

# Green roofs to mitigate the Urban Heat Island



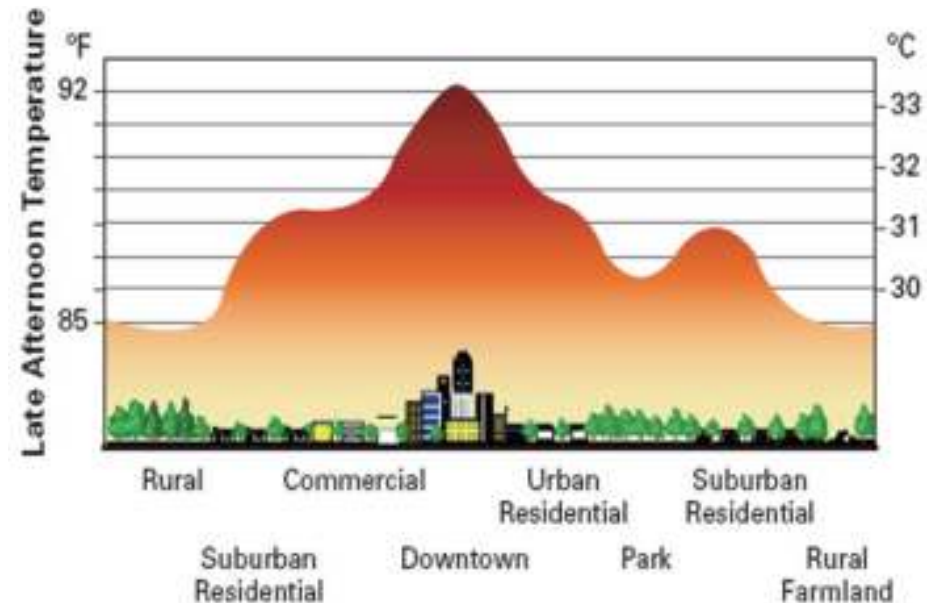
Adewunmi Gideon Fareo  
University of the Witwatersrand, Johannesburg  
MISGSA Graduate Modelling 2021

A green roof is a roof of a building on which there is vegetation



The Urban heat Island is a phenomenon where the temperature of urban areas and the inner cities is higher than the surrounding less dense outskirts.

This phenomenon is observed mostly in the late afternoons

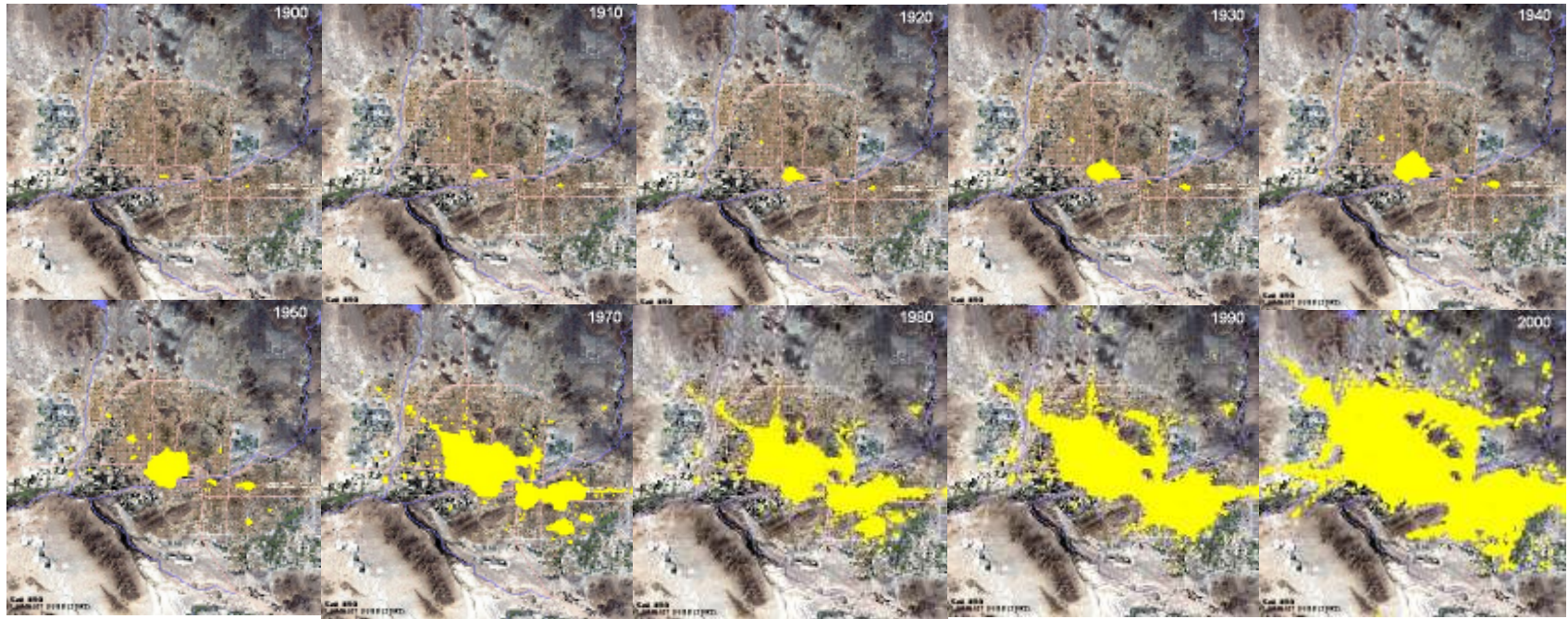


United nations report 2018 (population div of the Dept of Economic and Social Affairs)

At present, there are 55%  
of world population living  
in urban areas and cities  
across the world

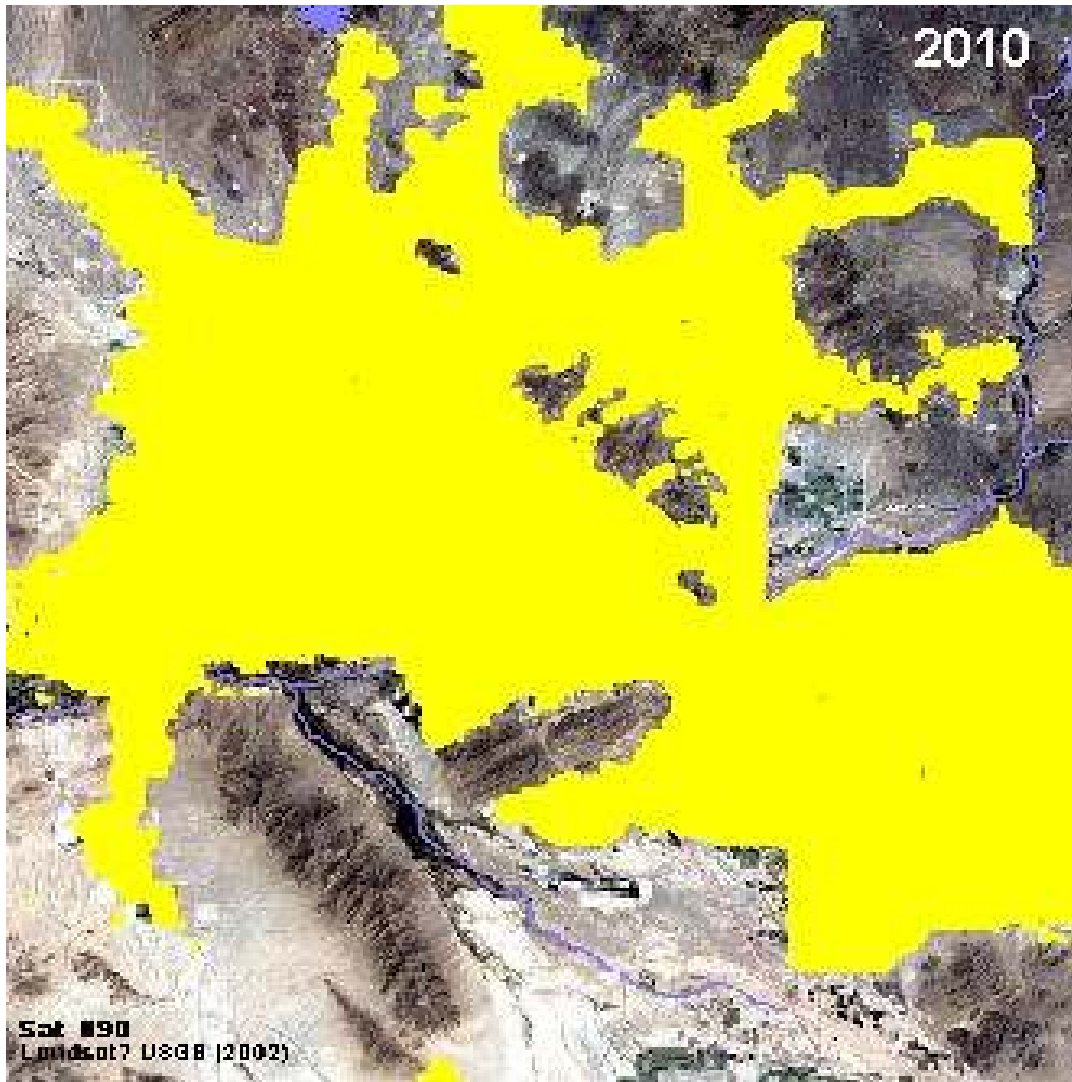
By 2050, it will be 67%





## **Urban Sprawl - the blob that ate Phoenix**

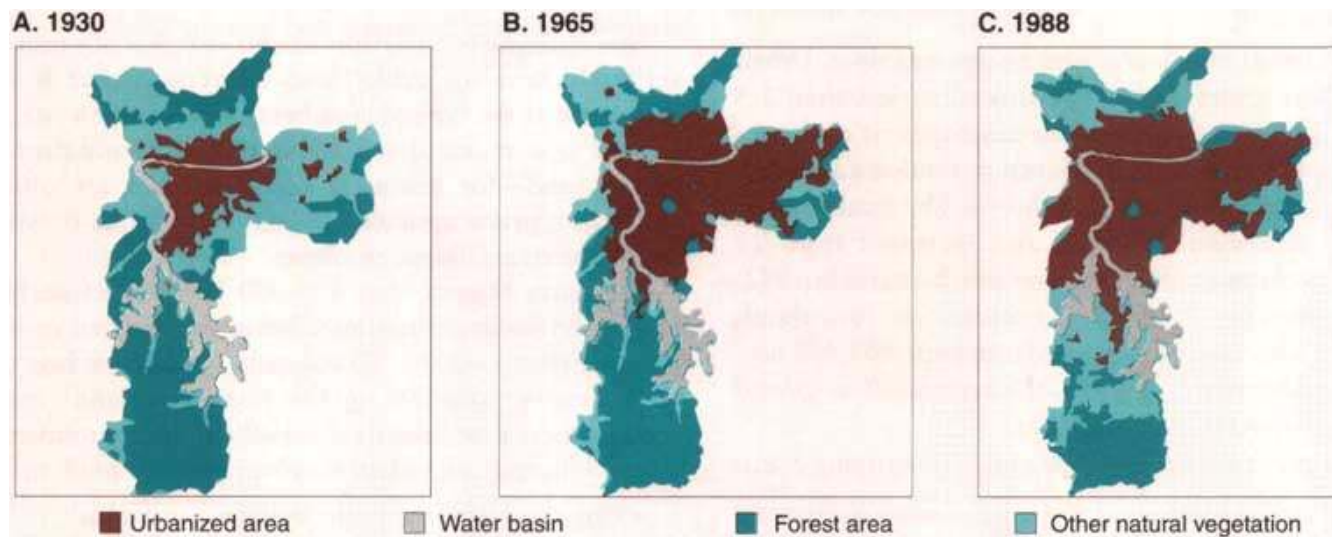
The growth of the Phoenix metropolitan area is out of control. Every year thousands of acres of farm land and Sonoran desert are turned into suburban housing developments, strip malls and parking lots.



Phoenix is now the 5th largest metropolitan area in the US and it has been running neck to neck with Las Vegas for three decades as the fastest growing city in America.

## Sao Paulo

Although most of the world's population will soon be living in developing world cities, the environmental problems most prominent in these cities have often been conspicuously absent from the global environmental agenda. Indeed, over the past two decades the global agenda has shifted away from local and regional problems such as air pollution and inadequate water supplies toward vast global concerns such as ozone depletion, climate change, and the loss of biological diversity.



**Changes in Land Use in Sao Paulo, Brazil, 1930-1988** ([www.nzdl.org/](http://www.nzdl.org/))

With increasing density of people living in urban areas come:

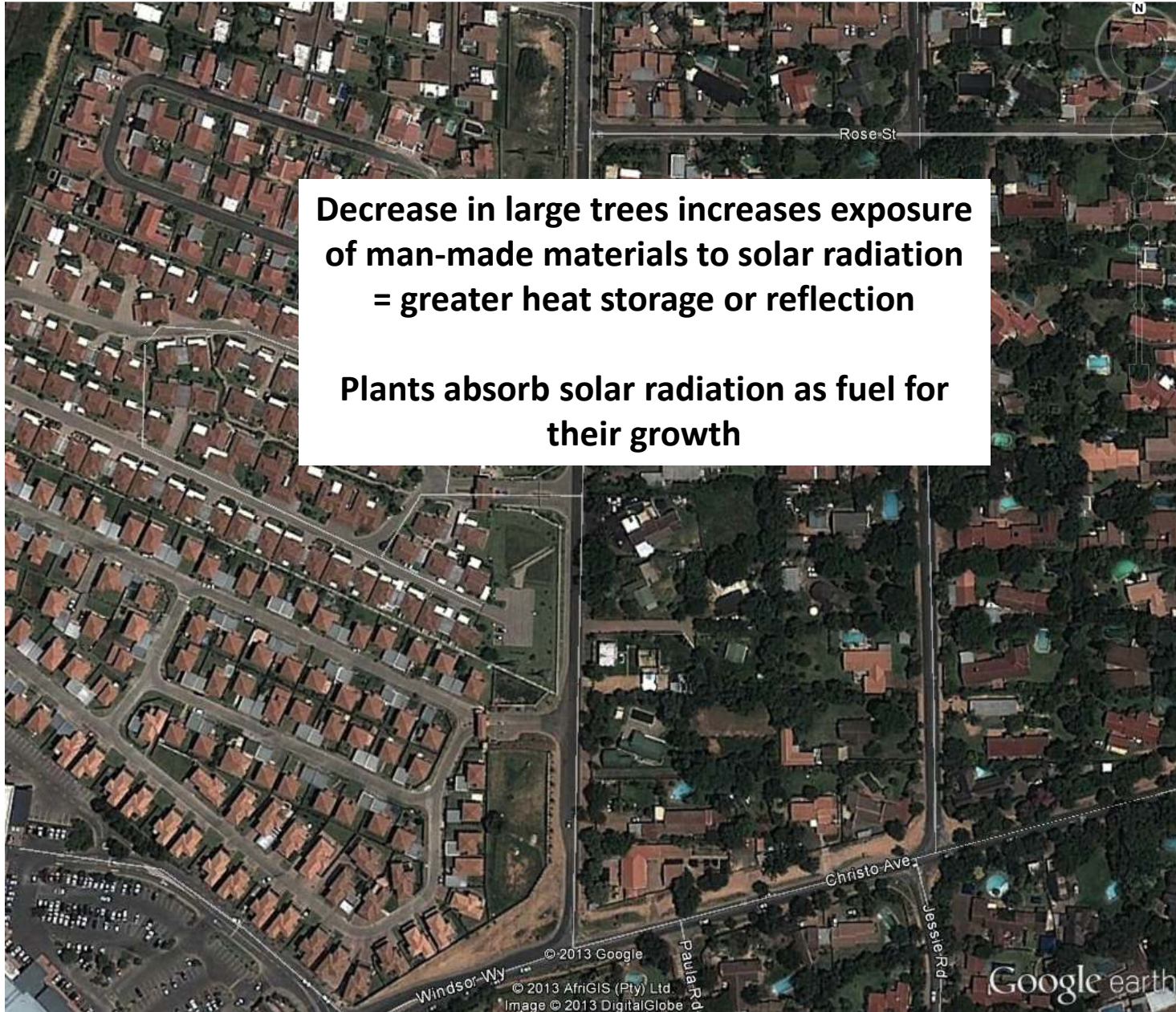
- Increase in dense materials, especially reinforced concrete for multi-storey buildings
- Increase in impervious (water resistant) materials such as asphalt, concrete, stone and rooftops
- Densification of anthropogenic (human activities) heat production
- Decrease in the number of large trees
- Premium on open (greened) spaces



Dense materials; impervious surfaces



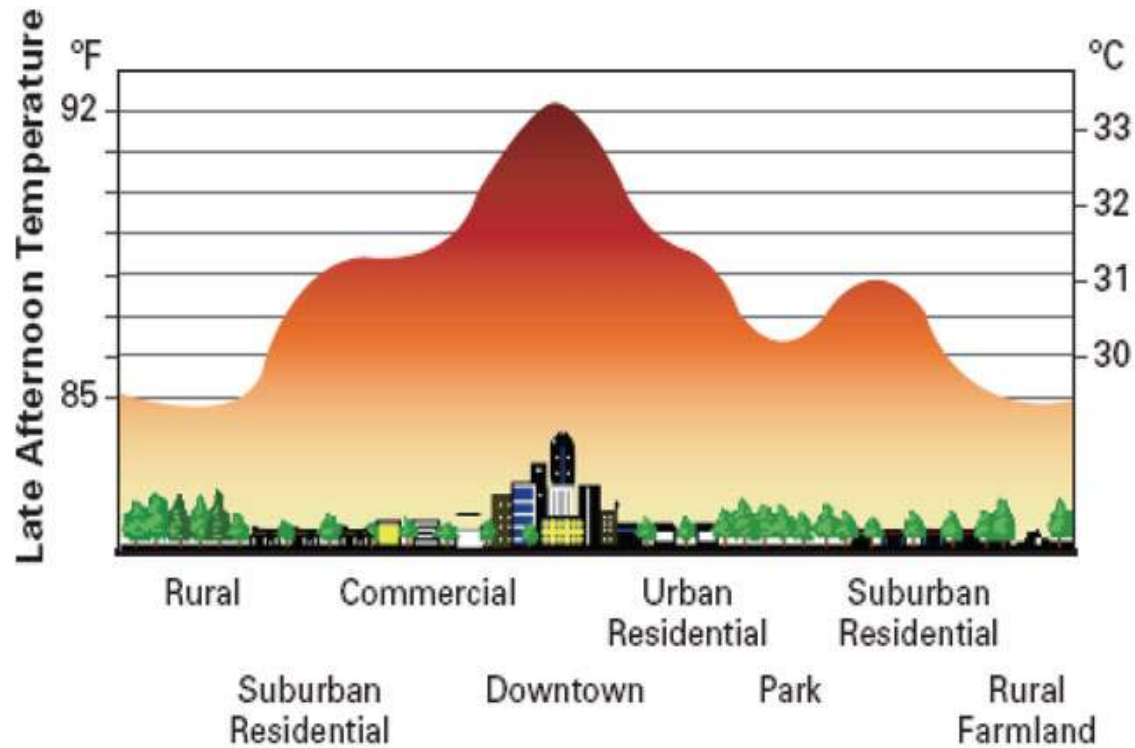




**Decrease in large trees increases exposure of man-made materials to solar radiation = greater heat storage or reflection**

**Plants absorb solar radiation as fuel for their growth**

## Urban Heat Island



All of these features associated with increased density contribute to the Urban Heat Island effect

## **Causes of the Urban Heat Island effect**

**Urban surface properties.** Roofs and pavements are typically dark in colour and thus absorb at least 80% of sunlight, causing them to get warmer than lighter coloured surfaces.

**Human activity.** Air conditioning, manufacturing, transportation, and other human activities discharge heat into our urban environments.

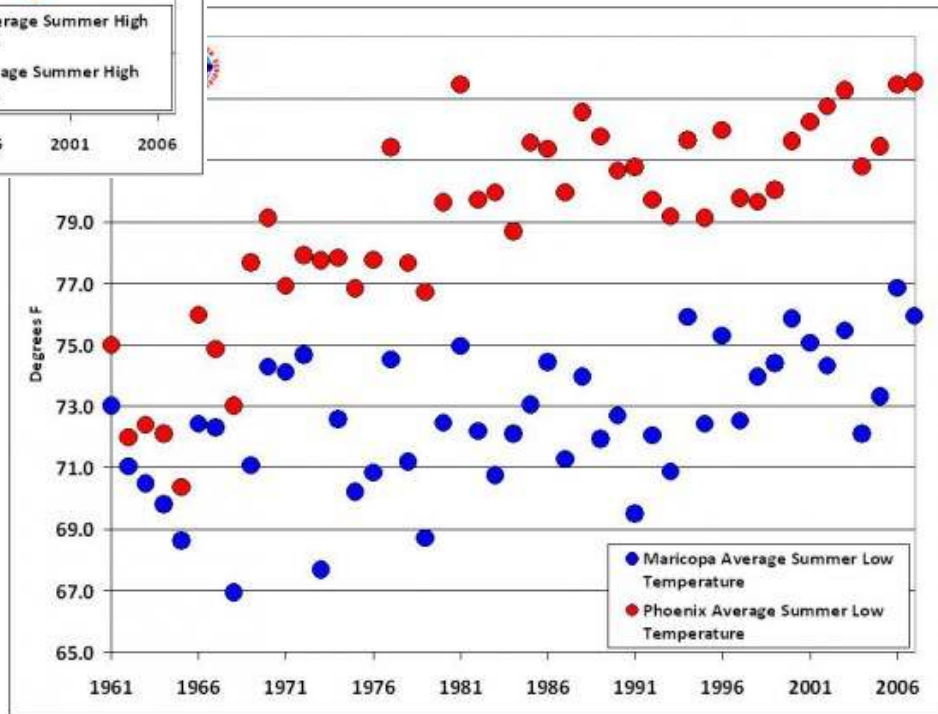
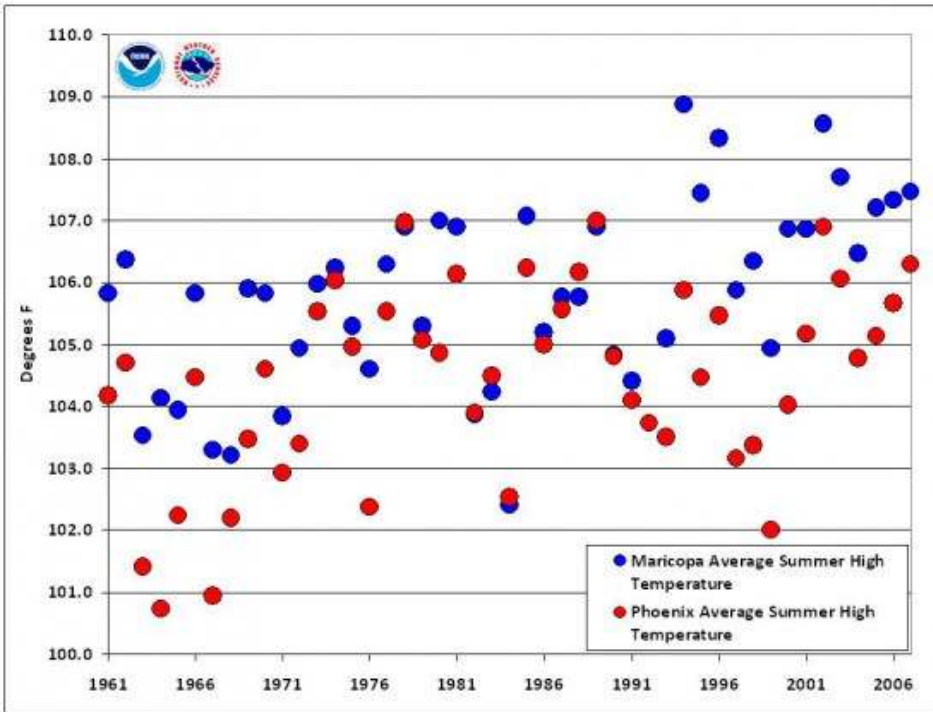
## **Consequences**

**Increased energy use.** Warm temperatures in cities increase the need for air conditioning to cool buildings.

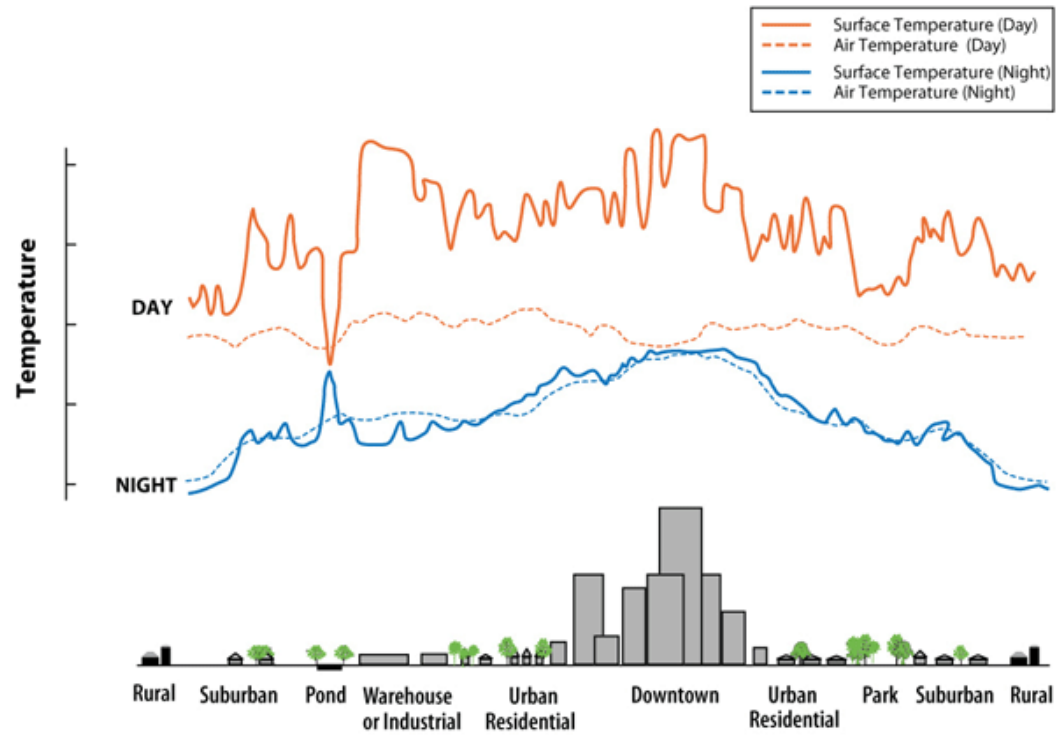
**Illness.** Higher air temperatures can aggravate heat-related and respiratory illnesses, and also reduce productivity.

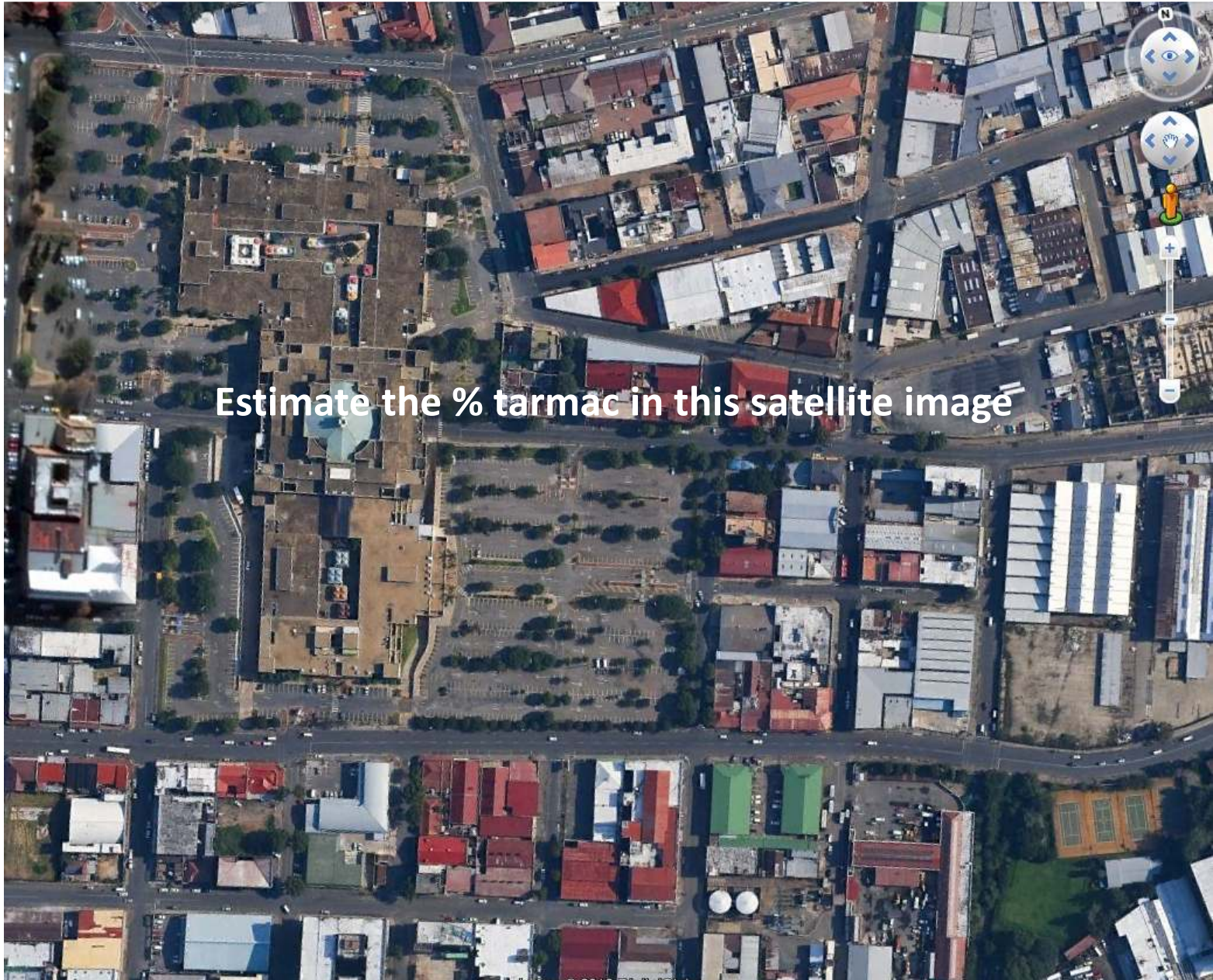
**Climatic threats.** Increase in incidence and severity of hail; severe thunderstorms; change in the locality of rainfall.

**Smog.** In winter, results in inversion layer that traps direct air pollution within the city.

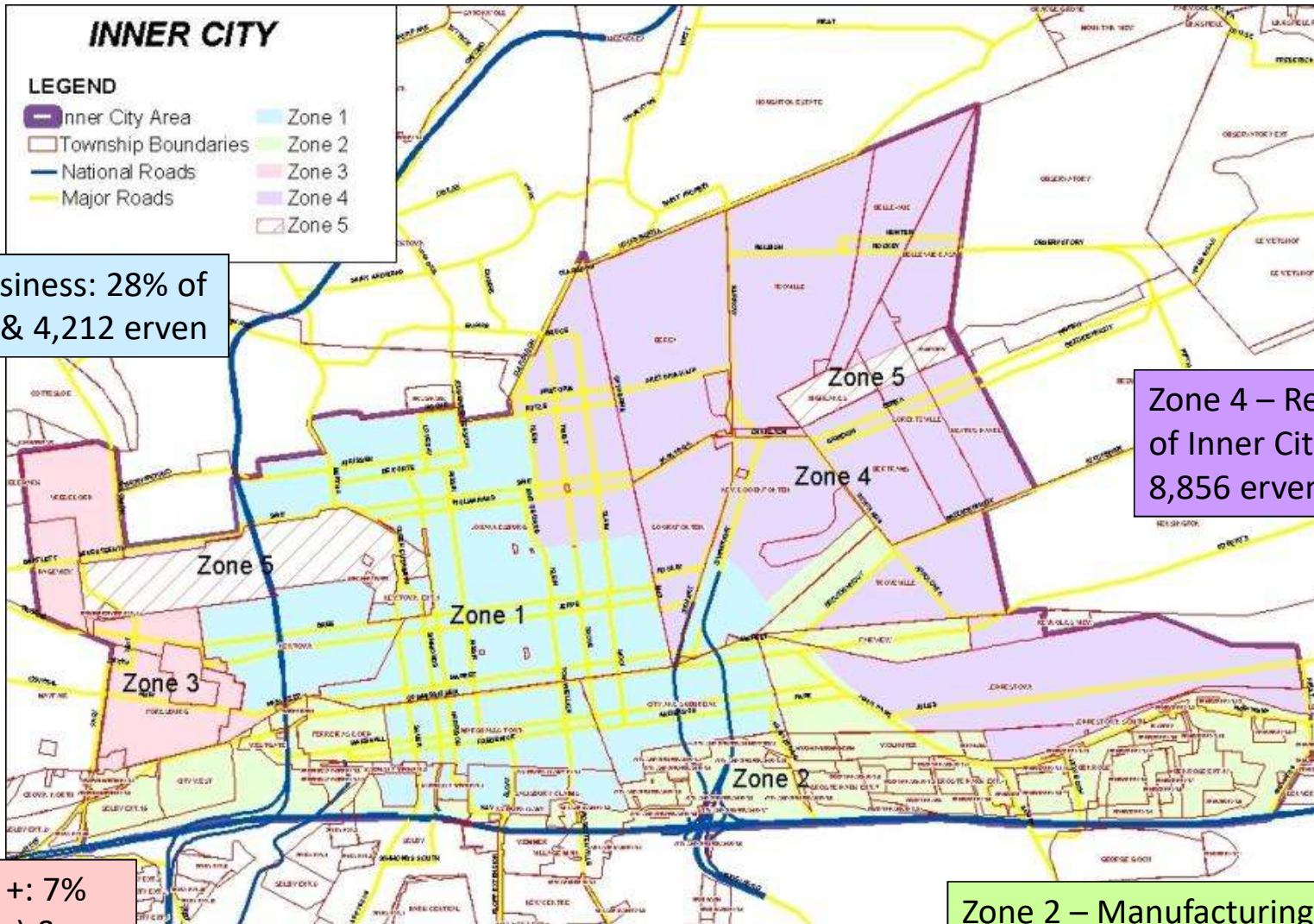


# Urban heat island: surface and air temperatures





Estimate the % tarmac in this satellite image



Zone 1- office & business: 28% of Inner City (502 ha) & 4,212 erven

Zone 4 – Residential +: 42% of Inner City (749 ha) & 8,856 erven

Zone 3 – Fordsburg +: 7% of Inner City (118 ha) & 1,858 erven

Zone 2 – Manufacturing & industrial: 23% of Inner City (417 ha) & 2,489 erven



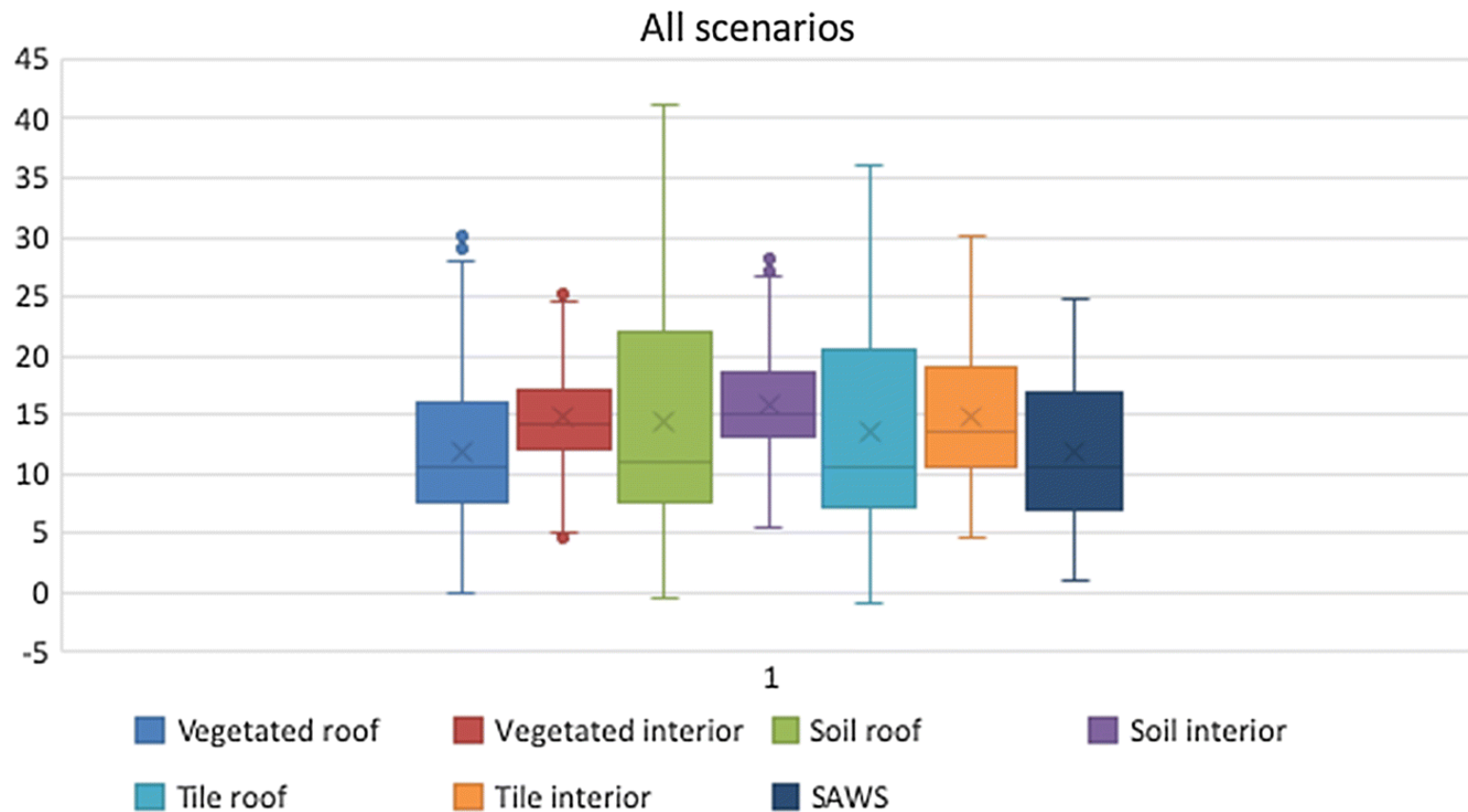
Green roof

Soil roof



Tile roof

Data from the South African Weather Service (SAWS) indicates that the temperature at the Johannesburg Botanical Gardens (Emmarentia Dam) match the data captured on this miniscule experimental roof almost exactly.



What is the effect that the use of green roofs on the Urban Heat Island?

