Progress in convection parameterization using multiscale and multicloud modeling constrained by observations.

Author: Boualem Khouider

A major challenge in contemporary parameterizations of cumulus convection is associated with their inability to capture the interactions across multiple temporal and spatial scales of cloud systems in the tropics, due to the lack of an adequate representation of subgrid variability associated with organized convection, inherited from the underlying quasi-equilibrium assumption (QEA). In this talk we discuss the recent breakthroughs achieved in this regard by the simple replacement of the Arakawa-Schubert parameterization (Arakawa and Schubert, 1974) for deep convection, in NCEP's Climate Forecasting Model, by a stochastic multicloud model (SMCM) parameterization. The SMCM is based of the representation of the multiple cloud types that characterize deep convection by an order parameter that takes discrete values on a square lattice overlaid on top of each model grid box and evolve dynamically as a Markovian process with transition probabilities depending on the large-scale (model resolved) dynamics and thermodynamics, whose parameters are systematically learned using cloud radar data. As implemented in CFS, the SMCM relies on prescribed heating profiles and parameters that are somewhat empirically obtained from a combination of observation and reanalysis data. There are multiple ways on how to extend the SMCM concept and incorporate it into existing (state-of-the-art) cumulus parameterization schemes, in order to once-and-for-all overcome the QEA deadlock. Here we discuss in detail the methodology on how to use the SMCM to modify the Zhang and McFarlane (ZM) cumulus scheme (Zhang and McFarlane, 1995) in the NCAR Community Climate Model version 5 (CAM5) and some preliminary results are reported here. Although, the new parametrization is still in the development phase, several improvement of CAM, in terms of the simulation of tropical waves and precipitation distribution will be also discussed.