Geophysical Research Abstracts
Vol. 12, EGU2010-13815, 2010
EGU General Assembly 2010

A general non linear model for temperature series

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Air temperatures in Europe are bounded variables, as shown by extreme theory. After having detrended both the location (mean) and scale (variance) for intrinsic low frequency and seasonnal effects, we obtain a reduced time series centered and scaled. We argue that considered as a continuous-time process, this stochastic process is a diffusion with seasonnal drift and volatility, necessarily non linear and with inaccessible boundaries (in order to translate the boundedness of values). We need an approximate discretization using an Euler scheme to avoid a too complicated discretized exact Markov chain. We propose a model of functionnal autoregressive with non linear volatility and periodic coefficients to get a model available for simulations and validated in many directions including extreme quantiles. We show that this model is not overfitted.