Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2018-787-RC4, 2018

Atmospheric Chemistry and Physics Discussions

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 #2

Received and published: 1 November 2018

This paper describes the characteristics of relatively intense tornado-scale vortices in a high-resolution numerical simulation of a mature tropical cyclone under environmental conditions resembling those of Typhoon Matsa (2005). It is found that the simulated vortices have locations and basic properties that are broadly consistent with limited observations. An effort is made to classify the vortices into 3 distinct categories. In my view, the article is well organized and provides useful information that is adequately summarized in the abstract and section 7. Moreover, I did not catch any obvious mistakes of major consequence. On the other hand, I was somewhat disappointed not to see a rigorous analysis of the generation and decay of a tornado-scale vortex belonging to any of the 3 categories. High-resolution TC simulations showing tornado-scale vor-

tices are not unprecedented [e.g., Stern and Bryan 2014], and it seems to me that the most interesting scientific questions pertain to the formation and decay mechanisms.

Below are some minor comments that might be worth considering before official publication.

Minor Comments:

1. The paper cites an earlier study suggesting that grid-spacing less than 100 m is necessary for simulating the development of tornado-scale vortices. However, it is not entirely clear to me that simulating the 1-2 km structures of interest requires 37-m horizontal grid spacing, especially since the vertical grid spacing is (apparently) of order 100 m in the boundary layer. A brief comment on what happens to the tornado-scale vortices when the finest horizontal grid is removed in the present numerical experiment might be worthwhile.

2. There is a recent LES study by Ito et al. [Scientific Reports, 7.1, 3798 (2017)] that addresses the variation of roll structure with location in a TC boundary layer. Perhaps the authors should to try to connect the aforementioned study to theirs.

3. Since this article pertains to coherent structures having large horizontal components of relative vorticity, it might be a good idea to specify upfront that the term "relative vorticity" in this paper (presumably) refers to the vertical relative vorticity.

4. Lines 170-171: In my view, it seems a little awkward to introduce tornado-scale vortices as small-scale features that are distinct from horizontal rolls, but later show that they incorporate horizontal rolls (in some sense). That said, I am not sure that any changes need to be made in response to the preceding comment.

5. Lines 256-258: This statement (added after the first review) needs to be rewritten. To begin with, the statement fails to clarify whether the azimuthally averaged wind speed is an azimuthal average of the total horizontal wind speed or of the tangential (azimuthal) velocity. Of lesser importance, "are directly" should be "are obtained directly", and

there should probably be a comma after "time-averaging".

6. Line 374: To facilitate quantitative comparison with future studies, I think that it might be worthwhile to more precisely define the Richardson number (with an equation).

7. Lines 426-428: The wording suggests (to me) that the cited studies definitively showed that the wind speed bands are connected to vertical momentum transport by the rolls, but such an interpretation is challenged by the final sentence of the paragraph. I would consider revising the paragraph so as not to mislead the reader upfront.

8. Line 130: I suggest changing "the similar features as revealed with the limited observational data" to "features similar to those revealed with limited observational data".

9. Lines 156-159: This section of the paragraph tries to say too much in one sentence.

10. Line 275: I believe that "France" should be "Frances".

11. Line 290: "wind size" should be "window size".

12. Line 325: I would change "the mesovortices" to "mesovortices".

13. Line 339: I might remove "consecutive" or change it to "continuous".

14. Lone 350: "close to RMW" should be "close to the RMW".

15. Line 364: "tornado-scale" should be "tornado-scale vortex".

16. Line 404: I would change "Besides" to "In addition".

17. Line 410: Should "frank" be "flank"?

18. Line 425: I might change "entrained" to "locally entrained".

19. Line 459: "associated strong turbulence" should be "associated with strong turbulence".

20. Lines 463-465: "nesting grids" should be "nested grids"; "shows the similar features

as revealed with the limited observations" should be something like "shows features similar to those revealed with limited observations"; "favorable" should probably be "favored".

21. Lines 478-480: These sentences seem largely redundant with the preceding paragraph.

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