2012 Special Program in Applied Mathematics and Applied Mechanics

A cloud-resolving model study of the transition from shallow to deep cumulus convection

2012 - 05 - 02 (Wed.)
15:00 - 17:00
308, Mathematics Research Center Building (ori. New Math. Bldg.)

In this study, a 2D cloud resolving model (CRM) is used to assess the control mechanism for the transition from shallow to deep cumulus convection in the diurnal cycle over land. By comparing with a 3D CRM under conditions taken from the Large-Scale Biosphere–Atmosphere field study (in the Amazon), the authors show that the 2D CRM reproduces the main features evident in previous 3D simulations reasonably well. To extract the essence of the transition from shallow to deep convection, the observed case is idealized to isolate two control parameters, the free troposphere stability and the relative humidity. The emergence of a distinct transition between shallow and deep convection shows that the convective transition is an intrinsic property of the system. A transition time is defined to evaluate the key mechanism of the transition. The authors show that the transition coincides with the time when the lapse rate of the virtual potential temperature of the clouds becomes larger than that of the environment, suggesting that the transition happens when shallow clouds become, on average, buoyant. This suggests that, given the opportunity, convection prefers to be shallow.