Mathematical Analysis of Atmospheric Models with Moisture

Edriss S. Titi
University of Cambridge
Texas A&M University
and
Weizmann Institute of Science

Abstract

In this talk I will present some recent results concerning the global regularity of the three-dimensional Primitive Equations of oceanic and atmospheric dynamics with various anisotropic viscosity and turbulence mixing diffusion. However, in the non-viscous (inviscid) case it can be shown that there is a one-parameter family of initial data for which the corresponding smooth solutions of the inviscid Primitive Equations develop finite-time singularities (blowup).

Capitalizing on the above results, one is able to provide rigorous justification for the derivation of the Primitive Equations of planetary scale oceanic dynamics from the three-dimensional Navier-Stokes equations, for vanishing small values of the aspect ratio of the depth to horizontal width.

In addition, I will also show the global well-posedeness of the coupled three-dimensional viscous Primitive Equations with a micro-physics phase change moisture model for cloud formation.

Furthermore, I will also consider the singular limit behavior of a tropical atmospheric model with moisture, as $\varepsilon \to 0$, where $\varepsilon > 0$ is a moisture phase transition small convective adjustment relaxation time parameter.