Geophysical Research Abstracts
Vol. 12, EGU2010-13469-1, 2010
EGU General Assembly 2010

Stochastic climate dynamics: Random attractors and time-dependent invariant measures

Michael Ghil (1,2)
(1) Ecole Normale Superieure, Paris, France (ghil@lmd.ens.fr), (2) University of California, Los Angeles, USA

This talk reports on attempts at the unification of two approaches that have dominated theoretical climate dynamics since its inception in the 1960s: the nonlinear deterministic (Lorenz, JAS, 1963) approach and the linear stochastic one (Hasselmann, Tellus, 1976). This unification, via the theory of random dynamical systems (RDS), allows one to consider the detailed geometric structure of the random attractors associated with nonlinear, stochastically perturbed systems. These attractors extend the concept of strange attractors from autonomous dynamical systems to non-autonomous systems with random forcing.

A high-resolution numerical study of two "toy" models is carried out in their respective phase spaces; it allows one to obtain a good approximation of their global random attractors, as well as of the time-dependent invariant measures supported by these attractors. The latter measures are shown to be random Sinai-Ruelle-Bowen (SRB) measures; such measures have an intuitive, physical interpretation, obtained essentially by "flowing" the entire phase space onto the attractor.

The first of the two models studied herein is a stochastically forced version of the classical Lorenz (1963) model. The second one is a low-dimensional, nonlinear stochastic model of the El Nino-Southern Oscillation (ENSO), based on that of Timmermann and Jin (GRL, 2002). In spite of their highly idealized character, both these models are of fundamental interest for climate dynamics and provide insight into its predictability.

This talk represents joint work with Mickael D. Chekroun (Ecole Normale Superieure, Paris, France, and University of California, Los Angeles, USA; chekro@lmd.ens.fr) and Eric Simonnet (Institut Non-Lineaire de Nice, Sophia Antipolis, France; Eric.Simonnet@inln.cnrs.fr).