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Low-Level Winds in Tornadoes

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One of the biggest challenges facing tornado research is characterizing the wind structure very near the surface. These winds impact and harm people and buildings, yet little is known about the intensity and distribution of tornadic winds in this very important region. During recent decades, there have been various approaches to quantifying near-surface winds including photogrammetry, laboratory and computer modeling, damage assessment, in situ observations, and fine-scale resolution radar observations. Tornadoes are relatively rare phenomena and, while there is a theoretical understanding of vortex structure, how this is manifested in the atmosphere remains an active field of research. With the advent of mobile research radars, observations of Doppler wind speeds and tornado structures have become, while sparse, increasingly more available. However, the interpretation of radar measurements is complicated by the effects of debris centrifuging and the unknown dependency of wind speed with height since most radar observations above building height. Attempts to couple proximate mobile radar observations with very near ground in-situ data in order to bridge the gap between the surface and radar observation height will be presented.

The DOW mobile radars have collected data below 100 m above ground level in over 50 tornadoes; some of these observations are coupled with very near-ground in situ data. This unique set of observations has allowed for some generalizations regarding tornado structure and low-level wind profiles. Preliminary results suggest that the most intense winds may be occurring very close the surface, and that the radius of maximum winds is largest near the surface, but there is variability among different diagnosed tornado structures. This has implications for the interpretation of wind-damage relationships and how radar observations are applied to tornado intensity rankings.

We will also present preliminary results from the Tiny-TWIRL-2019 tornado field campaign, ongoing at the time of submission of this abstract.