Geophysical Research Abstracts
Vol. 12, EGU2010-1813-1, 2010
EGU General Assembly 2010


# Assessing ergodic properties of ecological time series

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Estimating ergodic measures such as Lyapunov exponents or fractal dimensions was studied for more than 40 years. Deriving them from the equations of a given dynamic system solves only a part of emerging problems. When applying these theoretical algorithms to measured time series problems arise due to the finiteness of the data. First, the finite precision introduces noise and secondly, the finite number of measurements could cause problems in the limiting process. Therefore, methods were established for assessing ergodic properties of short time series based on measurements. Typical applications focus on the analysis of single time series, whereas our usage will aim for processing large numbers of measured time series.

We implemented a framework for assessing ergodic properties for a given time series. It enables us to estimate the maximum Lyapunov exponent, Hausdorff-, correlation and information dimensions. Initially, this is done within a Graphical User Interface to obtain suitable parameters for the estimation process. Afterwards, the procedure may be applied in a batch operation with pre-defined parameters for a large number of time series. This is necessary as we are not only interested in the ergodic properties of a single time series, but also a set of time series coming from different scenarios, spatially distributed measurement stations or model runs. In the present study, we assess ergodic properties of ecological time series originating from ozone and climate measurements and outputs of a mechanistic ecosystem model.