An Analysis of Polarimetric Radar Signatures Associated with Cyclic Mesocyclogenesis

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Introduction
On March 31, 2016, a supercell thunderstorm that underwent the process of cyclic mesocyclogenesis moved through Priceville, Alabama. Cyclic mesocyclogenesis is the process where a supercell thunderstorm produces a series of mesocyclones throughout its lifetime. The purpose of this project was to characterize the radar signatures associated with this process.

Methods
- Data from ARMOR, a UAH dual-polarization C-band radar at the Huntsville International Airport
- The polarimetric variables: Horizontal Reflectivity ($Z_{\text{H}}$; upper left), Doppler Velocity ($V_r$; upper right), Differential Reflectivity ($Z_{\text{DR}}$; lower left), and Specific Differential Phase ($K_{\text{DP}}$; lower right)
- GR2Analyst was used to analyze polarimetric variables
- Py-ART used to grid vertical and planar cross sections

Thunderstorm Features of Interest
- Mesocyclone: a vertically-rotating updraft, downdraft couplet within a supercell
- $Z_{\text{DR}}$ Arc: represents large oblate rain drops; found along the maximum gradient of $Z_{\text{H}}$, near forward flank downdraft
- $Z_{\text{DR}}$ Column: large oblate hydrometeors in the main updraft
- $K_{\text{DP}}$ Column: high concentration of mixed phased hydrometeors; associated with the midlevel updraft

Conclusions
- Hook echo signature, $Z_{\text{DR}}$ arc, $Z_{\text{DR}}$ column and $K_{\text{DP}}$ column associated with each mature mesocyclone
- During occlusion, all signatures dissipate except for $K_{\text{DP}}$ column, which persist throughout the storm’s lifetime
- $Z_{\text{DR}}$ arc-like feature is actually hail core during occlusion
- The main updraft also weakens during occlusion
- If these radar signatures occur in other cyclic supercells, they could lead to better forecasting of severe weather

Acknowledgements
I would like to express my gratitude to the RCEU staff: David Cook and Dr. Vogler, the Dean of the College of Science: Sundar Christopher, UAH Office of the Provost, UAH Office of the Vice President for Research and Economic Development, and the Alabama Space Grant Consortium.

References