

A Climatology of Tornado Warning Skill in Landfalling Tropical Cyclones Ben Schenkel^{1,2,3} (benschenkel@gmail.com), Kristin Calhoun², Thea Sandmæl^{1,2}, A. Addison Alford^{2,3},

1: Cooperative Institute for Severe and High-Impact Weather Research and Operations, University of Oklahoma, 2: NOAA/OAR NSSL, 3: School of Meteorology, University of Oklahoma, 4: NOAA/NWS Storm Prediction Center

1. Introduction

Motivation

- Most landfalling tropical cyclones (TCs) spawn tornadoes, which are responsible for 3% of TC fatalities (Rappaport 2014);
- TC tornadoes differ from their non-TC counterparts in two ways: 1) spawned by weaker, shallower, and smaller supercells (Schenkel et al. 2023) and 2) occur in convective-scale environments with higher shear and lower CAPE (McCaul 1991);
- These differences lend themselves to lower tornado warning skill in TCs compared to non-TC cases (Martinaitis 2017), although this skill has yet to be quantified for a large sample of TCs.

Research Questions

- . How does tornado warning skill differ for a large climatology (i.e., this study) versus the limited number of cases examined in prior work?
- 2. How do the radar and lightning characteristics of supercells differ based on whether a tornado was correctly warned or not?

2. Data and Methods

Data

- TC tornadoes: SPC TC tornado data from 2011-2021 (N = 557; Edwards 2022);
- TC non-tornadic mesocyclones: Subjectively identified rotating, TC non-tornadic cells collocated with false alarm tornado warnings from 2017–2018 (N = 84; Sandmæl et al. 2022);
- TC tornado warning data: NWS tornado warnings within 800-km distance of the TC center (N=2659; IEM 2022);
- Lightning data: Earth Networks Total Lightning Network (ENTLN) uses wideband network (1 Hz to 12 MHz) detected with time-of-arrival technique;
- Low-level mesocyclone rotation: 0.5°-tilt maximum azimuthal shear (i.e., across-azimuth gradient in radial velocity) data within 2.5-km of a tornadic or non-tornadic cell from WSR-88D single radars. False alarm data available only for a small subset of cases.

Methods

- Stratify TC tornadoes and warnings according to:
- **1. Hits (N=346):** Warning containing a tornado report;
- **Misses (N=211):** Tornado report not associated with a warning;
- 3. False Alarms (N=2313): Warning without a tornado report;
- Compute tornado warning verification statistics:
- 1. Probability of Detection: $\frac{\pi us}{Hits+Misses}$
- 2. Success Ratio: *Hits+False Alarms*
- Analysis focuses on testing:
- Tornado warning skill variability with previously identified factors (e.g., distance from TC);
- Supercell characteristic variability among hits, misses, and false alarms.





Harold Brooks^{2,3}, and Roger Edwards⁴



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