

Interactive comment on “Revisiting the Steering Principal of Tropical Cyclone Motion” by Liguang Wu and Xiaoyu Chen

Anonymous Referee #2

Received and published: 14 July 2016

Summary

The authors investigated the dynamics of tropical cyclone motion based on the case simulation of Typhoon Matsa (2005) which was conducted with the WRF model. The author found that the motion is to a high degree governed by the approximated potential vorticity (PV) equation derived by Wu and Wang (2000). On the other hand, estimation of the cyclone migration by the conventional steering principle does not yield a satisfying result, especially at short time scales. The authors also investigated various terms of the PV equation. The horizontal advection of storm PV by asymmetric flow (HA1) is approximately offset against horizontal advection of asymmetric PV by the storm flow (HA2) while vertical PV advection (VA) tend to cancel with diabatic heating (DH). The authors deduced that the main reason for deviation from the steering principle is that the tropical cyclone core becomes asymmetric by instabilities and describes

C1

a trochoidal motion with respect to its mean track.

General comment

This study presents results which are of interest for the scientific community. However, the presentation of results could be improved. Therefore, I recommend accepting this article after minor revision as described below.

Specific comments

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.

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 $(\partial P_1/\partial t)_f$ and $(\partial P_1/\partial t)_m$ are determined. It would also be good to see the formulas for the various contributions (HA, VA, DH and FR).

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?

3. Figure 8: To understand the figure better, the authors should show arrows of wavenumber 1 flow, V_1 and contours of symmetric PV, P_s in Fig. 8a while Fig. 8b should display the symmetric flow V_s and the wavenumber one PV field, P_1 . 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.

Technical comments

Caption Figure 2: Please indicate the pressure level for the wind vectors. I assume

C2

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?

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.

Page 11, line 237: It would improve the readability to use bold letters for vectors. Therefore, replace V_1 and V_s by \mathbf{V}_1 and \mathbf{V}_s , respectively.

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

Page 12, line 258: It should read “highly anticorrelated”.

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

Page 14, line 303: Replace q_s by \mathbf{q}_s .

Page 15, line 318: “Cyclone speed” does not relate to a direction. Use “cyclone motion” instead.

Caption of Fig. 10: Replace “daiabtic” by “diabatic”.

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”.

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.

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-369, 2016.