Kinematic and Microphysics Structure of Hailstorms in Southeast U.S.A. Using Aircraftr Multi-frequency Radar Measurements

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The Integrated Precipitation and Hydrology Experiment (IPHEx) field campaign was conducted in the Southeast U.S.A. from 15 May to 30 June 2014 in support of Global Precipitation Mission (GPM) ground validation. The NASA ER-2 high-altitude (~20 km) aircraft flew during this campaign as a GPM simulator with down-looking radars and radiometers. The main goal for the ER-2 was to collect high spatial and temporal resolution data sets to be used for GPM algorithm validation and improvement. Three nadir-pointing Doppler radars covering X- through W-band are used in this study. The High-altitude Wind and Rain Airborne Profiler (HIWRAP) at Ku and Ka-band, the Cloud Radar System (CRS) at W-band, and the ER-2 X-band Radar (EXRAD) all provided nadir reflectivity and Doppler measurements. HIWRAP provided Linear Depolarization Ratio (LDR) measurements at Ku and Ka-band that provided unique information on hail aloft in the storms. EXRAD also has a conical scan beam used for providing a swath and also horizontal wind measurements.

This presentation will provide an observational analysis of a case from 23 May 2014 that produced up to 5 cm hail from deep convection extending up to 15 km altitude. The environmental winds on this day were mostly from the northwest without much directional shear and with strong winds aloft. The precipitation, kinematic, and hail structure will be discussed using the multifrequency Doppler measurements along with polarimetric ground-based WSR-88D observations. The horizontal wind structure is calculated from the EXRAD conical scan data using a 3DVAR retrieval algorithm (Guimond et al. 2014), and the updraft properties are derived from the nadir vertical velocities with a fallspeed assumption. Since the ER-2 flew above the storms, the upper level microphysical and dynamical structures are measured at high-resolution and provide features that are not observed with the ground radars. Synthesis of the hailstorm airborne and ground-based observations show that the low-level inflow and upper-level outflow have configurations that are very favorable for hail development and they are consistent with historical research on hail recycling.

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