



Interactions of Cumulus Convection and the Boundary Layer

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The DOE ARM program has promoted understanding of cumulus convection by producing high-quality “single-column model” observational datasets that allow one to run and evaluate single-column models and cloud-resolving models based on observed large-scale conditions. The cloud and radiation fields produced by such simulations can then be compared to measurements by an ARM cloud profiling radar, as well as to satellite-based measurements. This is an excellent approach for stratiform cloud systems, but not for convective cloud systems, which are inadequately sampled by the cloud profiling radars. However, the existing observational systems at the ARM Southern Great Plains (SGP) Atmospheric Climate Research Facility (ACRF) can be used to provide a much more extensive spatial sampling of convective cloud systems. The resulting datasets include the 5-minute Oklahoma Mesonet data and the hourly Arkansas Basin River Forecast Center (ABRFC) gridded data. Because convective cloud systems generally have strong interactions with boundary layer circulations and thermodynamics, the boundary layer wind and thermodynamic fields contain a great deal of information about convective cloud systems and their interactions with the boundary layer.

We propose to “retrieve” this information from 13 years of mesonet and gridded data, and then analyze it in conjunction with ARM SCM datasets (now available for all of 1999, 2000, 2001 and selected IOPs during other years) to critically examine the following hypotheses.

1. Updraft and downdraft cumulus mass fluxes can be retrieved or estimated from surface mesonet observations of wind velocity combined with gridded rate.

2. Cold pool properties can be retrieved or estimated from surface mesonet observations of temperature, water vapor, and pressure.
3. Convective system evolution depends on cold pool development.
4. A prognostic cumulus parameterization that predicts both cloud-scale and mesoscale cumulus kinetic energy will exhibit improved convection initiation (triggering).
5. Cumulus parameterizations need to consider elevated , not just surface-based.