

Multi-periodic climate dynamics: spectral analysis of long-term instrumental and proxy temperature records

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Abstract:

The longest six instrumental temperature records of monthly means reach back maximally to 1757 AD and were recorded in Europe. All six show a V-shape, with temperature drop in the 19th and rise in the 20th century. Proxy temperature time series of Antarctic ice cores show this same characteristic shape, indicating this pattern as a global phenomenon. We used the mean of the 6 instrumental records for analysis by discrete Fourier transformation (DFT), wavelets, and the detrended fluctuation method (DFA). For comparison, a stalagmite record was also analyzed by DFT. The harmonic decomposition of the above mentioned mean shows only 6 significant frequencies above periods over 30 yr. The Pearson correlation between the mean, smoothed by a 15 yr running average (boxcar) and the reconstruction using the 6 significant frequencies yields $r = 0.961$. This good agreement has a 99.9% confidence level confirmed by Monte Carlo simulations. It shows that the climate dynamics is governed at present by periodic oscillations. We find indications that observed periodicities result from intrinsic dynamics.