Session: B6 Oral presentation

Multiple equilibria in a cloud resolving model

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Multiple equilibria in limited domain simulations (Sobel et al. 2007; Sessions et al. 2009) are believed to be related to some aspects of large-scale organization of convection in the tropics, including bimodality in the distribution of water vapor in the tropics (Zhang et al. 2003), multiple equilibria in the existence and location of the intertropical convergence zone (ITCZ; Bellon and Sobel 2009), and the tendency for randomly distributed convection to self-aggregate in radiative convective equilibrium simulations (Bretherton et al. 2005). In the limited domain simulations, multiple equilibria correspond to a state characterized by persistent precipitating deep convection or one which remains completely dry even in the presence of positive convective available potential energy. Using the weak temperature gradient (WTG) approximation in a cloud resolving model (CRM), we investigate the conditions under which multiple equilibria exist. The existence of multiple equilibria depends on surface wind speed, domain size, and the extent to which the WTG approximation is enforced. For conditions which support both equilibria, the initial moisture content of the troposphere determines which state is ultimately realized by the model. If the troposphere is initially dry in conditions which do not support the dry equilibrium, we are able to analyze the transition to the precipitating state. A particularly useful quantity for characterizing the environment either during the equilibrium state or during the transition from one state to another is the normalized gross moist stability (NGMS). The NGMS is defined as the ratio of saturated moist entropy export to moisture import into the model domain. Negative or small values are observed in the dry equilibrium state and during the transition from one state to another.