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VITALITY

Progetto VITALITY | Programma di Consulenza Specialistica | **Seminario**

Radiative-convective equilibrium as a fundamental laboratory to understand the role of clouds in the tropical climate

Abstract

The tropical energy budget is determined by the distribution of water vapour, the most important greenhouse gas, and clouds. Both of these in turn are strongly determined by the action and arrangement of convection in the tropics, both in the form so-called "shallow" cloud systems which are on the order of 1 or 2km in depth, or by deeper systems that span the depth of the troposphere to 14km. I will talk about how the arrangements of convection systems in the tropics can alter the distribution of water vapour both and, consequently, the tropical energy budget. The tropics are generally in a state known as radiative-convective-dynamical equilibrium, where a state of equilibrium exists between radiative cooling and dynamical warming associated with vertical motion. Convection permitting model simulations of this equilibrium can show bi-stable states of cloud regimes,where convection arrangement can alter drastically and spontaneously, which thus can have important implications for the energy balance and climate sensitivity. In these simulations, convection can be randomly distributed or become highly organised and tightly clustered. The first state produces a moist, opaque atmosphere, while the latter results in a very dry atmosphere which efficiently loses energy to space. However, the equilibrium state has an disturbing dependence on the details of the models and/or the simulation framework, such as the choice of turbulence representation or model domain size or resolution. I will attempt to explain some of this sensitivity using simple stochastic models. Finally I will show some recent work that shows how the distribution of water vapor on the 1000 km scales in the tropics is strongly determined by coupled wave dynamics, which are generally not permitted in the idealized simulation equilibrium framework.

Lunedì 31 marzo 2025 - Ore 15.30

Aula B - Dipartimento di Fisica

Adrian Mark Tompkins

ICTP - The Abdus Salam International Centre for Theoretical Physics

Dr. Adrian Tompkins is a research scientist in the Earth System Physics section of ICTP. His work focuses on cloud and convection dynamics, their representation in weather and climate models, and the role of tropical convection organization in climate sensitivity. He is particularly dedicated to improving weather prediction and climate model applications in developing countries. Over the past 13 years, Dr. Tompkins has taught at more than 35 schools, workshops, and training events across Africa, Asia, and Central/South America, organizing over 25 of these in 12+ African countries. His recent efforts emphasize training in open-access climate tools and datasets, particularly within the Copernicus climate services framework, hosted by ECMWF where he previously worked. His research has expanded to climate-health applications in Africa, where he leads the development of an open-source regional malaria transmission model and a high-efficiency agent-based model for human mobility. He serves on the technical advisory group of the malaria section at the Swiss Tropical and Public Health Institute and has held advisory roles in WCRP's (World Climate Research Program), WGSIP (Working Group on Subseasonal to Interdecadal Prediction) and WASCAL (West African Science Service Centre on Climate Change and Adapted Land Use) .

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