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Spatio-Temporal Analysis of Heatwaves Over Africa During1991–2024 and Its Impact on Population

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ABSTRACT

Heatwaves are among the most severe climate extremes, with significant impacts on human health, ecosystems and socio-economic systems. Africa, which experiences high warming and population growth relative to the global mean, faces increasing risks from intensifying heatwaves. Thus, continuous investigation of heatwaves variability is important for informed early warning systems and adaptation strategies. This study examines heatwave variability across Africa from 1991 to 2024, using daily maximum temperature from the European Centre for Medium-Range Weather Forecasts' fifth-generation reanalysis. The findings suggest that heatwaves in Africa are becoming more frequent, longer-lived, more intense and are affecting wider areas. There is a general increase in the mean duration of a heatwave event and the annual number of heatwave days over most of the continent. Heatwave frequency rises markedly, with trend-based extrapolations suggesting that whole sub-regions could experience 3-day events within the next decade, while 4- and 5-day events may likely affect over 70% of areas by the early 2030s. This reflects the increasing geographic footprint of heatwaves across Africa. Heatwave intensity also exhibits a steady increase over most of the continent. Population exposure analysis identifies regions such as Western Africa, Central Africa, Northern and Southern Eastern Africa and Madagascar as the most affected, with exposure levels in 2016–2020 exceeding those in 1991–1995 by more than 10-fold. By analysing multiple dimensions of heatwave behaviour, this research addresses important research gaps and provides valuable empirical evidence to support ongoing climate risk assessment and climate adaptation efforts. This work advances understanding of climate extremes and supports evidence-based policy-making to enhance resilience in Africa's most vulnerable regions.

Keywords: Africa | climate change | disaster risk reduction | global warming | heat health | population exposure | temperature extremes