Regional fact sheet - Urban Areas

Common regional changes

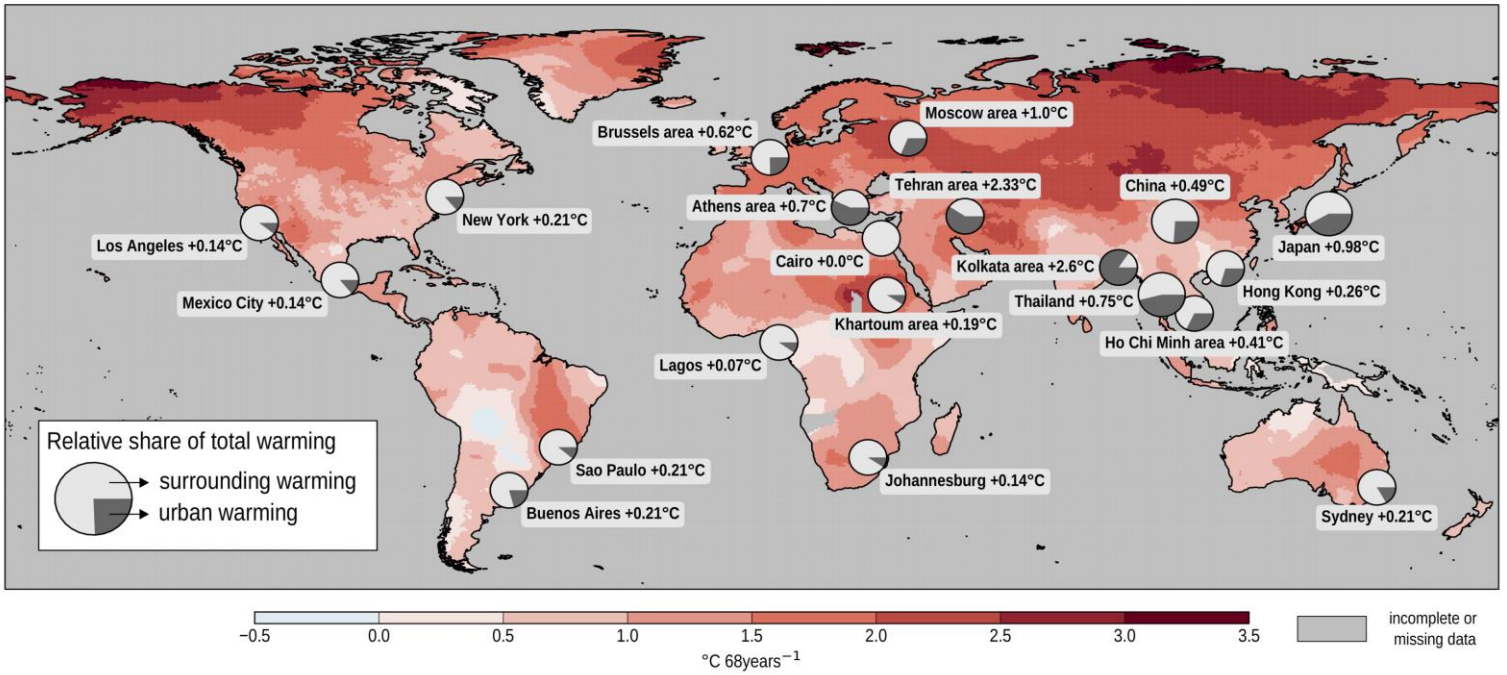
Urban centres and cities are warmer than the surrounding rural areas due to what is known as the urban heat island effect. This urban heat island effect results from several factors, including reduced ventilation and heat trapping due to the close proximity of tall buildings, heat generated directly from human activities, the heat-absorbing properties of concrete and other urban building materials, and the limited amount of vegetation.

Urbanization alters the water cycle, generating increased precipitation over and downwind of cities (*medium confidence*), and increasing surface runoff intensity (*high confidence*).

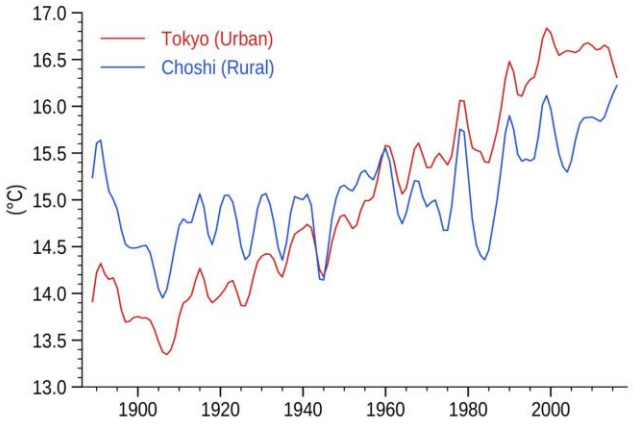
Urbanization can also induce phenomena such as the urban dryness island, which refers to conditions where lower humidity values are observed in cities relative to more rural locations, and to slower wind speed compared to adjacent suburbs and countryside.

Despite having a negligible impact on global annual mean surface air warming (*very high confidence*), urbanization has exacerbated the effects of global warming in cities (*very high confidence*).

(a) Trend in global (near) surface air temperature (CRU TS, 1950-2018)



(b) Temperature evolution Japan examples



The difference in observed warming trends between cities and their surroundings can partly be attributed to urbanization (*very high confidence*).

Annual-mean daily minimum temperature is more affected by urbanization than annual-mean daily maximum temperature (*very high confidence*).

Urbanization has exacerbated changes in temperature extremes in cities, in particular for nighttime extremes (*high confidence*)

Air pollution

- A warmer climate is expected to increase surface ozone by a few parts per billion over polluted regions, depending on ozone precursor levels (*medium* to *high confidence*).
- There is *medium confidence* that climate driven changes to meteorological conditions generally favor extreme air pollution episodes in heavily polluted environments, though with strong regional and metric dependencies.

Coastal cities

- Both sea levels and air temperatures are projected to rise in most coastal settlements (*high confidence*)
- The combination of extreme sea level, increased by both sea level rise and storm surge, and extreme rainfall/riverflow events will increase the probability of flooding (*high confidence*)
- There is *high confidence* in an increase in pluvial flood potential in urban areas where extreme precipitation is projected to increase, especially at high global warming levels

Common projections

- Future urbanization will amplify the projected air temperature change in cities regardless of the characteristics of the background climate, resulting in a warming signal on minimum temperatures that could be as large as the global warming signal (*very high confidence*).
- Compared to present day, large implications are expected from the combination of future urban development and more frequent occurrence of extreme climate events, such as heatwaves, with more hot days and warm nights adding to heat stress in cities (*very high confidence*).
- Impact assessments and adaptation plans in cities require high-spatial-resolution climate projections along with models that represent urban processes, ensemble dynamical and statistical downscaling, and local-impact models.

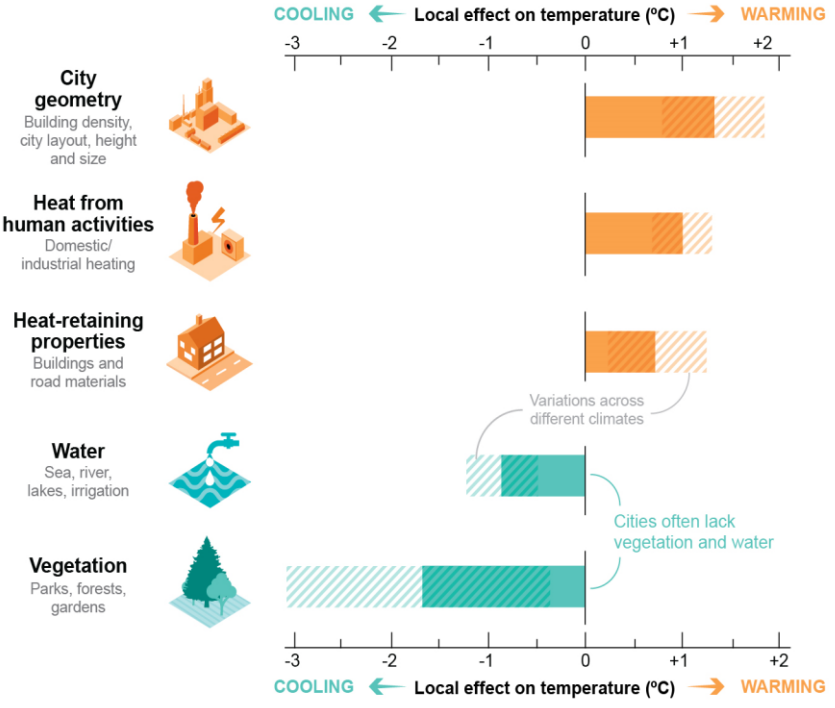
Three main factors contribute to amplify the warming of urban areas:

- Urban geometry. Tall buildings close to each other absorb and store heat and also reduce natural ventilation.
- Human activities, due to heat released from domestic and industrial heating or cooling systems, running engines, and other sources.
- The materials that make up cities. These materials are very good at absorbing and retaining heat and then re-emitting that heat at night.

The urban heat island effect is further amplified in cities that lack vegetation and water bodies.

FAQ 10.2: **Why are cities the hotspots of global warming?**

Cities are usually warmer than their surrounding areas due to factors that trap and release heat and a lack of natural cooling influences, such as water and vegetation.



Links for further information:

Common changes: 8.2, Box 10.3, 11.3, 11.4
Figures: 2.3, Box 10.3, 11.3, 11.4
Air pollution: 6.3, 6.5
Coastal cities: 12.3, 12.4, Box TS.14
Common projections: Box 10.3, 11.3, 11.4, 12.3, 12.4
Urban heat island effect: Box 10.3, FAQ 10.2