An assessment of regional record-breaking statistics in annual mean temperature

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Different datasets of global mean surface air temperature show consistently increasing values for the past 50 years. Since 1990, a large number of record warm years was detected: the 12 warmest years since 1880 have all occurred after 1990. The probability p of the event E of finding at least 12 of the largest values of a sequence of 126 random numbers (years 1880 to 2005) on the last 16 places (year 1990 to 2005) is $9.3 \cdot 10^{-14}$. However, annual mean surface air temperatures show serial correlations even in the absence of variations of external forcing. Two null-hypothesis have been used to calculate the probability that such series of warm record years may arise by chance in stationary, but serially correlated, series: an auto-regressive process of order 1 and long-memory process. The parameters of these processes are estimated from the observed data, using the complete record or just part of it. The resulting probabilities, estimated by Montecarlo realizations, hover over 10^{-4} to $10^{-3.}$

A similar analysis has been performed for the annual temperature averaged in each of the 26 regions defined by Giorgi and Bi (2005), derived from the HadCRU3 data set. Some of these series start earlier than 1880. The autoregressive parameter is estimated for each of these series, as well as the number of warmest years occurring in 1990-2005. The probabilities of these number of record years arising by chance under this null-hypothesis varies widely. For some regions, it is as high as 0.1, but for other regions, notably East Asia and Alaska, they are remarkably small, of the order of 10^{-6}, indicating that for these regions the late series of warm years would lie even more clearly outside the range of random fluctuations than for the global annual temperature.