Polarimetric Radar Signatures of Supercell Thunderstorms in Tropical Cyclones

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Radar sites near the tropical cyclone were identified using historical data from the National Hurricane Center. A database was created of these storms including:

- Presence of WER or BWER
- Base-scan maximum velocity difference
- Base-scan horizontal shear
- Presence of ZDR column, and approximate percentage
- Presence of DRCs
- Storm axis ratio
- Echo appendage length
- Echo appendage curvature
- Half-fall areal extent and cyclonicity
- Rhohv mean value in appendage
- ZDR arc areal extent
- ZDR arc width
- ZDR arc mean values
- ZDR column areal extent aloft
- ZDR column maximum altitude
- ZDR maximum storm-core value

analyze these signatures relate to severe weather reports from tropical cyclone supercells.

Methods

Only tropical cyclones occurring after the National Weather Service polarimetric radar upgrade were used in this study (2011-2015).

- Radar sites near the tropical cyclone were identified using historical data from the National Hurricane Center.
- The polarimetric WSR-88D radar datasets were obtained for those sites from the National Centers for Environmental Information (NCEI).
- Supercells were identified within the radar data by looking at reflectivity and radial velocity using the Weather and Climate toolkit. They were only included in further analysis if high reflectivity and strong rotation were present, the storm was within 50 km of the radar, and the storm lasted an hour or more.
- A database was created of these storms including:
  - Station site
  - Date
  - Beginning and end time
  - Beginning longitude and latitude
  - Brief description of the storm.
- Analysis of the 29 selected supercells looking at several polarimetric variables beginning with ZDR, using the data from the NCEI and the Weather and Climate toolkit.

Conclusions and Future Work

Preliminary Conclusions

Both tropical cyclone supercells have structures similar to the typical Great Plains supercell structure with the presence of a BWER/WER, high ZDR column, and a ZDR ring.

Future Work

- Continue analysis of various polarimetric variables in the selected supercells. Variables include:
  - Presence of WER or BWER
  - Base-scan maximum velocity difference
  - Base-scan horizontal shear
  - Presence of ZDR column, and approximate percentage
  - Presence of DRCs
  - Storm axis ratio
  - Echo appendage length
  - Echo appendage curvature
  - Half-fall areal extent and cyclonicity
  - Rhohv mean value in appendage
  - ZDR arc areal extent
  - ZDR arc width
  - ZDR arc mean values
  - ZDR column areal extent aloft
  - ZDR column maximum altitude
  - ZDR maximum storm-core value

- Determine how these signatures relate to severe weather reports from tropical cyclone supercells.

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Figure 1: Comparison of (A) a supercell by the WSR-88D KGEX in Jackson, MS on December 20, 2013, (B) a supercell by the WSR-88D KLTX in Wilmington, North Carolina associated with tropical cyclone Arthur on July 3, 2014, and (C) a supercell by the WSR-88D KMLB in Melbourne, FL associated with tropical cyclone Dorian on August 3, 2013.

Figure 2: Bar graphs showing the change in the approximate maximum height of the ZDR column through time. The threshold ZDR value was 1.0 db.

Figure 3: Charts indicating the presence of the weak echo region (WER), ZDR column, and ZDR ring. Solid lines indicate a strong presence. Dashed lines indicate a weak presence, and no line indicates that the variable was not present at that time.

A is the graph for the supercell in tropical cyclone Arthur. B is the chart for the supercell in tropical cyclone Dorian.