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Analysis of select MC3E cases from observational and cloud resolving model perspectives

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The Mid-latitude Continental Convective Cloud Experiment (MC3E) in 2011 provided an unprecedented opportunity to study storm dynamics and microphysics from various measurement platforms. The field campaign included a large network of ground instruments, an array of radars over a spectrum of wavelengths for remote sensing of clouds and precipitation, and in situ aircraft measurements. This diverse set of instrumentation is used to examine the kinematics and microphysical statistics from several cases. The ground radars include two polarimetric X-band radars operated by the US Department of Energy (DOE), one DOE C-band polarimetric radar, the NASA S-band polarimetric N-Pol radar, and a local polarimetric S-band National Weather Service Weather Surveillance Radar 88-Doppler radar. The utility of the availability of multiple wavelengths of radar for understanding precipitation microphysics is explored. A multi-wavelength hydrometeor identification algorithm synthesizing information from three different radar wavelengths from X- to S-band is used to investigate precipitation processes occurring during the cases. Additionally, using the principal of self-consistency, the polarimetric data can be interrogated to examine precipitation formation processes (e.g. warm-rain vs. ice processes). Radar-based microphysical retrievals are compared with in situ observations from instruments on board the University of North Dakota Citation. Dual-Doppler techniques are applied to the network of ground radars to retrieve vertical wind statistics. Vertical motions are also investigated using the NASA High Altitude Radar (HIWRAP), which flew onboard the NASA ER-2. Several types of cases are analyzed: a mesoscale convective system with extensive trailing stratiform (20 May 2011), a stratiform case with embedded convection (1 May 2011), a linear convective case (25 April 2011), and a strongly forced, very intense supercell (23 May 2011).

The MC3E cases have been simulated using the NASA Goddard Cumulus Ensemble Model with spectral bin microphysics. A simple conversion of bins to hydrometeor categories corresponding to the radar-based categories is tested on the model simulations and compared to the multi-wavelength radar hydrometeor identification. Statistics of vertical motion, reflectivity profiles, rainfall and hydrometeor type from the simulations are compared with the observations for the different cases.