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Long memory or shifting means in geophysical time series?

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Abstract

In the literature many papers state that long-memory time series models such as Fractional Gaussian Noises (FGN) or Fractionally Integrated series (FI(d)) are empirically indistinguishable from models with a non-stationary mean, but which are mean reverting. We present an analysis of the statistical cost of model mis-specification when simulated long memory series are analysed by Atheoretical Regression Trees (ART), a structural break location method. We also analysed three real data sets, one of which is regarded as a standard example of the long memory type. We find that FGN and FI(d) processes do not account for many features of the real data. In particular, we find that the data sets are not H-self-similar. We believe the data sets are better characterized by non-stationary mean models.
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1. Introduction

Many geophysical time series exhibit the property of statistical long memory. Statistical long memory, also known as long-range dependence, strong dependence, global dependence, or the Hurst phenomenon, can be defined in more than one, not necessarily equivalent, way. The two most commonly used definitions of long memory are: (1) that the serial correlations decay hyperbolically and so are not summable, that is

$$\rho(k) = c_\rho k^\alpha; \quad -1 < \alpha < 0 \tag{1}$$

$$\sum_{k=0}^{\infty} \rho(k) = \infty \tag{2}$$

where c_ρ is a constant and (2) that the spectrum of the series obeys a power law which has a pole at zero frequency, that is

$$f(\lambda) = c_f |\lambda|^{-\gamma}; \quad 0 < \gamma < 1 \tag{3}$$

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