# Reply to Reviewer 2

Thank you very much for your suggestions and comments. Our manuscript has been revised based on the reviewers' suggestions and comments. Our point-to-point responses to your comments are as follows:

*Title: The study refers only to one case simulation. Therefore, it should become apparent from the title that this is a case study. Maybe the title "Revisiting the Steering Principal of Tropical Cyclone Motion: A case study of Typhoon Matsa (2005)" could be more appropriate.*

In Section 2, we mentioned that in this numerical experiment we only adopted the large-scale environment from Typhoon Matsa (2005). The low-frequency background was obtained with a 20-day low-pass filter. We designed this numerical experiment to make the simulated tropical cyclone move in a realistic environment. For this reason, we changed the title into "Revisiting the Steering Principal of Tropical Cyclone Motion in a Numerical Experiment".

*1. Equation 1: It would be good for the reader to find more explanations. The equation is used to determine the migration velocity C but it is not clear to me how the tendencies* $\left(\frac{\partial P_1}{\partial t}\right)_f$ *and* $\left(\frac{\partial P_1}{\partial t}\right)_m$ *are determined. It would also be good to see the formulas for the various contributions (HA, VA, DH and FR).*

In the revised manuscript, we add the potential vorticity tendency equation as Eq. 2, which can make the reader better understand the contributions of individual terms to tropical cyclone motion. We also mentioned how to calculate the PV tendencies in the revised version of the manuscript.

The PV tendency in the moving reference frame can be calculated with the two-hour change of the wavenumber one component in the frame that moves with the tropical cyclone center. The PV tendency in the fixed reference frame can be calculated with the PV tendency equation, which has been included in the revised

manuscript. The tendencies $\left(\frac{\partial P_1}{\partial t}\right)_f$ *and* $\left(\frac{\partial P_1}{\partial t}\right)_m$ can be further obtained by transforming the resulting PV tendencies to the cylindrical coordinates originating at on the tropical cyclone centers and then obtaining the wavenumber one components.

*2. Page 11, line 232: I can see only in Fig. 6b that DH and VA are anticorrelated. Is there any explanation why these two terms should cancel each other out?*

As shown in the attached figure (Fig. 10 in the revised manuscript), this figure shows the wavenumber-one components of the 500-hPa vertical motion, 700-hPa winds relative to tropical cyclone motion, and 500-hPa heating rate after 18 hours of integration. The upward (downward) motion generally occurs in the entrance (exit) region of the 700-hPa winds. Thus the contribution of the HA term is negatively correlated with those of the VA and DH terms.

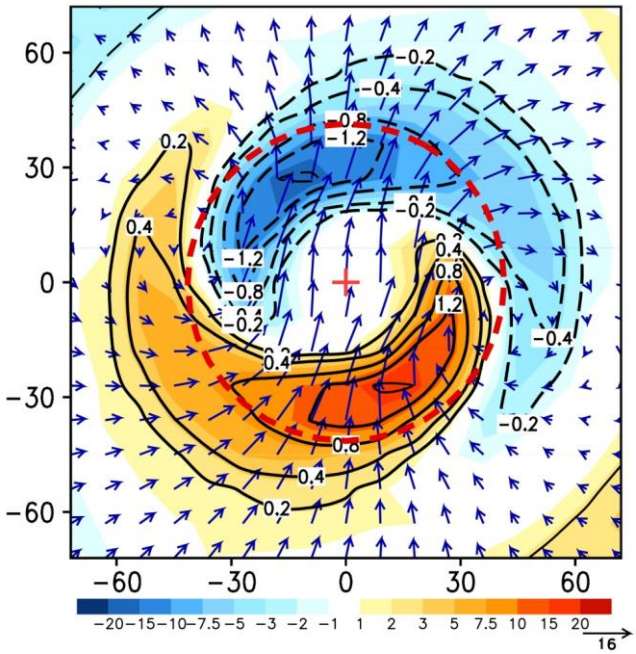


Figure 1 The wavenumber-one components of the 500-hPa vertical motion (contours, m $s^{-1}$), 700-hPa winds relative to the tropical cyclone motion (vectors, m $s^{-1}$), and 500-hPa heating rate (shaded, $10^{-4}$ K $s^{-1}$) after 18 hours of integration. The dashed circle indicates the radius of maximum wind.

*3. Figure 8: To understand the figure better, the authors should show arrows of wavenumber 1 flow, V1 and contours of symmetric PV, Ps in Fig. 8a while Fig. 8b should display the symmetric flow Vs and the wavenumber one PV field, P1. This would facilitate the understanding why HA1 and HA2 exhibit the displayed pattern. It*

*is impossible for me to follow the explanation in the text. When the flow is northward HA1 should be positive (negative) north (south) of the cyclone given that the symmetric PV is positive. However, Fig. 8 shows the opposite result.*

Thank you for your suggestion. Based on your suggestion, the figure (Fig. 9 in the revised manuscript) was modified.

*4. Caption Figure 2: Please indicate the pressure level for the wind vectors. I assume that the radar reflectivity results from a vertical integral. How is vertical wind shear defined? Is it just the difference wind vector between 200 and 850hPa? Is it the bold vector shown in the center? What is the scale of this vector?*

Sorry for the confusion. The caption for this figure has been revised. The wind vectors and radar reflectivity are at 700 hPa. The vertical wind shear is calculated as the difference between 200 and 850 hPa winds, which is the bold vector in the tropical cyclone center. As shown in the figure, two scale vectors are located at the right lower corner. The upper one is for the wind vectors at 700 hPa and the lower one is for the vertical wind shear.

*5. Fig. 5: The y axis should start at 0. In the figure caption please write "red boxes" and "black dots" instead of "right" and "left", respectively.*

We have revised the y-axis and the figure caption in the manuscript.

*6. Page 11, line 237: It would improve the readibility to use bold letters for vectors. Therefore, replace V1 and Vs by V1 and Vs, respectively.*

Done

*7. Page 12, line 254: The authors should use a notation like HA1' to denote that the contribution to conventional steering is removed.*

It has been used.

*8. Page 12, line 258: It should read "highly anticorrelated".*

It has been corrected.

*9. Page 13, line 288-291: The denotations VA1 and VA2 should be interchanged to have it consistent with HA1 and HA2.*

We have revised the denotation of VA1 and VA2 terms.

*10. Page 14, line 303: Replace* $q_s$ *by* $\boldsymbol{q}_s$.

Revised

*11. Page 15, line 318: "Cyclone speed" does not relate to a direction. Use "cyclone motion" instead.*

Replaced

*12. Caption of Fig. 10: Replace "daiabtic" by "diabatic".*

Corrected

*13. Page 16, line 343: I would write this sentence as follows: "In general, the tropical cyclone center rotates cyclonically relative to the mean track position".*

Revised

*14. Caption of Fig. 12: Please indicate the level of the displayed PV fields. Fig. 13a: Does this figure show anomalies of 9 hour running mean? If so, this should be indicated in the figure caption.*

The 700-hPa PV fields are demonstrated in Fig. 12. We have revised the figure captions of Fig. 12 and Fig. 13a have been revised.