



Climate Change

PURDUE
EXTENSION

Urban Heat Island Effect

City Heat

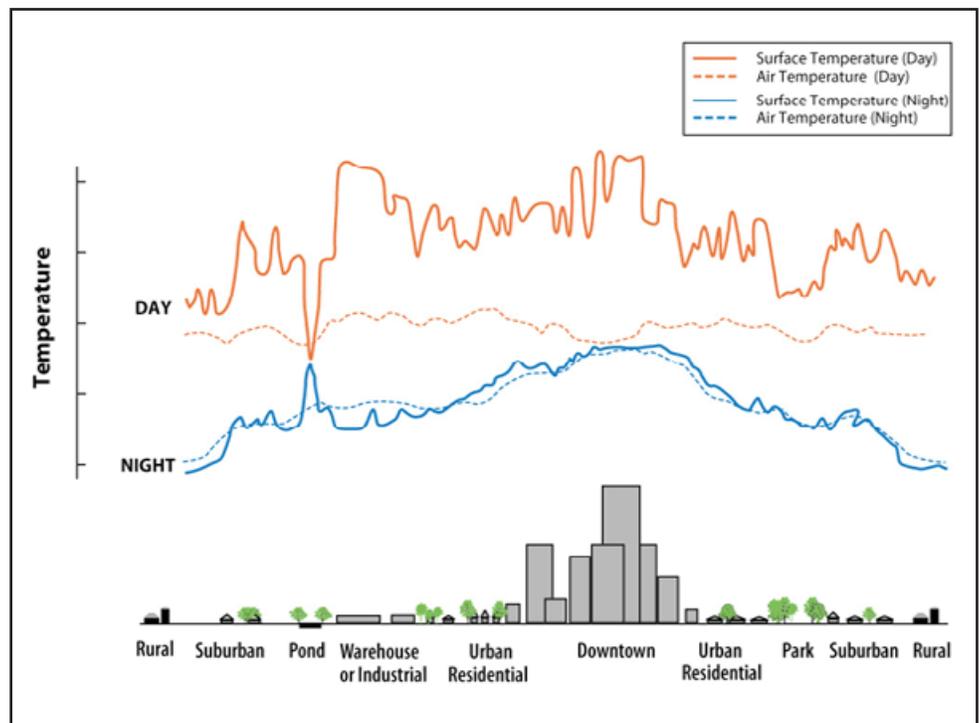
The conversion of the natural landscape into a town or city is known as urbanization. The once-natural landscape that had vegetation such as grasses, shrubs, trees, and permeable soils is converted into a landscape of highly reflective buildings, dark-colored building surfaces that absorb heat, and impermeable pavement. This process removes moisture from the atmosphere that was once provided by the vegetation.

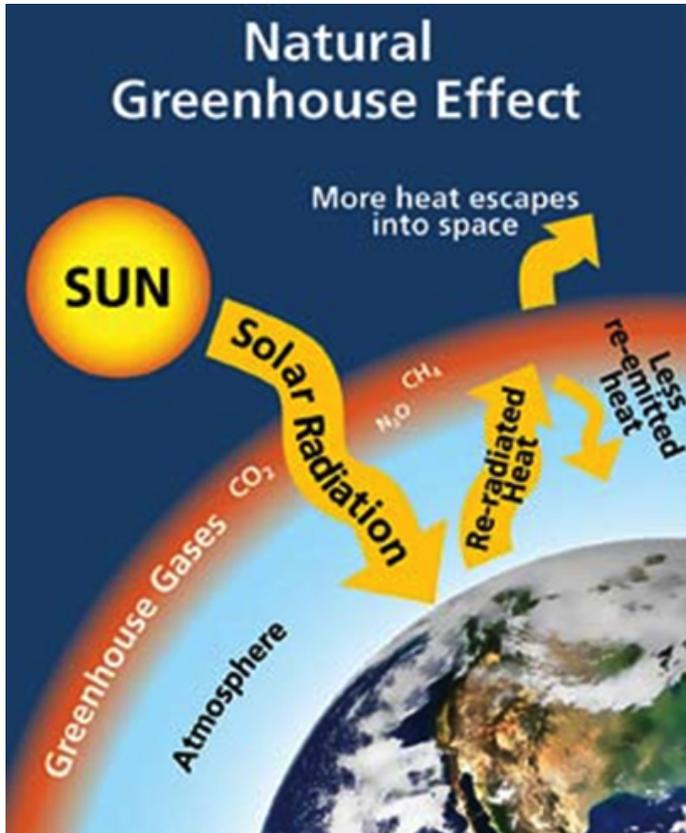
Temperatures on hot summer days in a rural landscape remain several degrees cooler than the temperatures in urban environments, because vegetation in the rural environment transpires (releases moisture). The moisture that is released by the plants evaporates and creates a cooling effect in the local atmosphere.

In cities, surfaces such as asphalt and black roofing shingles absorb solar radiation, heating the atmosphere to a temperature warmer than that in adjacent rural areas. This results in warm urban regions surrounded by slightly cooler rural regions—an “island” of warmer temperatures. This phenomenon is referred to as the “urban heat island effect.” The annual mean temperature of a city with a population of one million people or more can be 1.8°–5.4°F (or 1°–3°C) warmer than the surrounding rural areas. magnitude of billion-dollar weather disasters in the United States. Changes in climate are anticipated to increase the frequency of these events.

City-Generated Rain

Despite the fact that the urban heat island effect appears to affect only cities, research has shown that urban area activities can influence the weather at locations up to 1000 miles away. Research has found that urban heat islands can impact the climate by changing precipitation patterns downwind of the city. It is hypothesized that the heat energy released from cities creates additional showers and thunderstorm activity. The pollutants released near urban areas serve as cloud condensation nuclei that create clouds and rainfall. In some cities, rainfall rates have increased between 48% and 116%.





Surface Albedo

Surface albedo is a measurement of the reflectivity of solar energy on Earth's surface. The measurement varies from 0 to 1, where a value of zero characterizes a surface that absorbs all incoming energy and a value of one characterizes a surface that reflects all incoming energy. An asphalt driveway has an albedo of zero, and white snow has an albedo of one.

Increasing the albedo of surfaces in urban areas would help reduce the urban heat island effect. The difference in surface albedo characteristics between urban areas and rural areas is a major contributor to the differences in temperatures between the two locations.

Cooling Off

People can take several steps to mitigate the heat caused by urban heat islands.

Increase vegetation in urban areas to:

- Provide shade that can reduce peak summer temperatures by 2°–9° F.
- Reduce the need for air conditioning, which saves energy and improves air quality

Install green roofs or rooftop gardens to:

- Cool the air by evapotranspiration
- Reduce the need for air conditioning
- Remove carbon from the air, improving air quality

Install reflective roofs to:

- Increase reflection of sunlight resulting in less heat being absorbed
- Reduce the amount of energy needed to cool the structure

Use reflective pavement and install rain gardens to:

- Absorb less heat energy; keep cooler
- Allow rainwater to infiltrate the soil instead of running over the top of pavement and picking up pollutants

Resources

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