

A Statistical Perspective on Wind Profiles and Vertical Wind Shear in Tropical Cyclone Environments of the Northern Hemisphere

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A statistical analysis of environmental wind profiles around tropical cyclones (TCs) is performed in order to better understand how vertical wind shear influences TC intensity change. Wind profiles are computed from global atmospheric reanalysis around the best track locations of more than 6000 TC cases in the Northern Hemisphere deep tropics. The distributions of wind profiles obtained in this study provide a benchmark for developing realistic environmental flows in future modeling studies. From these distributions, it is found that the spread in environmental winds increases with height in each basin. The wind spread at 200 hPa is often more than twice as large as the spread at 850 hPa, confirming that the upper-level winds contribute more significantly to variability in the deep-layer vertical wind shear. Two new parameters are developed for describing the height and depth of vertical wind shear. Distributions of these parameters indicate that, in both TC and non-TC environments, vertical wind shear frequently occurs in shallow layers and in the upper troposphere. Partial correlations between intensity change and the shear height/depth parameters that control for relationships between these parameters and the deep-layer vertical wind shear are weak and, in some basins, not statistically significant. Nevertheless, the ability of the height and depth of vertical wind shear to modulate the intensity of real TCs may become more apparent in high resolution simulations and for cases with particularly low predictability.