CEA - Saclay 91191 Gif-sur-yvette Cedex
Service de Physique de l'Etat Condensé
SÉMINAIRE
Mercredi 22 Janvier 2014 à 11h15
Orme des Merisiers SPEC, Salle Itzykson, Bât.774

Maximum kinetic energy dissipation and entropy production: evidence from AOGCM numerical simulations

Salvatore PASCALE

Meteorologisches Institut, Universität Hamburg, Germany

Extremal principles of fluid turbulence provide an alternative to numerical solution of the Navier-Stokes equation. This is particularly attractive for global climate studies, where such principles may offer tight constraints to test climate models and simulations or to reproduce climates under different boundary conditions (e.g. climate of the past) with minimal information. The two main conjectures which have gained support in climatic studies are the Max-Dissipation [1] and Max-Entropy production principle [2], stating that steady state of the climate system is that, among all other possible steady states permitted by conservation law constraints, maximizing the rate of kinetic energy dissipation (material entropy production).
Here we concentrate on entropy analysis of the HadCM3 atmosphere-ocean general circulation model (AOGCM), the kind of model used for prediction of 21st-century global climate change [3]. In the AOGCM, we diagnose the entropy sources and sinks directly from the diabatic heating terms. The rate of material entropy production of the climate system is about 50 mW m-2 K-1. The largest part of the material EP (about 38 mW m-2 K-1), is due to the hydrological cycle. When we vary parameters in the physical formulation of the AOGCM, MEP might suggest that the most realistic version is the one with the largest EP. However, in the AOGCM there is no maximum in EP. There is, however, a maximum in KE dissipation in the atmosphere, similar to Lorenz's (1960) [1] conjecture.
We still lack a clear understanding of the theoretical basis and rage of validity of Max-D and Max-EP for global climate studies and the relationship between them.

[1] Lorenz EN (1955) Generation of available potential energy and the intensity of the general circulation. Scientific Report No. 1, UCLA Large Scale Synoptic Processes Project.
[2] Paltridge GW (1975). Global dynamics and climate - a system of minimum entropy exchange, QJRMS 101:475-484
[3] Pascale S, J M Gregory, M H P Ambaum, and R Tailleux. A parametric sensitivity study of entropy production and kinetic energy dissipation using the FAMOUS AOGCM. Climate Dynamics, 38(5-6):1211-1227, 2012.

A coffee break will be served at 11h00. The seminar will be given in English.