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# Simulation of Eyewall Vorticity Maxima in the Tropical Cyclone Boundary Layer

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The eyewall vorticity maximum (EVM) in the tropical cyclone (TC) boundary layer (TCBL) has been observed in intense hurricanes and the associated intense turbuleances pose a severe risk to the manned research aircraft when it penetrates hurricane eyewalls at a lower altitude. In this study, a realistic numerical experiment in which a TC evolvees in a typical large-scale background over the western North Pacific is conducted using the Advanced Weather Research and Forecast (WRF) model by incorporating the large eddy simulation technique. The simulated EVM shows the similar features as revealed with the limited observational data, including the updraft/downdraft couplet, the sudden jump of the wind speed, the radial location, and the horizontal scale. It is suggested that the WRF-LES framework can successfully simulate the EVM with the grids at the resolution of 37 m that cover the TC eye and eyewall.

The simulated EVM has a cyclonic circulation with a small horizontal scale of $\sim$1 km in the TCBL. It is accompanied by stronge updrafts (more than 15 ms-1) and large vertical components of relative vorticity (larger than 0.2 s-1). The EVM favorably occurs in the inner edge of the enhanced eyewall convection or rainband within the saturated, high-$\theta$e layer, mostly below the altitude of 2 km. Nearly in all of the simulated EVM cases, the narrow intense updraft is coupled with the relatively broad downdraft, constituting one or two updraft/downdraft couplets or horizontal rolling vortices, as observed by the research aircraft. The presence of the EVM also lead to significant gradients and wind gusts in the near surface wind speed.