Power-law persistence and trends in the atmosphere: A detailed study of long temperature records

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We use several variants of the detrended fluctuation analysis to study the appearance of long-term persistence in temperature records, obtained at 95 stations all over the globe. Our results basically confirm earlier studies. We find that the persistence, characterized by the correlation $C(s)$ of temperature variations separated by s days, decays for large s as a power law, $C(s)\sim s^{-\gamma}$. For continental stations, including stations along the coastlines, we find that γ is always close to 0.7. For stations on islands, we find that γ ranges between 0.3 and 0.7, with a maximum at $\gamma=0.4$. This is consistent with earlier studies of the persistence in sea surface temperature records where γ is close to 0.4. In all cases, the exponent γ does not depend on the distance of the stations to the continental coastlines. By varying the degree of detrending in the fluctuation analysis we obtain also information about trends in the temperature records.

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I. INTRODUCTION

The persistence of weather states on short terms is a well-known phenomenon: A warm day is more likely to be followed by a warm day than by a cold day and vice versa. The trivial forecast, that the weather of tomorrow is the same as other hand, long-term correlated data may look like uncorrelated data influenced by a trend.

Therefore, in order to distinguish between trends and correlations one needs methods that can systematically eliminate trends. Those methods are available now: both wavelet techniques (WT) (see, e.g., Refs. [4–7]) and detrended fluc-