Examples of using long tem memory in climate analysis

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Traditionally, the standard assumption about atmospheric (and oceanic) variability (apart of tides) is that of "short memory" – which may be described by an autoregressive process of order *n*. Often *n* just set to 1. The motivation is that the considered dynamics may often be approximated by a differential equation of order n, driven by an unexplained part which may be parameterized as white noise (plus external factors). The result is a red spectrum, which is actually found to be a good description of climate spectra.

In recent years, the somewhat more complex concept of long term memory processes has been employed. This application of this concept results in broader distributions and slower power-law decays of autocorrelation functions – therefore "long memory".

We review a number of studies dealing with long memory. First centennial and millennial simulations, with and without external forcing factors, are examined if the generated time series are consistent with long-memory behaviour. It turns out that they are, in particular when external forcing is present [1]. Second, the evidence for non-internal causes for the current multi-decadal warming and clustering of warmest years is found to not being compromised by the assumption of short term variability. Also under long term memory external factors are needed to explain global warming [2-4]. Third, long-term memory leads to a natural clustering of extreme events that can be seen in observable, reconstructed and model temperature records [5].

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