Reply to Referee # 1

This manuscript documents the small-scale vortices in the tropical cyclone boundary layer found in a two-way nested WRF-LES set up using the large-scale conditions of a real typhoon. The results are interesting and the presentation is quite clear. I have only a few minor comments about the model setup and interpretation of results.

Minor corrections:

1. The 100-m vertical resolution is relatively coarse for adequately resolving structures like the high theta_e layers shown in Fig. 7b. It is also coarse compared to the 37m horizontal resolution. A higher vertical resolution is also desirable for capturing the strength and scale of the horizontal roll vortices mentioned by the authors (Fig. 3a). Have the authors done any sensitivity tests to examine the impact of vertical resolution on the structure and distribution of the small-scale vortices focused on in the work?

We agree with you that the vertical resolution in the innermost domain is relatively coarse compared to the horizontal spacing of 37 m. We did not run experiments to examine the sensitivity to the vertical resolution because of the limit of the computation resource. In fact, we attempted to increase the vertical resolution, but the model cannot run on Tianhe-2 computer. For this reason, we conducted the LES-111 experiment (111.1m horizontal resolution) with 12 vertical levels below 1km. In LES-111 experiment, the vertical resolution and horizontal resolution are comparable in the TC boundary layer. The near-surface linear coherent structures and tornado-scale vortex (TSV) simulated in LES-111 are similar to those in the LES-37 experiment. In the revised manuscript, we have added a brief description about the issue.

2. I couldn't quite infer the exact connection between the "quasi-linear bands" and what is shown in Fig. 8 (paragraph starting on Line 334). Are the authors implying that the wind speed horizontal variability associated with the quasi-linear features could explain in part the wind speed jump associated with the "tornado-scale vortices"? Please be more explicit.

Previous studies suggested that the quasi-linear bands are associated with the horizontal rolls in the TC boundary. Our simulation shows that the simulated tornado-scale vortices are closely associated with horizontal rolls inside the RMW. The enhanced vertical motion increases the upward and downward momentum transports (Fig. 7a), amplifying the horizontal gradient of the near-surface wind speed (Fig. 8b). Therefore, the wind speed horizontal variability associated with the quasi-linear features could explain in part the wind speed jump associated with the tornado-scale vortices. The wind speed jump associated with tornado-scale vortices are clear in Fig. 8, but some tornado-scale vortices are not associated with pronounced near-surface wind speed jump. We have made it more explicit in the revised manuscript.

3. By categorizing the vortices into 3 groups, are the authors suggesting that they are generated/maintained by different physical mechanisms? Could they simply represent different phases in the life cycle of these coherent structures?

You are right. In this manuscript we did not focus on the mechanisms for tornado-scale vortex generation and maintenance. We think that considerable analysis is needed to understand the mechanisms. While strong vertical and horizontal wind shear inside eyewall may be important for the development of the tornado-scale vortices, we suggest that the three categories of tornado-scale vortices are associated with different hydrostatic stratification.

We used the 3-second model output to examine the evolution of the simulated tornado-scale vortices. It seems that the beginning of most simulated tornado-scale vortices is associated with horizontal rolls. Since the 3-second output does not contain the thermodynamic variables, we cannot examine the hydrostatic stratification. At this time we are not sure that the three categories represent different phases in the life cycle of these coherent structures. We have made it more explicit in the revised manuscript.