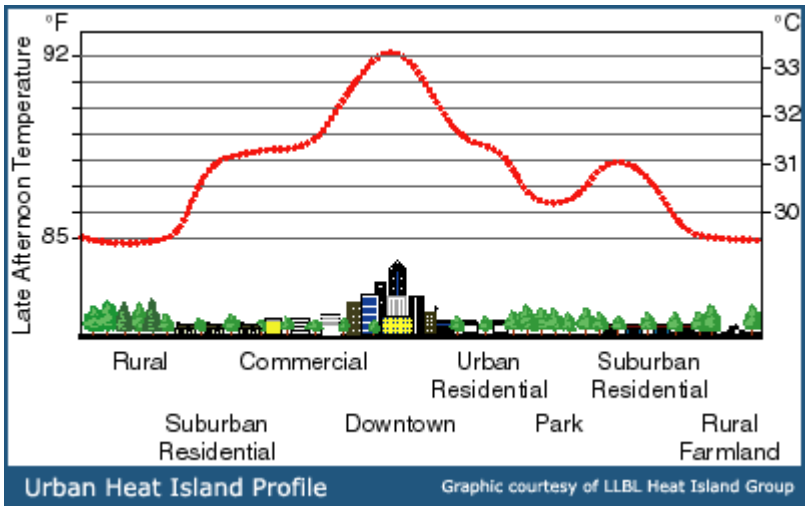
Urban heat island effects also carry over into surrounding rural areas, according to the new study, influencing the growth of plants up to 10km away from the city limit. At 3km from the fringe, the growing season begins two days earlier than normal and temperatures are still 0.8C higher than in remoter rural areas. It is only at 10km from the city limit that leaves finally emerge on trees at their normal time of year, around nine

days later than in town centres. In total, an area 2.4 times larger than any given settlement is actually affected by the heat leaking outwards from it.

The new urban heat island research was conducted along the Boswash (Boston-Washington) urban corridor and used satellite thermal images. The results appear in the journal *Geophysical Research Letters*.

Japanese take action

Temperatures in Tokyo reached an all-time high of 39.5C during July (*The Guardian*, 24 July 2004). Tokyo is a rare example of an MEDC city that has continued to grow very rapidly in recent decades. New concrete skyscrapers have intensified the heat island effect to the point where the Japanese government has recently introduced a novel law: 20% of all new building developments must be covered with trees or grass. Vegetation stops heat from penetrating into the urban fabric. This helps to reduce radiation heat storage, thereby lowering urban air temperatures. Typically, this is achieved by the provision of roof gardens. For instance, the Roppongi Hills multiplex cinema complex is covered with a 1,300 square metre spread of grasses, trees and shrubs.



Ringing the changes

As the teachers' notes for other "Geography in the News" articles often stress, GCSE and A-Level examiners will reward candidates who can most thoughtfully engage with words like "change" or "modify" when they appear in questions. Take the following A-level essay title as an example:

"Examine the ways in which urban growth modifies the physical environment" [25 marks]

The news item you have just read suggests a number of different interpretations of the word "modify" that could be employed when answering this essay, with an incline in difficulty, as follows:

(1) The climate of the area that the settlement has been built on has been changed. Quite simply, it has been heated up. The countryside has been turned into a town where a heat island has developed. Other locally observed changes could include greater wind speeds (along

"canyon" streets), lower frost incidence and changed precipitation levels (sometimes increased and sometimes decreased – it's complicated!).

(2) However, the changes described here *may not experienced by all settlements* to the same extent. In very cold environments, as one might expect, the thermal changes that towns bring are far greater than in temperate zones. In Calgary, in northern Canada, where winter temperatures can reach -20C, the city generates temperatures 7C warmer than those found in one cold valley lying to the west.

(3) Is it possible that the extent of the modification is *getting greater over time* in MEDC cities? Complex changes occurring in urban employment structures are resulting in more people working in high income office occupations (a change known as *Tertiarisation*). Such people spend more money on heat-generating consumer items such as fridges and air conditioning systems. Newbuild skyscrapers intensify the radiation storage effect (think of Canary Wharf in London). However, levels of heat-trapping smoke and pollution are lower than in past decades, so overall it is difficult to know whether individual cities are heating up or cooling down without careful reading of past research reports.

(4) Climatic modifications have *secondary effects* when, in turn, there are impacts upon the biosphere. Changes in diurnal temperature ranges and mean monthly temperatures lengthen the growing season and may modify local biodiversity, perhaps even encouraging deciduous plant growth in more northerly settlements where short growing seasons naturally favour coniferous species.

(5) The impact of the urban heat island is not just restricted to the settlement itself. The effect *extends into rural areas*, diminishing in intensity as distance increases. The **ecological footprint** of the settlement is thus far greater than might at first be supposed (2.4 times larger, in fact). The same is true of motorways in rural areas, where sound levels modify the calls and mating behaviour of birds far out into the surrounding countryside, according to some recent reports.

* See Keith Hilton (1985) *Process and Pattern in Physical Geography*