Warming trends in summer heatwaves seen in the Central England Temperature timeseries

Sandra Chapman (1), Nicholas Watkins (1,2,3), David Stainforth (4,2,1)

(1) Physics, Dept., University of Warwick, Coventry CV4 7AL, United Kingdom (s.c.chapman@warwick.ac.uk), (2) Centre for the Analysis of Time Series, LSE, London, UK, (3) STEM, Open University, Milton Keynes, UK, (4) Grantham Research Institute on Climate Change and the Environment, LSE, London, UK

The frequency and severity of heatwaves is expected to increase as the global climate warms. We apply crossing theory for the first time to determine heatwave properties solely from the distribution of daily observations. Our method quantifies how changes in the higher values in the distribution of daily temperatures translate into changes in average heatwave properties, without including any information on spatial or temporal correlation. This provides a useful baseline with which to assess recent heatwave occurrences, and a quantitative benchmark for models, essential for attribution of heatwaves. It is a quite general framework which takes as input quantitative, user-relevant heatwave properties and outputs the range of quantiles of the distribution that need to be accurately resolved in data, and in models. We use Central England Temperature timeseries to quantify how the simple increased occurrence of higher temperatures makes heatwaves (consecutive summer days with temperatures exceeding a threshold) more frequent and intense. We find an overall 2-3-fold increase in heatwave activity since the late 1800's. Week-long heatwaves that on average return every 5 years were typically below $\sim$28 degrees C and now typically exceed it. Our analysis takes as inputs average user-specific heatwave properties. Its output pinpoints the range of temperatures for which changes in the distribution must be well-resolved statistically in order to track how these heatwave properties are changing. This provides a quantitative benchmark for models used for the attribution of heatwaves.