Geophysical Research Abstracts,
Vol. 11, EGU2009-13947, 2009
EGU General Assembly 2009

Linking daytime land-atmosphere interactions, moist convection, and nocturnal rainfall in the SGP

A.P. Barros and P. Shrestha
Civil and Environmental Engineering, Duke University, Durham, NC 27708, USA

Data obtained from atmospheric profiles obtained during the Cloud and Land Surface Interaction Campaign (CLASIC) at Fort Cobb, OK in June 2007, a month of exceptional rainfall as compared to regional climatology, were mapped into CAPE phase-space (rCape, pCAPE) for daytime conditions. Three thermodynamic regimes defined by two critical values of pseudoadiabatic CAPE (pCAPEc,1∼600 J/kg, and pCAPEc,1∼ 1,200 J/kg) could be indentified: (1) fair-weather when pCAPE < pCAPEc,1; (2) shallow rain-showers corresponding to high CIN conditions (pCAPEc,1<pCAPE <pCAPEc,2); and (3) active cumulus convection corresponding to high CAPE conditions (pCAPE >pCAPEc,2). Regime 3 is consistent with the synchronic regime of rCAPE and pCAPE identified by Roff and Yano for the tropical ocean, whereas Regime 2 appears to be strictly a continental regime. Next, a coupled land-cloud model at high resolution (down to 1km×1km) was used to simulate a mesoscale convective system that produced very heavy nocturnal rainfall (after 10 PM LST) on June 19 to investigate the mechanisms by which persistence of instabilities generated in the free atmosphere by turbulent mixing during the day an din the presence of environmental wind shear have an impact on nocturnal enhancement of convective activity. The simulations show that excitation of internal tropospheric gravity waves by boundary layer eddies that form over areas with high surface sensible heat fluxes and low level directional wind shear penetrate the stable layer producing cumulus clouds, whose growth and decay was dependent upon the phase matching between the gravity waves and the boundary layer eddies. These gravity waves persist throughout the diurnal cycle. However, the presence of a capping inversion (high CIN values) inhibits development of deep convection during the daytime (Regime 2), leading to a potential severe storm outbreak during the midnight coinciding with the strengthening of the LLJ and erosion of the capping inversion (Regime 3).