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Long-range correlations in daily temperature records

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Climate research aims to identify and utilize persistent features of the atmosphere for predicting climatic anomalies. A better physical understanding gradually achieved by modeling requires a proper description for correlation properties of local variables on various scales spanning from days to decades. For short-time intervals, strong correlations characterize the dynamics, but on longer time scales asymptotic power-law correlations have been observed.

For the quantitative characterization of the scaling behavior we have used the method of detrended fluctuation analysis (DFA), which has proven useful in revealing the extent of long-range correlations in various time series (such as the heartbeat intervals, DNA nucleotide sequences, or some meteorological data). The most important advantage of DFA over conventional methods is that it permits the detection of correlations in nonstationary time series.

Several thousands of temperature records from the Global Daily Climatology Network [1] are analyzed by means of DFA. Long-range temporal power-law correlations extending up to several years are detected for each station. Contrary to earlier claims, the correlation exponent is not universal for continental locations. This conclusion is based on the observed geographic distribution of the exponents: lower and higher values than the global mean are located in spatially correlated regions [2, 3]. The spatial patterns are quite complex, simple parameter dependence such as elevation or distance from oceans cannot explain the observed variability. We haven't found a satisfying climatological explanation for the observed distributions yet.

[1] The Global Daily Climatology Network, produced by the Climate Analysis Branch, National Climatic Data Center, http://www.ncdc.noaa.gov/oa/ncdc.html

[2] A. Király and I. M. Jánosi (2005), Detrended fluctuation analysis of daily temperature records: Geographic dependence over Australia. *Meteorology and Atmospheric Physics* **88**, 119-128.

[3] A. Király, I. Bartos and I. M. Jánosi (2006), Correlation properties of daily temperature anomalies over land. *Tellus*, in print.