EMS Annual Meeting Abstracts
Vol. 13, EMS2016-633, 2016
16th EMS / 11th ECAC

Divergence of nearby trajectories approximated via autocovariance function and mutual information

Jan Skořepa
Charles University in Prague, Department of Atmospheric Physics, Czech Republic (skorejan@seznam.cz)

The chaotic properties of the atmosphere can be described through characteristics such as correlation dimension or maximal Lyapunov exponent. The latter one is related to divergence of nearby trajectories in the phase space. Speed of this divergence, estimated from time series through phase space reconstruction techniques, can be employed for predictability studies. There are numerous possibilities how to set up the parameters needed for phase space reconstruction, including the embedding dimension, time of delay or Theiler window. Last but not least also type and quality of meteorological data have impact on resulting divergence rates.

In my study I estimated divergence of nearby trajectories through the commonly applied algorithm of Rosenstein for maximal Lyapunov exponent. The divergence was then also approximated using simpler statistics derived from autocovariation function or from mutual information. The results obtained by different approaches are compared on data from three dimensional deterministic Lorenz system, as well as on randomly generated time series and on daily temperature series at the 500 hPa level from the ERA-40 reanalysis dataset. It is shown that approximation via autocovariation function and mutual information fits relatively well for meteorological series, random data and specific reconstruction parameters of the Lorenz system, but becomes inaccurate for some usual settings of the Lorenz system.