Global heating pushes tropical regions towards limits of human livability

Rising heat and humidity threatening to plunge much of the world's population into potentially lethal conditions, study finds

Research was centered on latitudes found between 20 degrees north, a line that cuts through Mexico, Libya and India, to 20 degrees south. Photograph: Noah Seelam/AFP/Getty Images

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The climate crisis is pushing the planet's tropical regions towards the limits of human livability, with rising heat and humidity threatening to plunge much of the world's population into potentially lethal conditions, new research has found.

Should governments fail to curb global heating to 1.5C above the pre-industrial era, areas in the tropical band that stretches either side of the equator risk changing into a new environment that will hit "the limit of human adaptation", the study warns.

Humans' ability to regulate their body heat is dependent upon the temperature and humidity of the surrounding air. We have a core body temperature that stays relatively stable at 37C (98.6F), while our skin is cooler to allow heat to flow away from the inner body. But should the wet-bulb temperature – a measure of air temperature and humidity – pass 35C, high skin temperature means the body is unable to cool itself, with potentially deadly consequences.

"If it is too humid our bodies can't cool off by evaporating sweat – this is why humidity is important when we consider livability in a hot place," said Yi Zhang, a Princeton University researcher who led the new study, published in Nature Geoscience. "High body core temperatures are dangerous or even lethal."

The research team looked at various historical data and simulations to determine how wet-bulb temperature extremes will change as the planet continues to heat up, discovering that these extremes in the tropics increase at around the same rate as the tropical mean temperature.

This means that the world's temperature increase will need to be limited to 1.5C to avoid risking areas of the tropics exceeding 35C in wet-bulb temperature, which is so-called because it is measured by a thermometer that has its bulb wrapped in a wet cloth, helping mimic the ability of humans to cool their skin by evaporating sweat.

Dangerous conditions in the tropics will unfold even before the 1.5C threshold, however, with the paper warning that 1C of extreme wet-bulb temperature increase "could have adverse health impact equivalent to that of several degrees of temperature increase". The world has already warmed by around 1.1C on average due to human activity and although governments vowed in the Paris climate agreement to hold temperatures to 1.5C, scientists have warned this limit could be breached within a decade.

This has potentially dire implications for a huge swathe of humanity. Around 40% of the world's population currently lives in tropical countries, with this proportion set to expand to half of the global population by 2050 due to the large proportion of young people in region. The Princeton research was centered on latitudes found between 20 degrees north, a line that cuts through

Mexico, Libya and India, to 20 degrees south, which goes through Brazil, Madagascar and the northern reaches of Australia.

Mojtaba Sadegh, an expert in climate risks at Boise State University, said the study does "a great job" of analyzing how rising temperatures "can render portions of the tropics uninhabitable in the absence of considerable infrastructure investments."

"If this limit is breached, infrastructure like cool-air shelters are absolutely necessary for human survival," said Sadegh, who was not involved in the research. "Given that much of the impacted area consists of low-income countries, providing the required infrastructure will be challenging."

"Theoretically no human can tolerate a wet bulb temperature of above 35C, no matter how much water they have to drink," he added.

The study is just the latest scientific warning over severe dangers posed by heat. Extreme heatwaves could push parts of the Middle East beyond human endurance, scientists have found, with rising temperatures also posing enormous risks for parts of China and India.

The global number of potentially fatal humidity and heat events doubled between 1979 and 2017, research has determined, with the coming decades set to see as many as 3 billion people pushed beyond the historical range of temperature that humans have survived and prospered in over the past 6,000 years.