

Reconstruction of past climate using series with red noise

David R.B. Stockwell

Introduction

Artificially generated series with red noise—containing more low frequency than high frequency noise—closely resemble the statistics of natural temperature series, and have been used to evaluate the performance of specific climate reconstruction methodologies [6]. The tendency to 'trendiness', also known as long term persistence (LTP) can help identify false attributions of significance [5].

Also if a methodology generates the same results with random data, as with the real data, it is highly likely the methodology simply embodies a logical fallacy known as *petitio principii*, or the circular argument, where the conclusions are assumed implicitly in the premises. While past evaluations [5, 6], have used simulated series to evaluate a very specific methodology [4] here I use an approach so general, it is common to virtually all published reconstructions to date.

Method and Results

The general methodology is as follows. Collect a number of tree-ring widths or densities from cores of large trees older than the instrumental temperature record, select those that are best correlated with the instrumental temperature record, calibrate them using a linear regression on ring index and temperature, and then average the result.

The only deviation from the steps above is to substitute the tree-ring index with 1000 sequences of 2000 random numbers containing red noise generated with a multiple time scale fluctuation approach [3]. About 20% (204) of those sequences had a positive slope and a very high significance $P(> |t|) < 0.001$ in a simple linear regression of values against temperatures. After re-calibrating each series using the inverted linear model, the mean of the series together with one and two sigma confidence intervals was plotted on Figure 1.

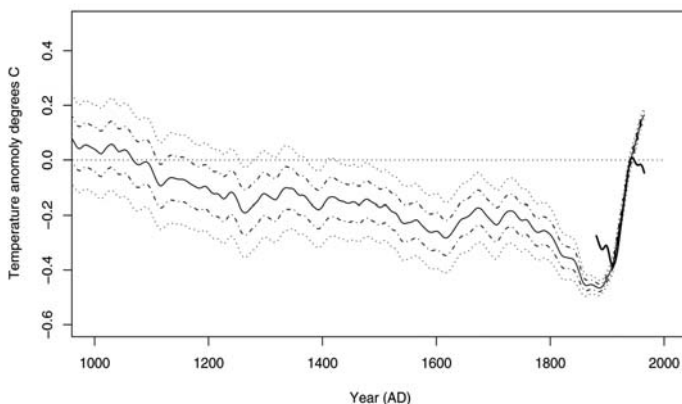


Figure 1: Reconstruction of past climate (thin black line) and one and two sigma confidence intervals (dashed and dotted lines) using a random stochastic series with red noise, selected for significant correlation with temperatures from 1885-1990, and re-calibrated with linear regression against the 1961-1990 global annual mean temperature. The series have been smoothed with a 50-year Gaussian-weighted filter and are anomalies from 1961-1990 mean. Observed temperature for 1855-1990 (thick black line) from [2]

Conclusions

The resulting reconstruction is very similar to published reconstructions (e.g. see [1]), exhibiting a gradual decline in temperatures from an apparent Medieval Warm Period (MWP), and an anomalous 20th Century warming popularly known as the 'hockey-stick' [4]. Clearly the 'hockey-stick' pattern is easily produced by selecting those random series that correlate over the period of the calibration temperatures (producing the blade) and revert to randomness elsewhere (producing the handle). The apparent height of the MWP is an function of the arbitrary zero calibration point. Thus all the salient aspects of past climate usually associated with millennial reconstructions are essentially already encoded into the methodology, so that a 'hockey-stick' shape is inevitable on any data resembling natural LTP series.

References

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