Multi-scalar drivers and responses to heat exposure in Asian cities

Robert Wilby

Professor of Hydroclimatic Modelling

Loughborough University, UK

ADB

URBAN CLIMATE CHANGE RESILIENCE TRUST FUND
Asian Development Bank

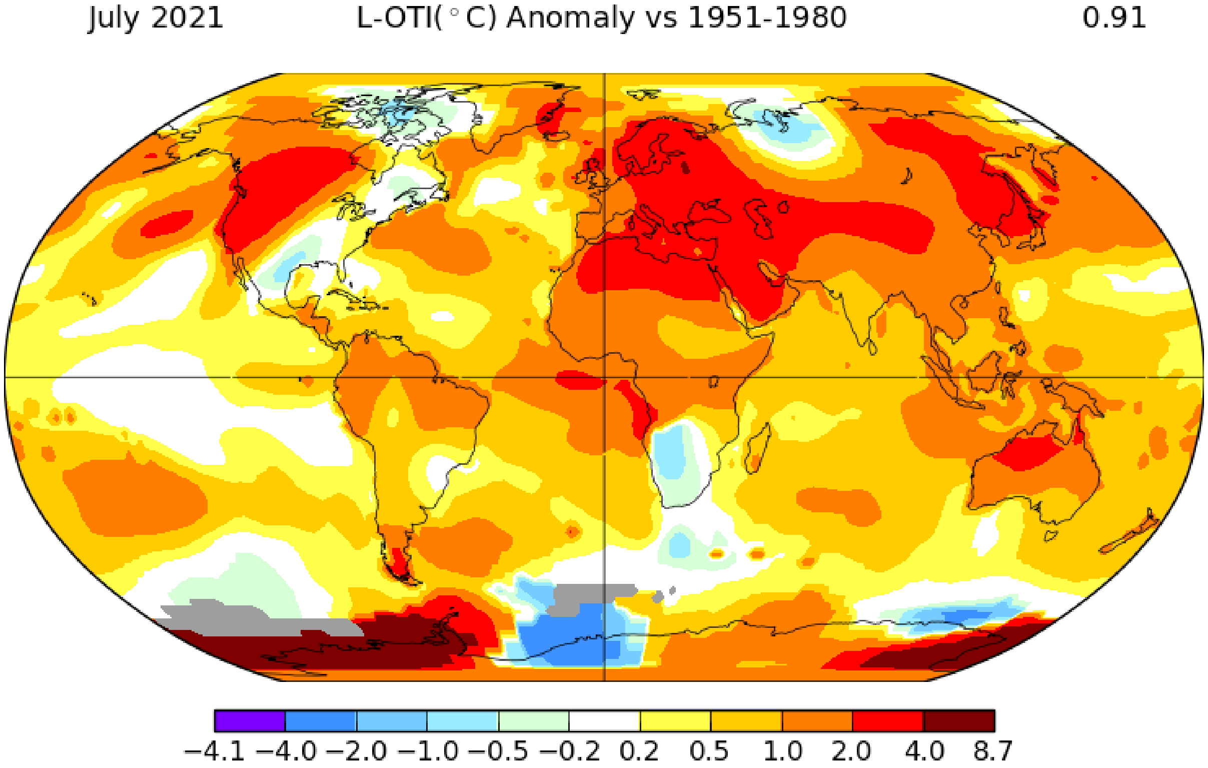
The ROCKEFELLER FOUNDATION

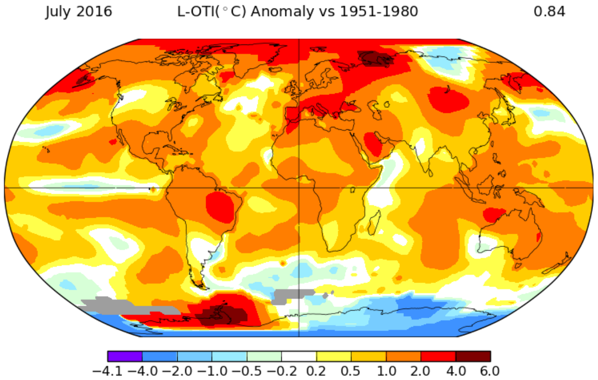
UKaid from the British people

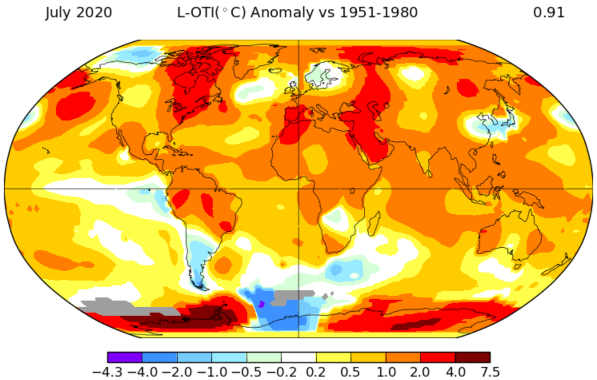
Atlantic Council

Adrienne Arsht-Rockefeller Foundation Resilience Center

Global temperature records keep being broken

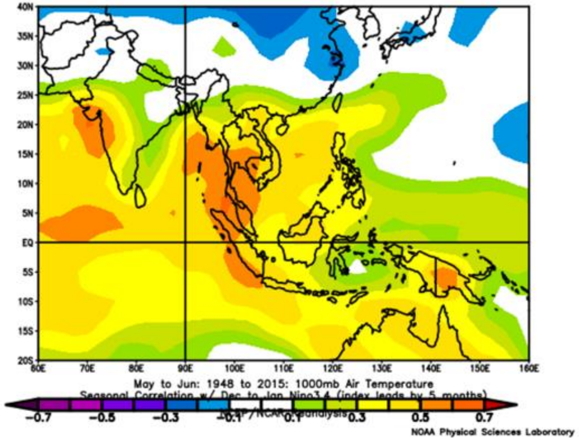




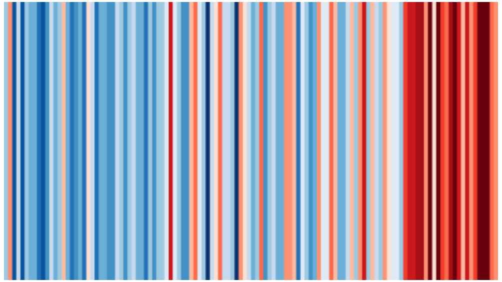


Mean surface temperature anomalies in July 2021 (hottest month on record), July 2020 and July 2016 (previous records). Data source: [NASA/GISS]

Drivers of heat at regional to human scales

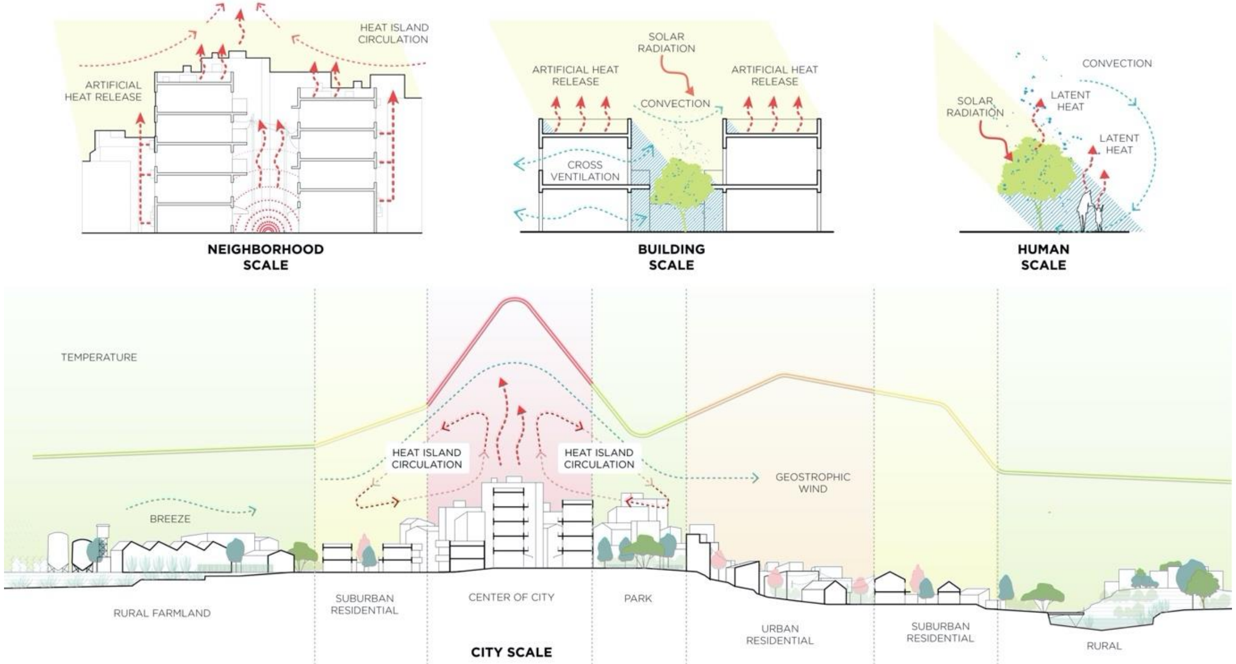


Following El Niño in winter, temperatures tend to be higher across South and Southeast Asia in May to June



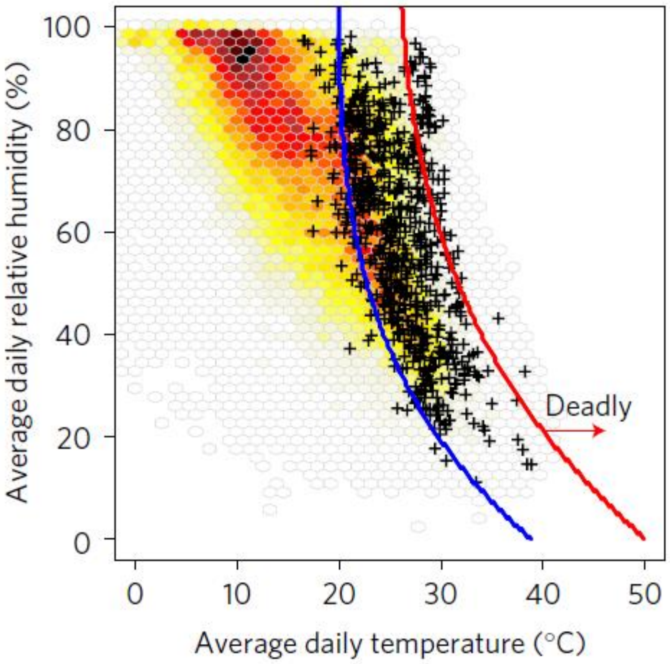
Warming stripes for Pakistan 1901-2020

Source: Ed Hawkins

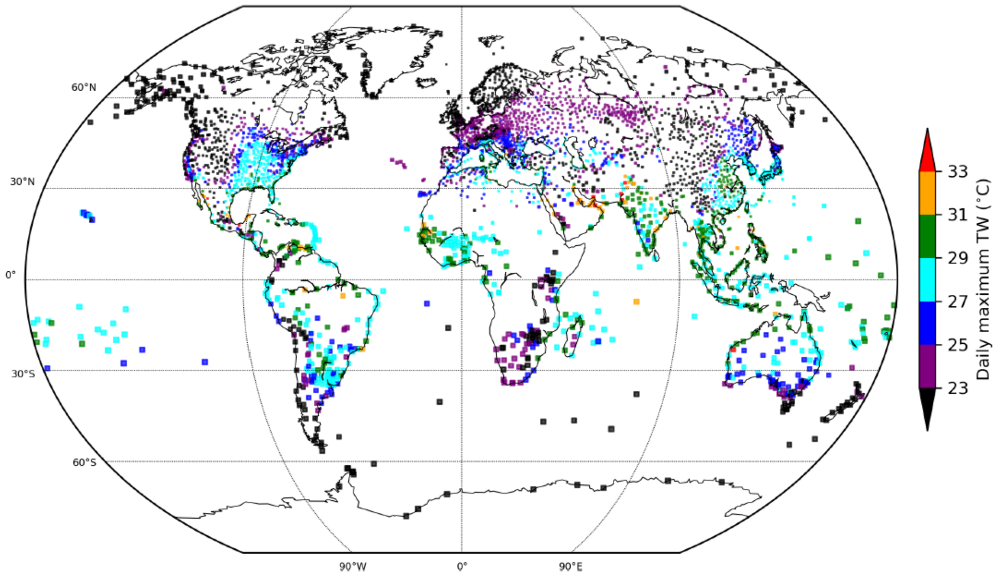


Heat in the city at human, building, neighborhood and city scales.
Source: Belinda Tato

Humid heat is what really matters

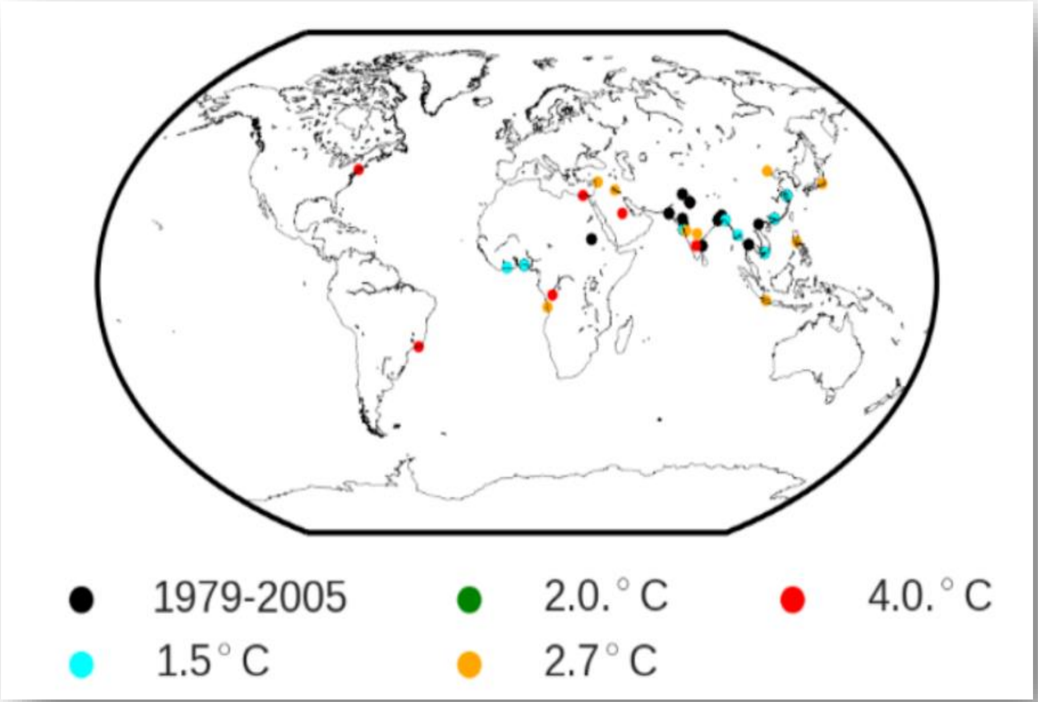


Mean daily surface air temperature and relative humidity recorded during lethal heatwaves (black crosses) compared with periods of equal duration but from randomly selected dates (i.e., non-lethal heat events; red to yellow gradient indicates the density of such non-lethal events). The blue line is the threshold that statistically separates lethal and non-lethal heat events, and the red line is the 95% probability threshold; areas to the right of the thresholds are classified as deadly and those to the left as non-deadly. Source: [Mora et al. (2017)]



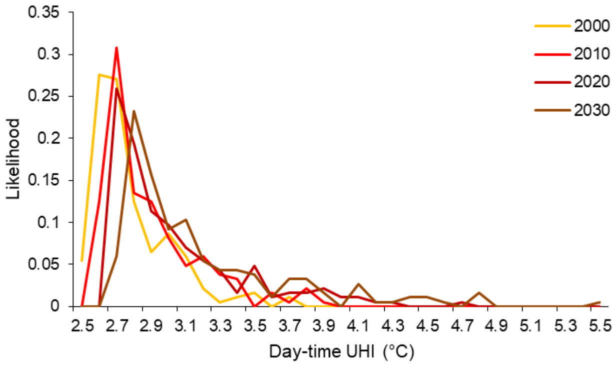
Observed global extreme humid heat. Colour symbols represent the 99.9th percentile of observed daily maximum wet-bulb temperature (TW) for 1979–2017 for HadISD stations with at least 50% data availability over this period. Marker size is inversely proportional to station density. Source: [Raymond et al. (2020)]

Cities in the frontline

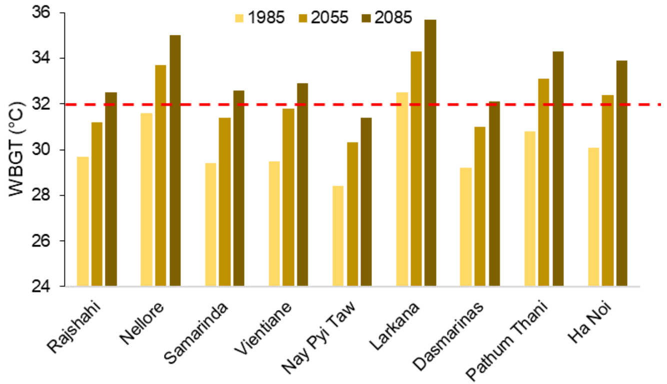


City regions projected to experience deadly heat stress for the first time under different amounts of global warming. Black circles mark locations already experiencing deadly heat stress during the 1979-2005 reference period. Source: [Matthews et al. (2017)]

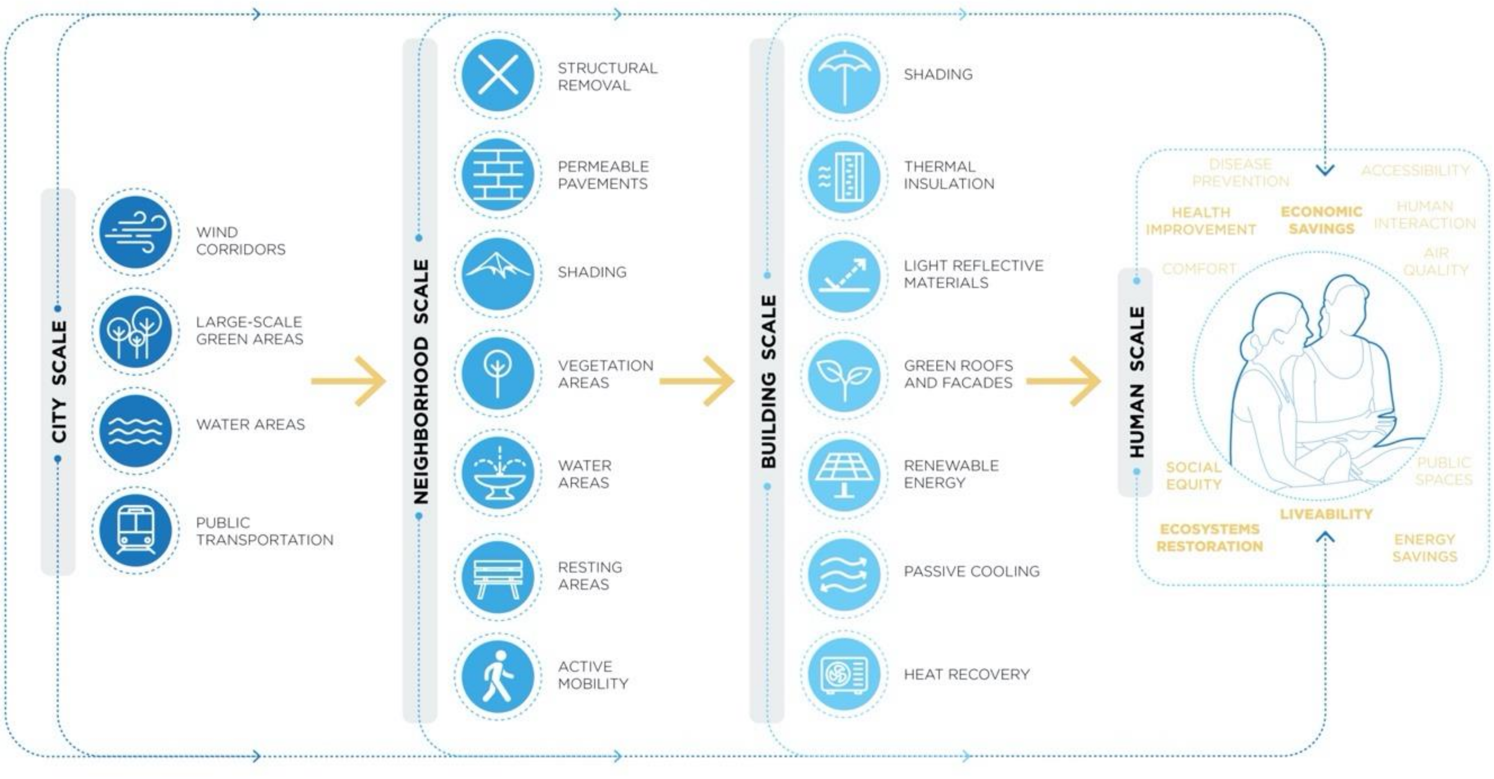
Changes in the distributions of day-time urban heat island intensity for 185 secondary cities (with 0.5 to 5 million people) due to population growth by years 2000, 2010, 2020 and 2030. Source: ADB (2021)



Mean daily maximum WBGT (°C) in the locally hottest month for the hottest secondary cities in Bangladesh, India, Indonesia, Lao DPR, Myanmar, Pakistan, Philippines, Thailand and Viet Nam respectively in 1985, 2055, and 2085 under SSP370. At WBGT = 32°C only 25% light labor is possible. Source: ADB (2021)



Reducing heat exposure at different scales



Adaptations at city, neighborhood, and building scales to manage heat impacts at human scales. Source: Belinda Tato

Take home messages

1) Humid heat is a better metric than temperature for evaluating impacts.
2) The frequency, duration and severity of high heat is increasing in South and Southeast Asia.
3) ‘Hot spots’ of extreme humid heat are found in Pakistan, India, and Thailand.
4) El Niño conditions favour higher heat in the pre-monsoon period.
5) City and population growth increases the intensity of urban heat islands.
6) Heat varies *within* cities due to green space, water bodies, local breezes, altitude, street orientation, building type and density.
7) The urban poor are consistently more exposed to extreme heat.
8) Heatwave impacts may be compounded by other concurrent hazards (such as poor air quality and drought), plus service and infrastructure failures.
9) Climate models show further rise in the frequency, duration and severity of extreme humid heat.
10) Official meteorological data and climate models underestimate heat actually experienced by people *inside* homes, workplaces, and public spaces.

Thank you