A Comparison of X-band Polarization Parameters with
In-Situ Cloud & W-band Radar Measurements in the Comma Head of A Winter Cyclone

Joseph A. Finlon1, David M. Plummer1, Robert M. Rauber2, Greg M. McFarquhar3,
Brian F. Jewett1, Kevin R. Knupp2, David Leon3

1Department of Atmospheric Sciences, University of Illinois at Urbana-Champaign, 2Atmospheric Science, University of Alabama, Huntsville, 3University of Wyoming Atmospheric Science

1. Objectives

• Analyze the vertical change of dual-polarization parameters (from ground-based radar) within the 22 February 2010 cyclone during the Profiling of Winter Storms (PLOWS) field campaign.
• Relate these findings to coincident in-situ cloud microphysical measurements.

2. Data

Both the Mobile Alabama X-band (MAX) Doppler Radar and the W-band Wyoming Cloud Radar (WCR) profiled the comma head region of a cyclone as the NSF/NCAR C-130 aircraft made vertically stacked passes along the same azimuthal angle as the MAX RHI radar scans.

3. Methodology

• Reflectivity and dual-polarization variables from the MAX were averaged at specific C-130 altitudes during times when the aircraft was close to the X-band radar.
• 2D-C images, as well as size distributions and corresponding bulk parameters determined from 2DC/2DP probes, were used when the C-130 was in the view sampled by the MAX RHI scans.

4. Dual-Polarization Measurements

Fig. 1 The MAX radar measured reflectivity (Z) and radial velocity, as well as the correlation coefficient (ρ) and differential reflectivity (Zdr).

Fig. 2 The two-dimensional cloud (2D-C, above) and precipitation (2D-P) probes captured particle size and shape along with other variables.

Fig. 3 WSR-88D regional radar for 0045 UTC, 22 February 2010. The MAX radar location (pink triangle) is shown, with the black line outlining the scanning direction and flight path of the MAX and C-130, respectively.

Fig. 4 (a) WCR reflectivity cross section for the same path as (b-d) MAX RHI variables. Pink dot in RHI scans denote the location of the C-130 aircraft, with average values of Z, ρHV, and Zdr as the aircraft flew toward/away from the MAX radar. Same as in Fig. 5 but at a different aircraft altitude.

5. Microphysical Measurements

Fig. 5 (a) Size distribution, (b) concentration, (c) IWC, (d) median mass diameter, and (e) mass-weighted area ratio for four different altitudes within the cyclone. Increasing particle size deeper within the cloud support particle growth by aggregation as in Fig. 6. Current work is examining linkage between area ratio and Zdr data on a point-by-point basis.

6. Conclusions

• Dual-pol measurements of ρHV and Zdr are consistent with more uniformity in particle shape and larger particle size deeper within the cloud, respectively.
• Corresponding probe data suggests that growth by aggregation is occurring during the particle’s descent (no liquid water is present at these levels for riming to occur).
• Uniqueness of coincident ground- and air-based measurements of the same cyclone region give further insight into the MAX radar’s dual-pol values.

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Contact
finlon2@illinois.edu
www.joe.finlon.me