# South Asia faces increased double-threat of extreme heat, extreme pollution

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Scientists know that extreme heat has a negative impact on the human body—causing distress in the respiratory and cardiovascular systems. They also know that extreme air pollution can also have serious impacts

on the human body. But as climate change impacts continue globally, how often will humans be threatened by both of those extremes when they occur simultaneously?

A new study in the AGU journal *AGU Advances*, answers that question for South Asia.

"South Asia is a hot-spot for future climate change impacts," said Yangyang Xu, an atmospheric scientist at Texas A&M University and lead author of the new study. Extreme heat occurrences worldwide have increased in recent decades, and at the same time, many cities are facing severe air pollution problems, featuring episodes of high particulate matter (PM) pollution, he said. This study provides an integrated assessment of human exposure to rare days of both extreme heat and high PM levels.

"Our assessment projects that occurrences of heat extremes will increase in frequency by 75% by 2050, that is an increase from 45 days a year to 78 days in a year," Xu said. "More concerning is the rare joint events of both extreme heat and extreme PM will increase in frequency by 175% by 2050. Climate change is not just a global average number, it is something you can feel in your neighborhood.

The study's regional focus was South Asia: Afghanistan, Bangladesh, Bhutan, India, Myanmar, Nepal, and Pakistan. The scientists used a high-resolution, decadal-long model simulation, using a state-of-the-science regional chemistry-climate model. Xu led the first of its kind research project, and scientists from the National Center for Atmospheric Research (NCAR) in Boulder, Colorado, led the development of the fully coupled chemistry-climate model and performed model simulations for the present-day and future conditions.

"These models allow chemistry and climate to affect each other at every

time step," said Rajesh Kumar, a project scientist at NCAR and co-author of the new study. The study was also co-authored by Mary Barth and Gerald A. Meehl, both senior scientists at NCAR, with most of the analysis done by Texas A&M atmospheric sciences graduate student Xiaokang Wu.

As climate change impacts continue to become reality, it is important for scientists to consider human impacts of multiple extreme conditions happening simultaneously, Xu said. Projected increases in humidity and temperature are expected to cause extreme heat stress for the people of South Asia, where the population is projected to increase from 1.5 billion people to 2 billion by 2050.

"It is important to extend this analysis on the co-variability of heat and haze extremes in other regions of the world, such as the industrial regions of the U.S., Europe, and East Asia," Barth said.

The analysis also showed that the fraction of land exposed to prolonged dual-extreme days increases by more than tenfold in 2050, much larger than the increase when assessed individually.

"I think this study raises a lot of important concerns, and much more research is needed over other parts of the world on these compounded extremes, the risks they pose, and their potential human health effects," Xu said.

**More information:** Yangyang Xu et al. Substantial Increase in the Joint Occurrence and Human Exposure of Heatwave and High-PM Hazards Over South Asia in the Mid-21st Century, *AGU Advances* (2020). DOI: 10.1029/2019AV000103

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