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The Impact of Idealized Terrain on Upstream Tropical Cyclone Track

Abstract

Tropical cyclones (TCs) approaching Taiwan usually undergo significant track deflection prior to landfall, resulting in uncertainty in TC track forecasts. To understand the physical mechanisms, a series of numerical simulations are conducted by Weather Research and Forecasting (WRF) model with an idealized bell-shaped terrain. By analyzing the asymmetric winds and potential vorticity tendency, the track deflection process is divided into two stages. Initially, the background steering flow dominates the TC track, while the TC is still far away from the terrain. As the TC approaches terrain, the channeling effect strengthens the low-level northerly winds in the western inner core. Through vertical momentum transport, the wind asymmetries develop in the mid-levels. In sensitivity experiments, the deflection is associated with the terrain height. As the terrain height increases, the magnitude of track deflection increases. However, topography width and length have little effect on the degree of the track deflection. In addition, vortices with different initial positions experience different track and physical processes. Consequently, the combined effects of large-scale background steering flow, low-level channeling effect, and midlevel wind asymmetry all contribute to the southward track deflection.

Keyword

Potential Vorticity (PV) Tendency Diagnosis, Track Deflection

Reference

Huang, K.-C., and C.-C. Wu, 2018: The impact of idealized terrain on upstream tropical cyclone track. J. Atmos. Sci., 75, 3887–3910. https://doi.org/10.1175/JAS-D-18-0099.1