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Changing population dynamics and uneven temperature emergence combine to exacerbate regional exposure to heat extremes under 1.5°C and 2°C of warming

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Understanding how continuing increases in global mean temperature will exacerbate societal exposure to extreme weather events is a question of profound importance. However, determining population exposure to the impacts of heat extremes at 1.5°C and 2°C of global mean warming requires not only (1) a robust understanding of the physical climate system response, but also consideration of (2) projected changes to overall population size, as well as (3) changes to where people will live in the future. This analysis introduces a new framework, adapted from studies of probabilistic event attribution, to disentangle the relative importance of regional climate emergence and changing population dynamics in the exposure to future heat extremes across multiple densely populated regions in Southern Asia and Eastern Africa (SAEA). Our results reveal that, when population is kept at 2015 levels, exposure to heat considered severe in the present decade across SAEA will increase by a factor of 4.1 (2.4-9.6) and 15.8 (5.0-135) under a 1.5°- and 2.0°-warmer world, respectively. However, projected population changes by the end of the century under an SSP1 and SSP2 scenario can further exacerbate these changes by a factor of 1.2 (1.0-1.3) and 1.5 (1.3-1.7), respectively. Contrary to common assumptions, a large fraction of this additional risk increase is not related to absolute increases in population, but instead attributed to changes in which regions exhibit continued population growth into the future. Further, this added impact of population redistribution will be twice as significant after 2.0°C of warming, relative to stabilisation at 1.5°C, due to the non-linearity of increases in heat exposure. Irrespective of the population scenario considered, continued African population expansion will place more people in locations where emergent changes to future heat extremes are exceptionally severe.