Utilizing Environmental and Radar Predictors to Anticipate Tornado Intensity

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1. Introduction

Weak (EF0-1) and strong/violent (EF2+) tornadoes pose very different threats to human life. Anticipated strength of a tornado based on environmental and radar signatures would be valuable information for the NWS to include in its warnings. This presentation will describe and effort to utilize both environmental and radar data to anticipate tornado severity. For this study, one-hour Rapid Refresh (RAP) Bufkit data were interrogated in SHARPpy to analyze the tornado environments. Archived radar data were analyzed in the GR2Analyst radar software. Around 200 tornadoes from 2017 were analyzed in this research project to determine correlations between the severe weather environment and rotational velocity values.

2. Rotational Velocity

$$Rotational\ Velocity$$

$$V_{rot} = (|V_{in}| + |V_{out}|)/2$$

Where V_{in} are the inbound radial velocity winds and V_{out} are the outbound radial velocity winds relative to the radar.

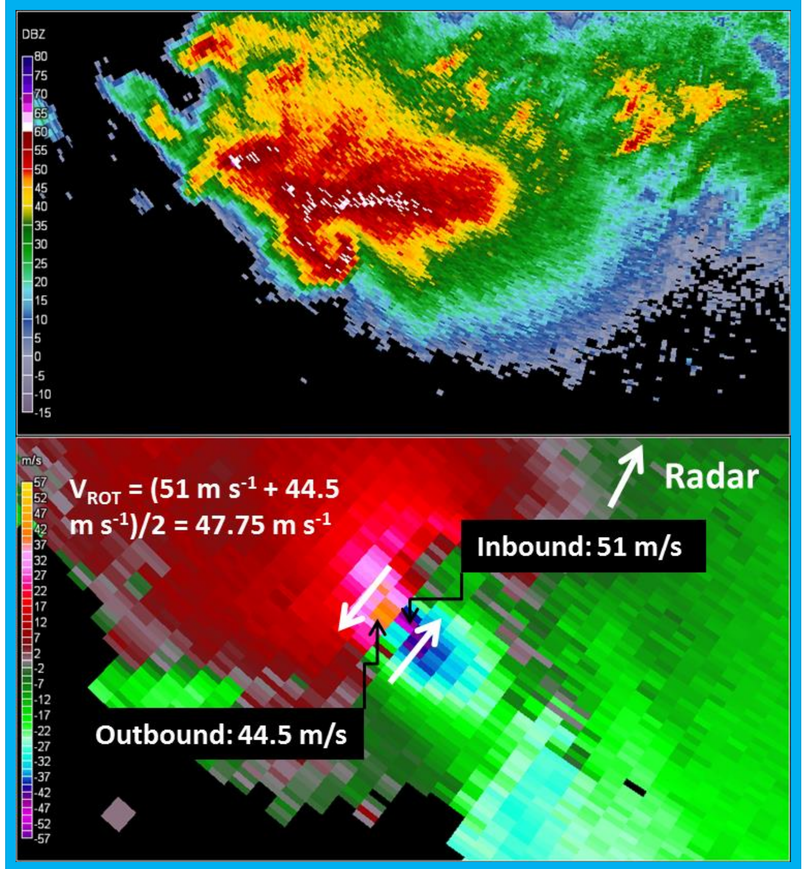

Figure 1: Radar Reflectivity (Top) and Radial Velocity (bottom) of a tornadic supercell near Dimmit, TX on 15 April 2017.

3. Results

Average Characteristics of Tornadoes Studied	Weak (143)	Significant (57)
Path Length	**5.1 mi**	**7.4 mi**
Supercell Path Length	4.7 mi	14.9 mi
QLCS Path Length	5.3 mi	6.8 mi
Path Width	**220 yds**	**615 yds**
Supercell Path Width	176 yds	719 yds
QLCS Path Width	249 yds	360 yds

Table 1: Displays the average path length and winds of weak/significant tornadoes and weak/significant supercell/QLCS tornadoes.

Median Values for All Tornadoes Studied		
Enviro Parameter	**Weak (143)**	**Significant (57)**
mlCAPE	745 J/kg	1,114 J/kg
0-3km CAPE	45 J/kg	56 J/kg
0-1km SRH	274 m²/s²	250 m²/s²
0-3km SRH	349m²/s²	335 m²/s²
Effective SRH	273 m²/s²	277 m²/s²
mlLCL	643m	631m
0-1km RH	89%	90%
STP (cin)	1.0	1.5
STP (fixed)	1.1	1.7

Tables 2 and 3: Environmental and Radar predictors for all tornadoes studied.

Median Values for All Supercell Tornadoes Studied		
Radar Parameter	**Weak**	**Significant**
Vrot	43 kt	61 kt
TDS CC Average (21 weak, 28 sig)	82	76
TDS Width	1.18 nm	1.58 nm
TDS Height	5,500 ft	11,200 ft

Median Values for All QLCS Tornadoes Studied		
Radar Parameter	**Weak**	**Significant**
Vrot	40 kt	44 kt
TDS CC Average (21 weak, 28 sig)	85	85
TDS Width	0.90 nm	1.1 nm
TDS Height	4,800 ft	3,700 ft

4. Results

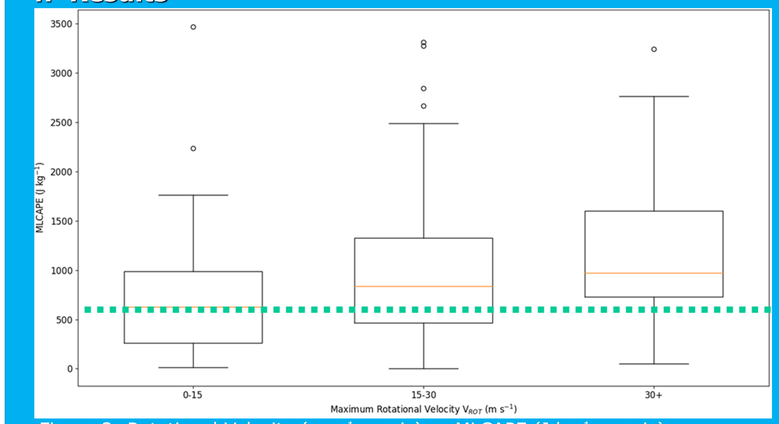

Figure 2: Rotational Velocity (m s^{-1} x-axis) vs MLCAPE (J kg^{-1}, y-axis).

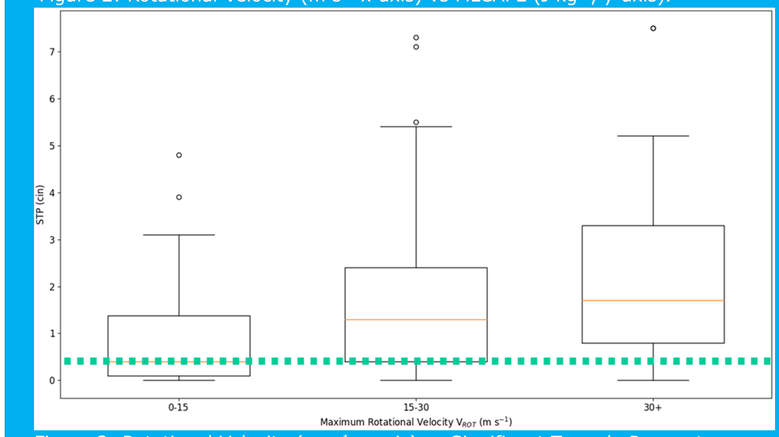

Figure 3: Rotational Velocity (m s^{-1} x-axis) vs Significant Tornado Parameter (effective layer).

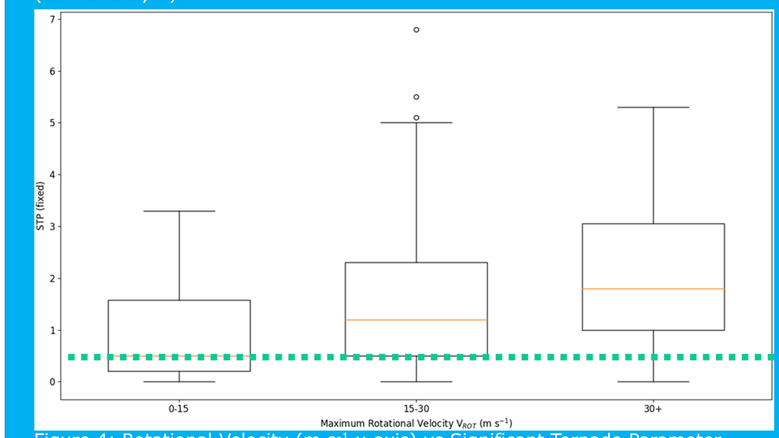

Figure 4: Rotational Velocity (m s^{-1} x-axis) vs Significant Tornado Parameter (fixed layer).

5. Acknowledgments

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