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Interactive comment on "Tornado-Scale Vortices in the Tropical Cyclone Boundary Layer: Numerical Simulation with WRF-LES Framework" *by* Liguang Wu et al.

Anonymous Referee #3

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This paper studies the tornado-scale vortex embedded in the tropical cyclone (TC) boundary layer (TCBL) by using very high horizontal resolution (∼37m at inner most domain) of the Advanced Weather Research and Forecast (WRF) model with the large eddy simulation (LES) technique. The WRF-LES framework used in this study successfully simulated the tornado-scale vortex and showed the features similar to the observations, such as the updraft/downdraft couplet, the sudden jumps of wind speed at the inner side of the RMW below 2km altitude with scales of 1-2km. The study provides detailed insightful analysis on the small scale features, scale integrations in TC as many of the operational forecast centers moves their hurricane model system towards higher and higher resolution systems. It is amazing that TC dynamic model

is able to simulate such detailed small-scale features. This study provides insightful information for hurricane modelers in both research and operational communities to develop very high resolution TC forecast systems. 1. The paper uses the explicit convection for all nested domains (P7, line 149). However, the 9km resolution is still in the upper end of scale gray-zone between parameterized and explicit convection. 2. The time step used in this simulation is not mentioned in the paper? 3. The study raised an interesting question on the representation of TC intensity in terms of wind speed in the best track. Currently, for West Pacific TC, the JMA, along with most meteorological agencies around the world, uses a 10-minute averaging time for TC's maximum sustained wind, CAM uses 2-minutes while the JTWC uses a 1-minute averaging time. Ten-minute wind speeds are slower than 1-minute wind speeds, usually by a factor of 1.10–1.20 for tropical cyclones. In the paper, the authors showed that the life time of the tornado-scale vortex is around 40sec-138sec (PP11, line249-250), which seems indicating that 1-2 minutes averaging time is more adequate to represent max sustained wind in TC, especially for high resolution hurricane model verification. On the other hand, the "Wind-Pressure relationship" is commonly used in TC verification by comparing model produced "W-P relationship" with the one in best track. While the observed TC's minimum sea level pressure is not affected by tornado-scale vortex, the maximum sustained wind speed in best track needs to be more accurate when high resolution TC model is verified.

Minor corrections: 1. P5, line 108, "When the horizontal resolution was decreased . . ." should read "When the horizontal resolution was increased . . .: 2. P9, line 198, ". . .wind size. . ." should be ". . .window size . . .."

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