# MMM SEMINAR SERIES

# *Mesoscale Environmental Conditions Accompanying Tornadoes in Eastern U. S. Landfalling Tropical Cyclones*


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Tornadoes often occur within tropical cyclone rainbands and account for approximately 3% of the fatalities associated with Atlantic tropical cyclones (TCs). Though total amounts of property damage and fatalities are less than those associated with other landfalling tropical cyclone (LTC) hazards, including extreme winds and storm surge, tropical cyclone tornadoes (TCTs) occur over much smaller areas, which complicates their prediction. In the current study we use model reanalysis fields to help clarify TCT environmental conditions by constructing composites (multi-case averages) for different objectively defined TCT environment types. Our analyses are distinct from previous studies because they reveal spatial and diurnal patterns of mesoscale environmental predictors for different TCT environment categories based on LTC strength at landfall, number of TCTs, and inland distance of the LTC. Thus, the information is more specific than in past studies, and can raise situational awareness for weather forecasters.

Each composite is based on 27 years of both Gulf of Mexico and Atlantic LTCs from 1995 through 2021. For 72 cases of LTCs with wide ranging TC intensities at landfall, daytime TCT frequency maxima are found in the northeast, right-front, and downshear-right quadrants when their composites are constructed in ground-relative, TC-heading relative, and environmental shear relative coordinates, respectively. TCT frequency maxima are located near corresponding regional maxima in lower-tropospheric vertical shear, which itself is enhanced by the TC circulation. Though the lower-tropospheric vertical shear strength is among the best predictors of TCT frequency, the strong diurnal cycle of TCTs is governed primarily by relatively small (e.g., 200-400 J $kg^{-1}$) daily variations in convective available potential energy (CAPE), where CAPE magnitudes are significantly less than for typical continental (e.g., Great Plains) tornado environments. Both composite maximum lower-tropospheric vertical shear magnitudes and TCT frequencies are largest for strong LTCs (e.g., category 2 hurricane or greater at landfall). Among the composites with weaker LTCs, large variations in TCT frequency result from both differences in CAPE and lower-tropospheric vertical shear. TCT environments occurring well inland are distinguished from a composite of the broader TCT environment by having stronger westerly shear associated with a significant north-to-south baroclinic zone, which enhances mesoscale ascent that favors deep convection on the remnant TC's east side.


**Thursday, 2 November 2023, 2:00pm**

**Refreshments 1:45pm**

**Please also join colleagues for refreshments and informal discussion after the seminar until 3:30pm**

NCAR-Foothills Laboratory, 3450 Mitchell Lane

FL2-1022, Large Auditorium

**Seminar will also be live webcast**

***https://operations.ucar.edu/live-mmm***

Participants may ask questions during the seminar via Slido.