Tropical Cyclone Intensification under Moderate Vertical Wind Shear: Serendipity or a Result of Favorable Factors?

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Deep-layer (200−850 hPa) vertical wind shear is generally an inhibiting factor for tropical cyclone intensification. This inhibition stems from a number of processes, including: vertical misalignment of the vortex, increased static stability, and dry air intrusions. Despite these processes, tropical cyclones often intensify under moderate shear—the range of shear magnitudes that are neither too weak to have little influence nor too strong to completely halt intensification (5–10 m s-1). Predictions of intensification under moderate shear can be highly uncertain, and some studies attribute such uncertainty to stochastic convective-scale processes. However, an alternate hypothesis is that certain detectable factors—associated with both the tropical cyclone and its environment—can help offset the effects of shear and aid intensification. This hypothesis was explored from three different perspectives: (1) two case studies based on retrospective forecasts from the Advanced Hurricane WRF model, (2) a global, climatological analysis, and (3) a set of idealized numerical simulations produced with the Advanced Research WRF model. These perspectives consistently show that the three-dimensional distribution of thermodynamic quantities is critical; tropical cyclones are likely to intensify under moderate shear when thermodynamic conditions favor symmetric rainfall around a low-level center of circulation. Vorticity budgets and energetics were calculated to link those conditions to physical mechanisms driving intensification. Results from those calculations and implications for future work will be discussed.

SPECIAL TIME

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