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Future changes in African heatwaves and their drivers at the convective scale

Cathryn Birch[1], Lawrence Jackson[1], Declan Finney[2], John Marsham[3], Rachel Stratton[4], Simon Tucker[4], Sarah Chapman[1], Cath Senior[4], Richard Keane[1,4], Francoise Guichard[5], and Elizabeth Kendon[4]
[1]School of Earth and Environment, University of Leeds, Leeds, UK
[2]Ronin Institute for Independent Scholarship, Montclair, NJ, USA
[3]University of Leeds Met Office Strategic (LUMOS) Research Group, School of Earth and Environment, University of Leeds, UK
[4]Met Office, Exeter, UK
[5]CNRM, Université de Toulouse, Météo-France, CNRS, Toulouse, France

The future change in dry and humid heatwaves is assessed in 10 year pan-African convective scale (4.5km) and parameterised convection (25km) climate model simulations. Compared to reanalysis, the convective scale simulation is better able to represent humid heatwaves than the parameterised simulation. Model performance for dry heatwaves is much more similar. Both model configurations simulate large increases in the intensity, duration and frequency of heatwaves by 2100 under RCP8.5. Present day conditions that occur on 3 to 6 heatwave days per year will be normal by 2100, occurring on 150-180 days per year. The future change in dry heatwaves is similar in both climate model configurations, whereas the future change in humid heatwaves is 56% higher in intensity and 20% higher in frequency in the convective scale model. Dry heatwaves are associated with low rainfall, reduced cloud, increased surface shortwave heating and increased sensible heat flux. In contrast, humid heatwaves are predominately controlled by increased humidity, which is associated with increased rainfall, cloud, longwave heating and evaporation, with dry bulb temperature gaining more significance in the most humid regions. Approximately one third (32%) of present day humid heatwaves commence on wet days, suggesting the potential for compound flood-humid heat climate extremes. Moist processes are known to be better represented in convective scale models. Climate models with parameterised convection, such as those in CMIP, may underestimate the future change in humid heatwaves, which heightens the need for mitigation and adaptation strategies and indicates there may be less time available to implement them to avoid future catastrophic heat stress conditions than previously thought.