7.3 Climate change in Hong Kong?

7.3 Hong Kong is no exception - Climate change in Hong Kong?

Summary

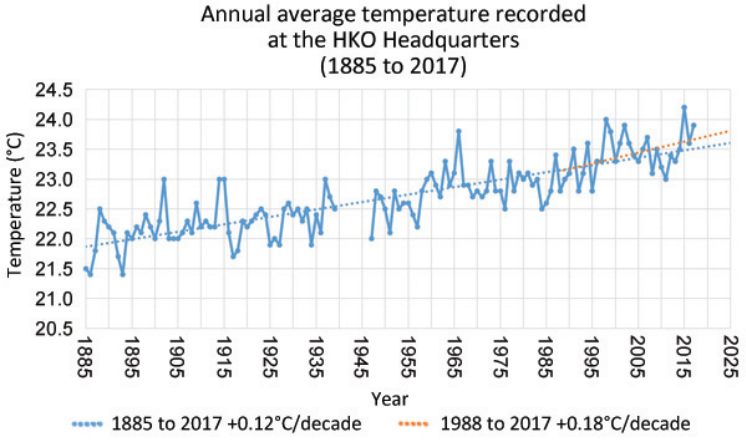
Hong Kong is not exempted from the impacts of climate change. In line with the global trends, Hong Kong records more hot weather, more extreme rainfall and sea level continues to rise. With Hong Kong gradually developing into a densely populated city, urban development also plays a role in affecting the climate of Hong Kong.

7.3.1 Climate change in Hong Kong

The Hong Kong Observatory (HKO) has been conducting meteorological observations since 1884 except for the Second World War during 1940-1946. The HKO possesses more than 130 years of meteorological observation records which are important references for climate change researches in Hong Kong.

(a) Temperature rise

Fig 3.1 shows a long-term ascending trend of the annual average temperature in Hong Kong. For the past hundred years, the annual average temperature increased at a rate of about 0.12°C per decade. The increase has become more significant in the later half of the 20th century.



Latest temperature trend

More information

Fig 3.1 **Annual average temperature recorded at the HKO Headquarters**[i]

Data source: HKO

(b) More very hot days but fewer cold days

The number of hot nights (with a daily minimum temperature of 28°C or above) and very hot days (with a daily maximum temperature of 33°C or above) have increased by about 35 times and 6 times respectively over the last hundred years or so. On the contrary, the number of cold days (with a daily minimum temperature of 12°C or below) has decreased.

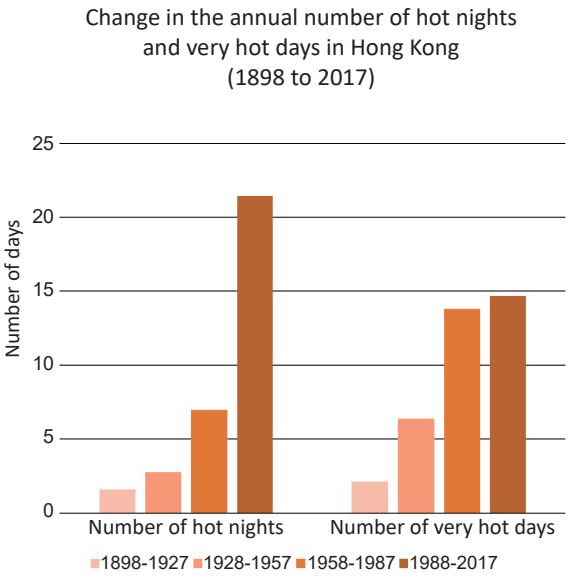


Fig 3.2a **Change in the annual number of hot nights and very hot days in Hong Kong[ii]**

Data source: HKO

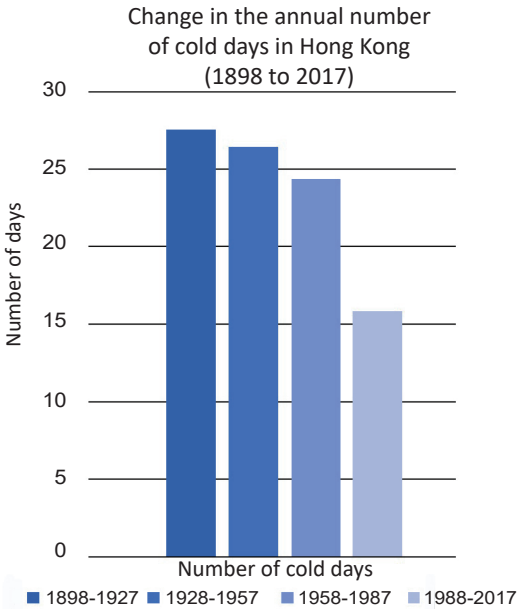


Fig 3.2b **Change in the annual number of cold days in Hong Kong**

Data source: HKO

(c) More frequent extreme rainfall

Extreme rainfall events have become more frequent. The hourly rainfall record at the HKO Headquarters was usually broken once per decade in the past, but it was repeatedly broken in recent decades. The latest record of the highest hourly rainfall at the HKO Headquarters was 145.5mm in 2008. A more sophisticated analysis shows that the chance of an extreme rainfall event with hourly rainfall of 100 mm or more has doubled over the last century.

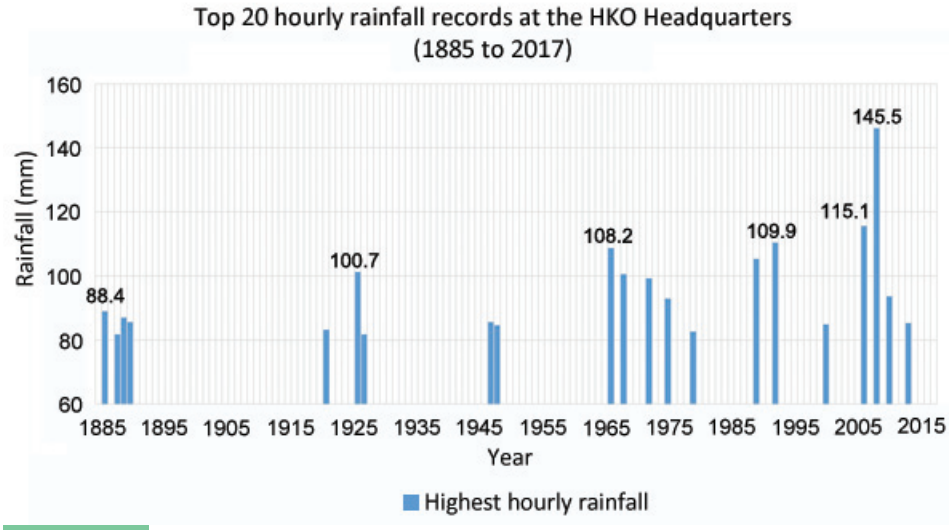


Fig 3.3 **Top 20 hourly rainfall records at the HKO Headquarters[iii]**

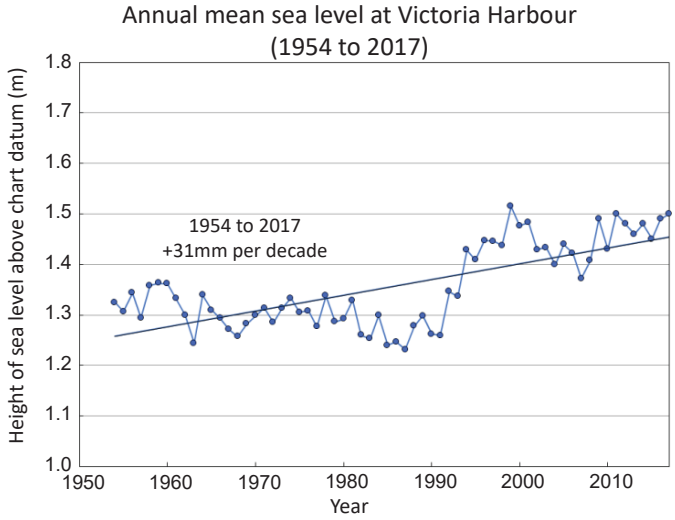
Data source: HKO

Extreme weather events

More information

(d) Sea level rise

Tide gauge records in Victoria Harbour since 1954 indicated an obvious rise of the mean sea level. On average, the mean sea level in Victoria Harbour rose at a rate of about 31 mm per decade in the past 60 years or so.



Latest mean sea level trend

More information

Fig 3.4 **Annual mean sea level at Victoria Harbour[iv]**

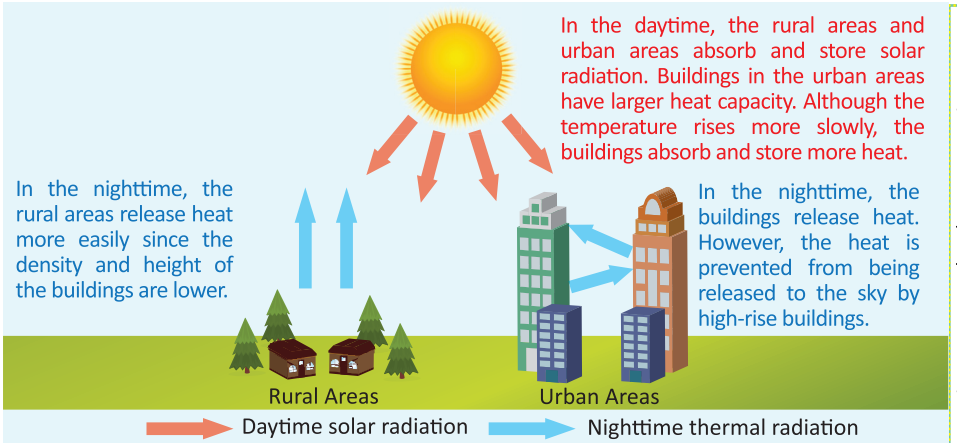
Source: HKO

7.3.2 How does urban development affect the climate of Hong Kong?

Both global warming and local urban development affect the climate of Hong Kong. According to researches from the HKO, urban development is one of the factors causing Hong Kong's warming trend and the contribution could be up to 50%.

Urban heat island effect

Owing to urban development, the cooling rate of the urban areas has gradually become lower than that of the rural areas, causing the average temperature in the urban areas to be generally higher than that in the rural areas. This phenomenon is called the urban heat island effect. Urban development includes land use changes, dense building development, heat emissions and human activities. Fig 3.5 shows the causes of the urban heat island effect.



- Buildings in the urban areas have higher heat capacity, absorbing and storing more solar radiation.
- High-density and tall buildings block the view of the sky, reducing the amount of heat released to the sky.
- A lot of heat is emitted from buildings, air conditioners, vehicles and industrial activities in the urban areas.
- High-density buildings reduce wind speed and cooling rate.

Fig 3.5 **Impact of urban development on the heat balance in the urban areas[v]**

In Hong Kong, the urban heat island effect is primarily a nighttime phenomenon, which is more significant in winter, especially with a stable atmosphere, light breezes and clear skies. Fig 3.6 shows an example in 2010. Under the influence of a continental airstream over southern China, the weather in Hong Kong was mainly fine on 17 December 2010. Light winds at night enhanced radiation cooling, bringing the temperature at Ta Kwu Ling down to a minimum of 0.2°C in the early morning on 18 December. Affected by urban development, the nocturnal cooling in the urban areas was much slower than that in the rural areas and the minimum temperature at the HKO Headquarters in Tsim Sha Tsui was 10.7°C, more than 10°C higher than that at Ta Kwu Ling.

The daily minimum temperatures from urban to rural areas on 18 December 2010

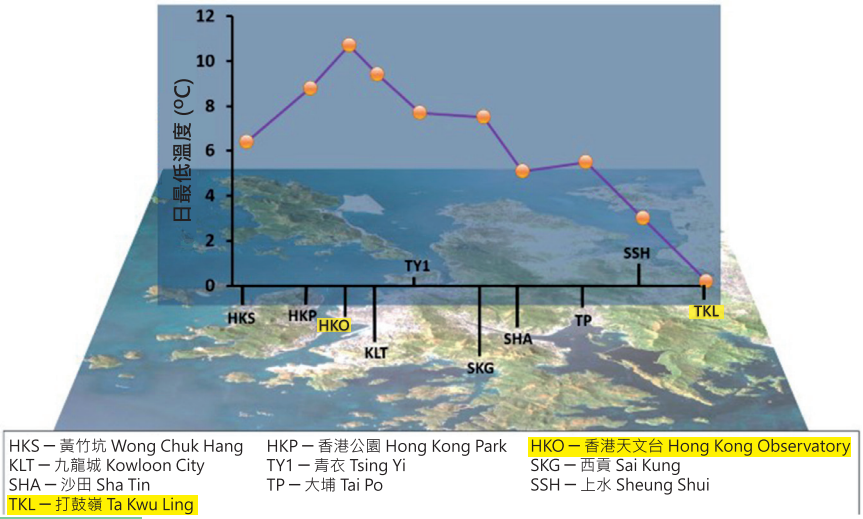


Fig 3.6 The daily minimum temperatures from urban to rural areas on 18 December 2010[vi]

Source: HKO

Impact of urban development on the surface wind speed

The high-rise buildings and dense urban development in Hong Kong have increased land surface friction, obstructing air flow and reducing wind speed in the urban areas. Fig 3.7 shows that there is no obvious trend of the annual average wind speed at Waglan Island for 1968-2015, while the wind speed at King's Park in the urban areas exhibits a significant downward trend.

The annual average wind speed at King's Park and Waglan Island (1968 to 2015)

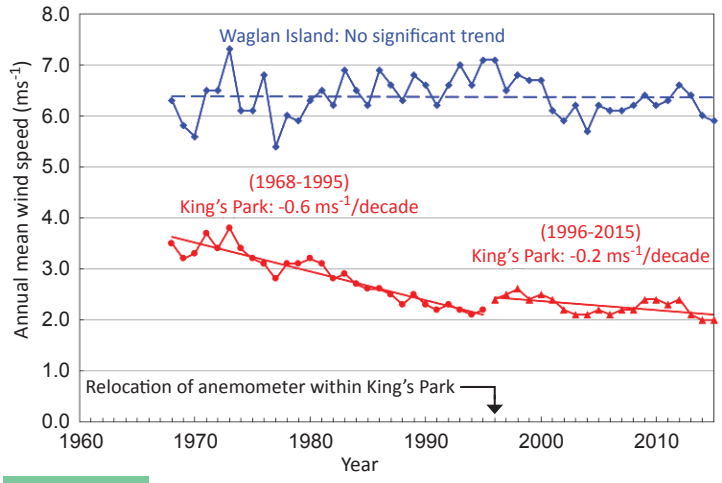


Fig 3.7 The annual average wind speed at King's Park and Waglan Island[vii]

Source: HKO

Buildings creating wall effect

More information

Other possible impacts of urban development

Over the past 50 years or so, the annual mean cloud cover in Hong Kong has increased by about 1.1%[viii] per decade. One of the possible reasons is that human activities release suspended particulates into the atmosphere, increasing the concentration of condensation nuclei and favouring cloud formation. In addition to the increased condensation nuclei in the atmosphere, the urban heat may enhance convection. Both factors favour precipitation. Research from the Hong Kong Observatory points out that the increasing trend of rainfall in the urban areas was higher than that in the New Territories and offshore areas for 1956-2005.

The increase in suspended particulates and cloud cover reduces the amount of solar radiation reaching the ground. Since the 1970s, the amount of solar radiation observed in Hong Kong shows an overall decreasing trend.

Relative humidity is affected by air temperature and the amount of water vapour in the air. In general, relative humidity decreases with increasing temperature. During the day, the temperature rise in the rural areas is significantly higher than that in the urban areas and hence the relative humidity is lower in the rural areas. In the evening, the rural areas cool faster than the urban areas and hence the relative humidity is higher in the rural areas.

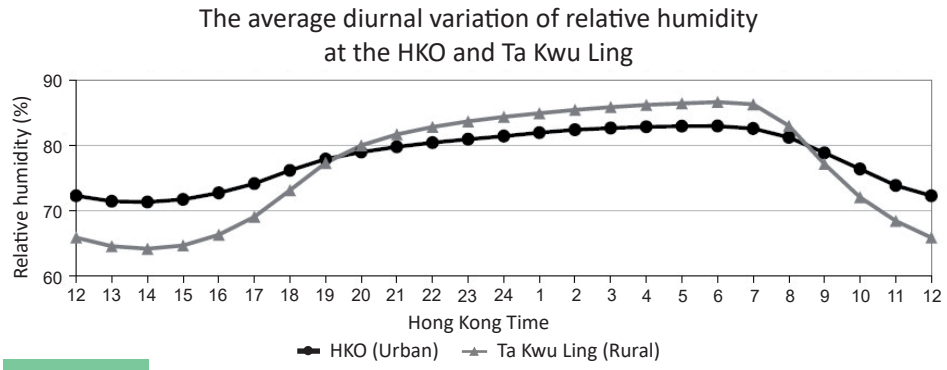


Fig 3.8 **The average diurnal variation of relative humidity at the HKO and Ta Kwu Ling[ix]**

Source: HKO

Urban heat island effect and global warming

Urban development causes the urban heat island effect, which then makes the city warmer. However, the impact of the urban heat island effect is confined to cities and has limited contribution to global warming. The Fifth Assessment Report of IPCC points out that the urban heat island effect has contributed no more than 10% to the warming of global land surface over the past hundred years.

Measures to mitigate urban heat island effect

Enhance urban greening: Trees help to provide cooling. The temperature in tree shades is much lower than the temperature of concrete or asphalt exposed to sunlight. Increase in the urban greening ratio can provide more tree shades and create a cooler environment for pedestrians.

The yellow and orange areas in the thermal image at Fig 3.9a show that road surface and buildings exposed to direct sunlight have relatively higher temperature. The blue and dark blue areas show that the temperature is relatively lower in areas under tree shades. The temperature difference can be 10°C or higher.

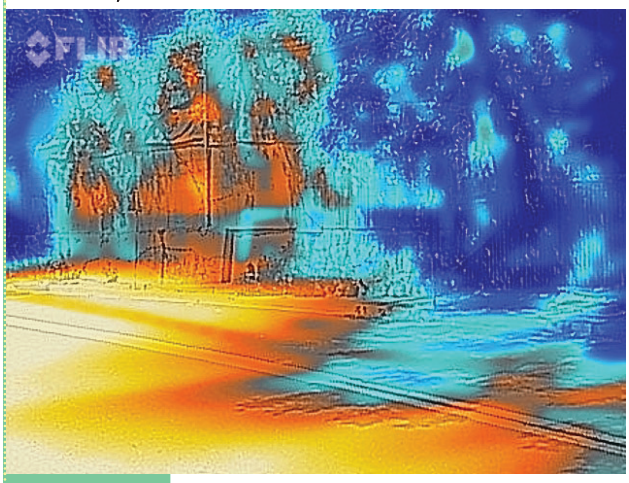


Fig 3.9a **Thermal image**

Fig 3.9b **Photo**

Improve building materials: Use heat-proof building materials and enhance reflectivity of buildings.

Improve urban planning: Urban planning and design are very important. Building bulk, building height, city permeability and green coverage should all be considered in the planning stage. For example, widening the distance between buildings can reduce the "wall effect", enhancing natural ventilation and mitigating the urban heat island effect.

7.3.3 Microclimate

Although Hong Kong is a small place, the variation in geographical location and site environment results in significant differences in temperatures as shown in Fig 3.10a and Fig 3.10b. Even in the same district, the temperature and humidity at different locations can be different. This is referred as microclimate.

Microclimate is a special climatic situation within a small range, mainly affected by factors such as topography, wind direction, building orientation and density.

Smart weather: Microclimate

More information

Spatial variation of the average maximum temperature at different stations in summer (2010 to 2015)

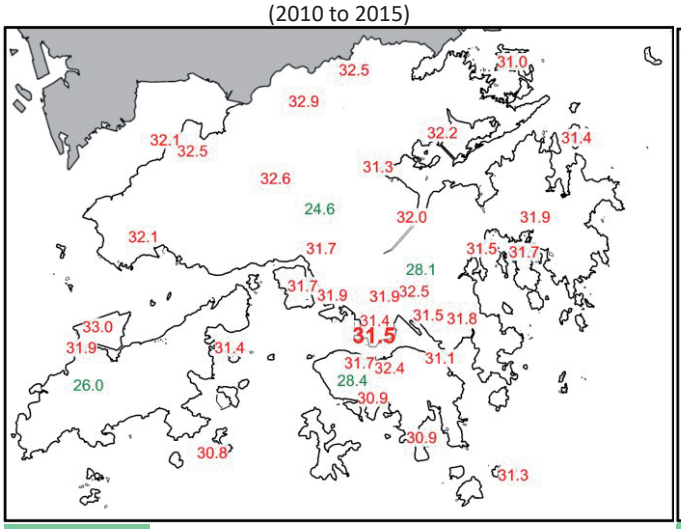


Fig 3.10a **Spatial variation of the average maximum temperature at different stations in summer. Stations on high ground shown in green[x]**

Source: HKO

Spatial variation of the average minimum temperature at different stations in winter (2010 to 2015)

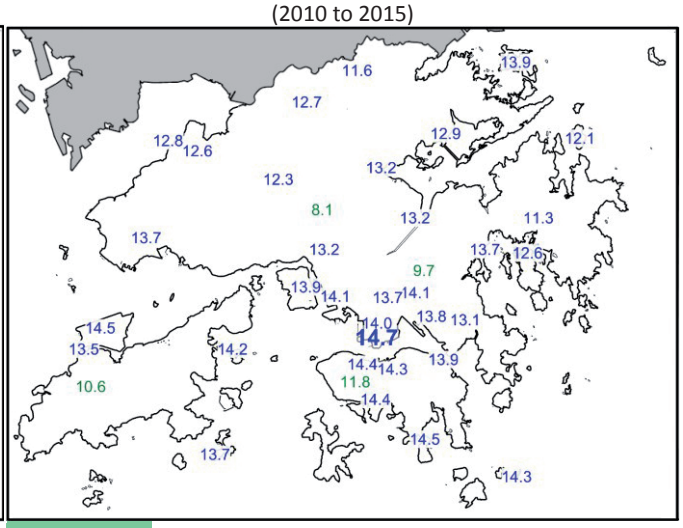


Fig 3.10b **Spatial variation of the average minimum temperature at different stations in winter. Stations on high ground shown in green**

Source: HKO

In 2017, the HKO installed more than 30 temperature micro-stations on Kowloon Peninsula to study microclimate in the urban areas. Preliminary findings of the study show that the temperature distribution of Kowloon Peninsula is affected by wind direction. Fig 3.11 shows that in the case of easterly winds, the temperature on the east side of Kowloon Peninsula is relatively lower compared to the urban centre and the west side of the Peninsula and the temperature difference can be up to about 4°C.

Preliminary results of the microclimate study on Kowloon Peninsula

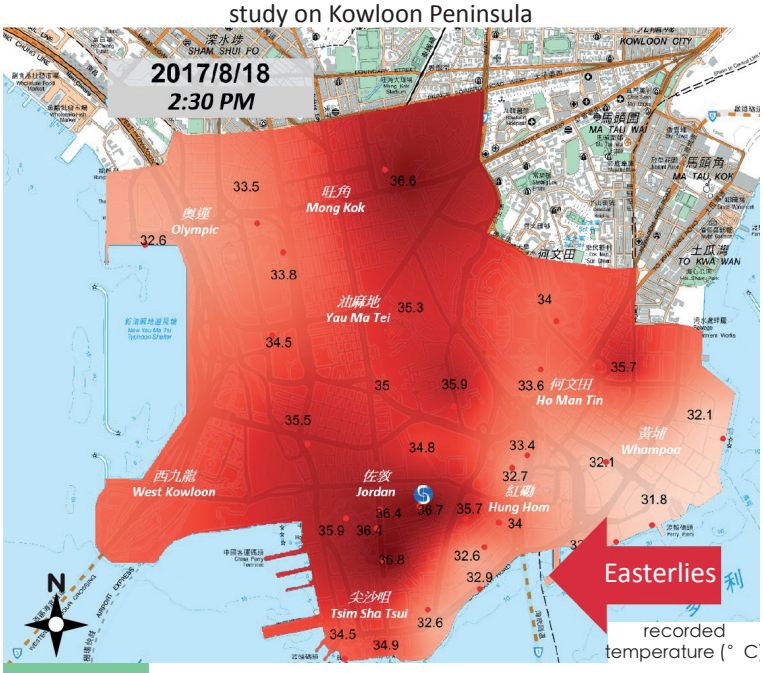


Fig 3.11 **Preliminary results of the microclimate study on Kowloon Peninsula**

Source: HKO

There are temperature differences between different parts of Nathan Road in Tsim Sha Tsui. Fig 3.12 shows that the temperature station at the **junction of Nathan Road and Haiphong Road** generally recorded higher temperatures, followed by the temperature station near **Park Lane Shopper's Boulevard**. The temperature station near the **ChungKing Mansions** generally recorded lower temperatures. The higher temperatures at the junction of Nathan Road and Haiphong Road could be due to the heavy traffic on-site while the lower temperatures near ChungKing Mansions could be attributed to the blocking of sunlight by the buildings around.

Urban microclimate studies can provide basic urban climate information to support improvement of town planning.

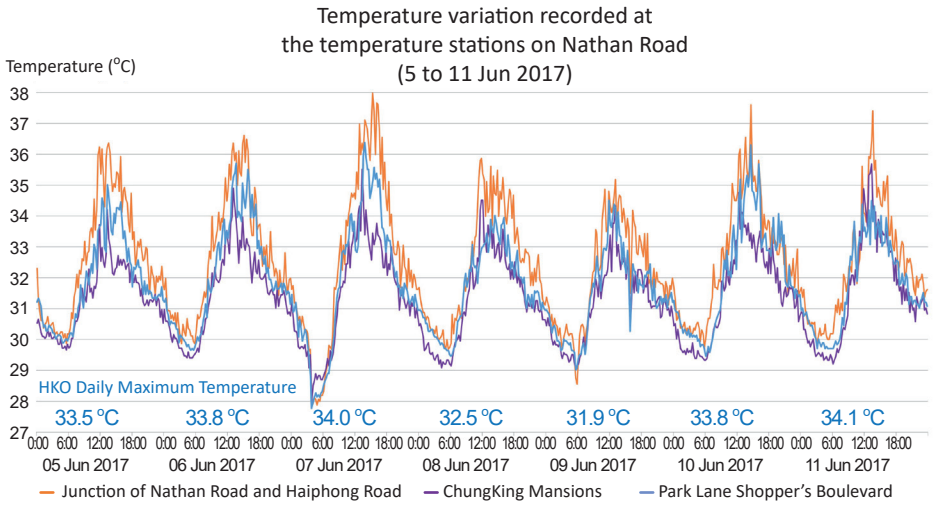


Fig 3.12 Temperature variation recorded at the temperature stations on Nathan Road

Source: HKO

Fig 3.13 Urban microclimate stations

Source: HKO