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# Statistical properties of record-breaking temperatures

William I. Newman (1), Bruce D. Malamud (2), and Donald L. Turcotte (3)

(1) Department of Earth and Space Sciences, Department of Physics and Astronomy, and Department of Mathematics, University of California, Los Angeles, California, USA (win@ucla.edu), (2) Department of Geography, King's College London, London, United Kingdom (nh-malamud@kcl.ac.uk), (3) Department of Geology, University of California, Davis, California, USA (dlturoctte@ucdavis.edu)

A record-breaking temperature is the highest or lowest temperature at a station since the period of time considered began. The temperatures at a station constitute a time series. After the removal of daily and annual periodicities, the primary considerations are trends (i.e. global warming) and long-range correlations. We first carry out Monte Carlo simulations to determine the influence of trends and long-range correlations on record-breaking statistics. We take a time series that is a Gaussian white noise and give the classic record-breaking theory results for an independent and identically distributed process. We then carry out simulations to determine the influence of long-range correlations and linear temperature trends. For the range of fractional Gaussian noises that are observed to be applicable to temperature time series, the influence on the record-breaking statistics is less than 10%. We next superimpose a linear trend on a Gaussian white noise and extend the theory to include the effect of an additive trend. We determine the ratios of the number of maximum to the number of minimum record-breaking temperatures. We find the single governing parameter to be the ratio of the temperature change per year to the standard deviation of the underlying white noise. To test our approach, we consider a 30 yr record of temperatures at the Mauna Loa Observatory for 1977–2006. We determine the temperature trends by direct measurements and use our simulations to infer trends from the number of record-breaking temperatures. The two approaches give values that are in good agreement. We find that the warming trend is primarily due to an increase in the (overnight) minimum temperatures, while the maximum (daytime) temperatures are approximately constant.