Demonstrating the Utility of Conditional Probabilities of Tornado Damage Rating in the Impact-Based Warning Era

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BACKGROUND

- Conditional probabilities of tornado damage rating from near-storm environment data and radar-based storm-scale characteristics (2009-2013) were analyzed (Fig. 1).

INGREDIENTS-BASED APPROACH

Near-Storm Environment

- Significant Tornado Parameter (STP; effective-layer calculation) can be used to gauge atmospheric tornado potential and assessed using a sounding or the SPC mesoscale analysis (max value within 100 mi.).

Convective Mode

- Supercells disproportionately produce higher EF-scale damage rating tornadoes.

Low-level Circulation

- The highest peak inbound and outbound velocities (i.e., $V_{in}$) at 0.5° elevation tilt—using velocity bins exhibiting cyclonic (anticyclonic) rotation within 5 mi and ≤ 45° angle from the center of the circulation—from one of the volume scans during the tornado event were recorded.

Conditional Tornado Probabilities

- Using conditional probabilities can aid in the decision-making of tornado “threat tags” accompanying a tornado warning. Probabilities can help in assigning confidence towards a particular outcome (i.e., base tier tornado warning vs. considerable tornado warning) contingent upon a tornado occurring. The “condition” is met with the occurrence of a Tornadic Debris Signature (TDS) or confirmation of a tornado.

OPERATIONAL FORECASTER APPLICATION

- Consider using “Considerable Damage Threat” tags for $V_{rot}$ 45-59 kt. Strongly recommend “Considerable Damage Threat” for $V_{rot}$ > 60 kt.

Case 1. EF4 Mayflower-Vilonia, AR 4/27/2014
Case 2. EF1 Mercer Co., PA 7/8/2014
Case 3. EF2 Lancaster Co., NE 5/11/2014

IMPACT-BASED WARNING (IBW) TASK

- Diagnose and anticipate the most probable category of tornado intensity.

Considerable overlap of events by different EF-scale magnitudes lends uncertainty to a particular EF-scale outcome. One solution is to use probabilities (i.e., raw and normalized) to express this uncertainty.

Figure 1. Spatial plot of tornado events (4770).