Geophysical Research Abstracts,
Vol. 11, EGU2009-888, 2009
EGU General Assembly 2009

Estimating parameters for stable processes in climate time series via power variations

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We provide a method to analyse a paleoclimatic temperature time series from a Greenland ice-core covering the period of the last 100.000 years. In 1999 P. Ditlevsen proposed to model it as a stochastic differential equation

$$X_t^\varepsilon = x_0 - \int_0^t U'(X_s^\varepsilon)ds + \varepsilon L_t$$

with $\varepsilon > 0$ and U being a double well potential. He also conjectured that the random forcing has a strong non-Gaussian, heavy-tailed component α-stable component. As the stability index alpha completely determines the dynamics of X, one is interested in effective estimation of this value from given time series.

With the help of non-standard limit theorems for the the so-called power variations of L and X we develop a method to estimate the stability index α and the amplitude parameter ε without imposing additional assumptions on the shape of U.