UP 10: Lecture by Michael Ghil on Climate Change

Time: Thursday 8:30–9:15 Location: H 0105

Plenary Talk UP 10.1 Thu 8:30 H 0105

The Complex Physics of Climate Change: Nonlinearity and Stochasticity — •Michael Ghil — Ecole Normale Supérieure, Paris, France — UCLA, Los Angeles, USA

Recent estimates of climate evolution over the coming century still differ by several degrees. This uncertainty motivates in part the work presented herein.

The complex physics of climate change arises from the large number of components of the climate system, as well as from the wealth of processes occurring in each of the components and across them. This complexity has given rise to countless attempts to model each component and process, as well as to two overarching approaches to apprehend the complexity as a whole: deterministically nonlinear and stochastically linear. Call them the Ed Lorenz and the Klaus Hasselmann approach, respectively, for short.

We propose a "grand unification" of these two approaches that relies on the theory of random dynamical systems. In particular, we apply this theory to the problem of climate sensitivity, and study the random attractors of nonlinear, stochastically perturbed systems, as well as the time-dependent invariant measures supported by these attractors.

Results are presented for several simple climate models, from the classical Lorenz convection model to El Nino-Southern Oscillation models. Their attractors support random Sinai-Ruelle-Bowen measures with nice physical properties. Applications to climate sensitivity and predictability are discussed.

This talk presents joint work with M. D. Chekroun, D. Kondrashov, J. C. McWilliams, J. D. Neelin, E. Simonnet, S. Wang, and I. Zaliapin.