As urban areas are increasingly exposed to both higher mean and extreme air temperatures, lack of access to residential cooling is a challenge with dramatic consequences for human health and wellbeing. Despite rapid growth in air-conditioning (AC) penetration, billions of people still lack access to basic thermal comfort in the Global South. With around a billion people still living in informal housing, the condition of the housing stock also has a major impact. Different socio-economics and climate change futures will greatly influence the vulnerability of urban populations to heat stress, with possible exacerbations for many world regions. To plan adaptation and mitigation strategies, it is therefore vital to estimating cooling gaps, although studies addressing this challenge are largely missing.

This study assesses the impact of different future climates and Shared Socioeconomic Pathways (SSPs) on the extent and location of cooling gaps across urban areas in the Global South. We estimate both the extent of population potentially vulnerable to heat stress and the energy requirements to bridge the cooling gaps in urban areas.

Our results show severe cooling gaps primarily in South Asia, South-East Asia and Sub-Saharan Africa. Hotspots include major Indian cities Mumbai, New Delhi and Kolkata, each hosting fifteen to twenty million people likely exposed to heat-stress.

The extent of future cooling gaps vary substantially depending on different climate and socio-economic growth futures, that result in varying combinations of urbanization, growing wealth and increasing temperatures. By 2050, rapid urbanization will lead to even larger cooling gaps in megacities of South East Asia and Sub-Saharan Africa where income level will remain relatively low, in particular Dhaka, Karachi, Kinshasa, and Lagos.

In the sustainability scenario with reductions in inequality (SSP1), the extent of potentially vulnerable urban population will decrease due to improved access to cooling technologies driven by GDP growth across the Global South, despite higher urbanization. Conversely, in less sustainable scenarios with higher levels of inequality (SSP2 and SSP3), AC access will remain relatively low in many regions, leading to an overall increases in cooling gaps of 10-25%, despite lower urbanization levels. Rising temperatures further increase the cooling energy requirement in the range of 5-30% in the 1.5°C scenario up to 20-50% or more in the 3.0°C scenario compared to current climatic conditions.

This study provides a first estimation of future cooling gaps in the urban Global South. Bridging these gaps would entail massive energy requirements, increasing the mitigation challenge. Adaptation and mitigation strategies should therefore encompass urban planning, housing design, and awareness campaigns to reduce vulnerability, in addition to cooling systems affordability and efficiency, to reduce unnecessary greenhouse gases emissions while providing much-needed basic thermal comfort.