Climate information relevant for the Cities, Buildings, and Transport

This fact sheet presents AR6 WGI assessments for changes to climate factors connected to responses in cities, buildings and transport sectors, highlighting climate information and data needs that inform sectoral assessments and further actions for adaptation, mitigation and resilience planning. This WGI fact sheet is focused on the assessment of **climatic variables** (e.g., temperature, precipitation, and wind). Summaries of confidence for **climatic impact-driver changes** in each region can be found in **Table TS.5**

***Impacts and adaptation** options for cities and key infrastructure are assessed in the WGII Report, particularly in Chapter 6 and Cross-Chapter Paper 2. **Mitigation aspects** are assessed in the WGIII Report Chapters 8, 9 and 10.*

HEAT AND COLD

- Despite having a negligible effect on global annual mean surface air warming, urbanization has exacerbated the effects of global warming in cities. {Box 10.3}
- Cities intensify human-induced warming locally, and further urbanization together with more frequent hot extremes will increase the severity of heatwaves (*very high confidence*). {Box 10.3, 11.3, 12.4, Box TS.14}
- Extreme heat events raise temperatures in buildings and cities already warmed by the urban heat island effect (urban center and cities being warmer than the surrounding rural areas) and can induce disruptions in critical infrastructure networks. {12.3.1.2}
- Heat affects transportation infrastructure by warping and buckling of roads and airport runways, for example, high temperatures reduce air density leading to aircraft take-off weight restrictions. {12.3.1.2}
- Urbanization increase nighttime temperature due to the urban heat island effect, which exacerbate extreme heat event in cities {11.3, 12.4, Box TS.14}
- 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*). {Box 10.3}
- Extreme cold, which overall has become less frequent and intense, can mechanically alter roads, railroads and buildings. {11.3, *12.3.1.3}*

WET AND DRY

- Urbanization increases mean and heavy precipitation over and/or downwind of cities (*medium confidence*) and resulting runoff intensity (*high confidence*). {8.2, Box 10.3, 11.3, 12.4, Box TS.14}
- Heavy downpours can lead to pluvial flooding in cities, roadways, farmland, subway tunnels and buildings (particularly those with basements). Heavy precipitation may overwhelm city transportation and storm water drainage systems, which are typically designed using intensity–duration–frequency information, such as the return periods for 1-, 6- or 24-hour rainfall totals. {12.3.2.3}
- The alternation of dry and wet spells induces swelling and shrinkage of clay soils that can lead to sinkholes and destabilize buildings. {12.3.2.7}

Coastal-specific Wet and Dry

- In coastal cities, the combination of more frequent extreme sea level events (due to sea level rise and storm surge) and extreme rainfall/riverflow events will make flooding more probable (*high confidence*). {8.2, Box 10.3, 11.3, 12.4, Box TS.14}
- Tropical cyclones and severe coastal storms can deliver wind, water and coastal hazards with the potential for widespread mortality and damages to cities, housing, transportation and energy infrastructure, ecosystems, and agricultural lands. {12.3.3.3}
- Information on frequent inundation by salt water can be highly relevant for water resources, crops, aquaculture and transportation systems due to corrosion and undercutting of coastal roads, bridges, and rails. {12.3.5.2}

SNOW AND ICE

- Regional information about the spring and autumn seasonal periods in which freeze-thaw cycles are common (such as the dates of first spring thaw and last spring frost, or the number of days where Tmax> 0 ℃ and Tmin< 0 ℃) are particularly useful in estimating the rate of potential road and building damages or determining seasonal truck weight restrictions. {*12.3.1.4*}
- Changes in permafrost temperature, extent, and active layer thickness are metrics that track how permafrost thaw below for e.g. roads, airstrips, rails, and building foundations in high-latitude and mountain regions may destabilize settlements and critical infrastructure. {*12.3.4.2*}
- The seasonal extent of thin ice and iceberg density also determines the viability of shipping lanes and seasonal roads. Arctic sea ice thickness, extent, and average age have significantly decreased over the past four decades, with largest declines in September. Future declines in Arctic sea ice are virtually certain and practically ice-free conditions (<1 million km2 in the September mean) would likely first appear before 2050 even under strong mitigation scenarios. Arctic coastal erosion is also expected to increase with sea ice loss and permafrost thaw. {*12.3.4.3, 12.4.8, 12.4.9*}
- Freezing rain and ice storms can be treacherous for road and air travel. {*12.3.4.4*}

AIR POLLUTION

- A warmer climate is expected to increase surface ozone by a few parts per billion over polluted regions, such as cities, depending on ozone precursor levels *(medium to high confidence).* {6.3, 6.5}
- Climate driven changes to meteorological conditions generally favor extreme air pollution episodes in heavily polluted environments, though with strong variations across regions and selected metrics (indicators) (*medium confidence*). {6.3, 6.5}
- Air pollution dedicated policies will facilitate reaching air quality improvements more rapidly in many regions to reach the World Health Organization guidelines. Additional policies (e.g., access to clean energy, waste management) envisaged to attain Sustainable Development Goals bring complementary air pollution reduction. {6.6.3, 6.7.3, Box 6.2, Box TS.7}

CONCURRENT CHANGES IN CIDs

- Every region of the world will experience concurrent changes in multiple CIDs by mid-century (*high confidence*). Even for the current climate, climate change-induced shifts in CID distributions and event probabilities, some of which have occurred over recent decades, are relevant for risk assessments. {TS4.3.1} (Figure 1)

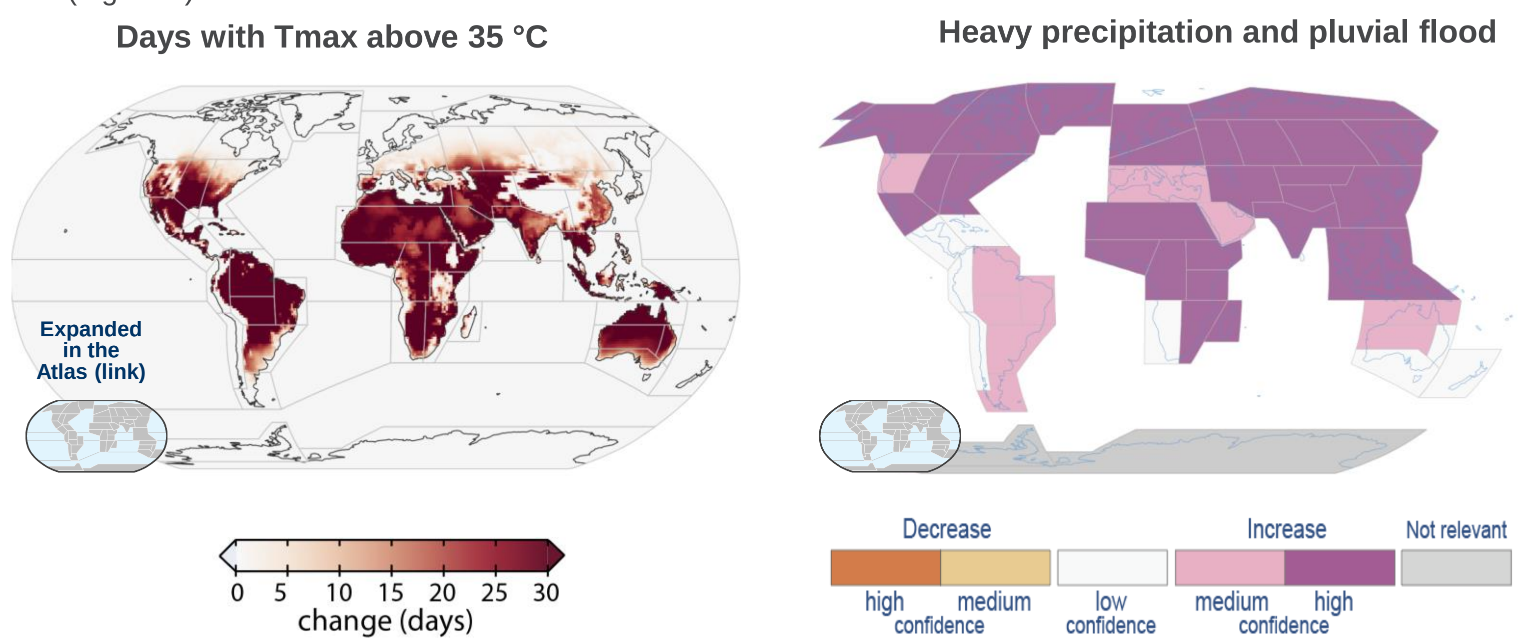

Figure 1: Projected changes in climatic impact-drivers for days with Tmax above 35 °C and heavy precipitation and pluvial flood. Changes refer to a 20–30 year period centred around 2050 and/or consistent with 2°C global warming. {Interactive Atlas}