13A.2 THE EVOLUTION OF A HURRICANE-TROUGH INTERACTION FROM A SATELLITE PERSPECTIVE

Deborah E. Hanley*

The Center for Ocean-Atmospheric Prediction Studies, The Florida State University, Tallahassee, Florida

1. INTRODUCTION

Most of the previous studies of interactions between tropical cyclones and extratropical upper-tropospheric troughs have concentrated on the use of diagnostic calculations from analyses. Very few have made use of satellite imagery (e.g., Velden 1987; Bosart et al. 2000). The similarities between PV and water vapor signatures in Hurricane Bertha (1996) will be presented in this paper.

"Superposition"-type interactions occur when an upper-tropospheric PV maximum approaches within 400 km of the tropical cyclone center (Hanley et al. 2001, hereafter HMK). HMK found that 78% of all superposition cases intensified. Hanley (1999) noted in several case studies of tropical cyclone-trough interactions that there was very strong similarity between the PV structure of the upper-tropospheric trough and signatures observed in satellite water vapor imagery (i.e., *GOES-8* 6.7 μm imagery). The high percentage of intensifying superposition cases observed by HMK suggests that identification of such interactions by numerical guidance or by satellite imagery could improve the forecasting of intensity change during this type of interaction.

Hurricane Bertha was following a north-northwest path on 10-11 July with decreasing maximum winds. Prior to landfall near Wilmington, North Carolina, at 2000 UTC 12 July, Bertha accelerated and the winds in Bertha abruptly increased to 46 m s^{-1} (Pasch and Avila 1999).

The storm was much stronger at landfall than originally forecast. The failure of official forecasts to adequately describe the intensification of Bertha highlights the challenge of forecasting tropical cyclone intensity during a trough interaction.

2. DATA

Six-hourly uninitialized 1.125° European Centre for Medium-Range Weather Forecasts (ECMWF) gridded analyses are used to calculate potential vorticity (PV). *GOES-8* 6.7 μm water vapor imagery are used for comparison.

3. DISCUSSION

Figure 1 contains water vapor imagery and horizontal plots of PV for three times, beginning 0600 UTC 12 July and ending 1800 UTC 12 July. The approaching trough (PV maximum on the 345 K surface) can been seen to approach the hurricane from the west, beginning 0600 UTC 12 July (Fig. 1b), and by 1200 UTC 12 July (Fig. 1d), has reached the center of Bertha. During this time, the hurricane has intensified by 10 hPa. By 1800 UTC 12 July (Fig. 1f), the main part of the trough has moved to the east of the hurricane, leaving behind a small PV maximum, which has superposed with the hurricane center. This interaction is also clearly shown in the water vapor images corresponding to the same times as in the PV plots. The water vapor brightness temperature contours are approximately parallel to the PV contours, with the dark regions on the satellite imagery corresponding to regions of high PV (Figs. 1a,c,e). More details of this study can be found in Hanley (2002). The similarities of the PV and water vapor images suggest that some types of hurricane-trough interactions may be recognizable from satellite imagery and may aid in the forecasting of intensity changes during such interactions. However, more cases need to be examined before any kind of guidelines can be determined for use in an operational setting.

* *Corresponding author address:* Dr. Deborah Hanley, Center for Ocean-Atmospheric Prediction Studies, The Florida State University, 227 Johnson Building, Tallahassee, FL, 32306-2840; e-mail: hanley@coaps.fsu.edu.

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4. REFERENCES

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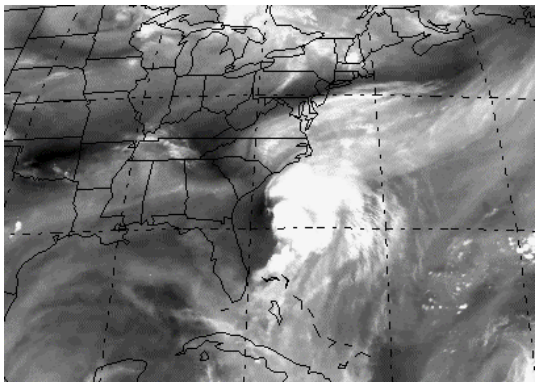
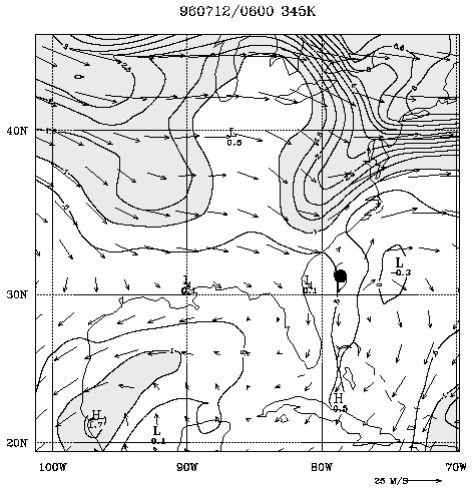
(a)



(b)



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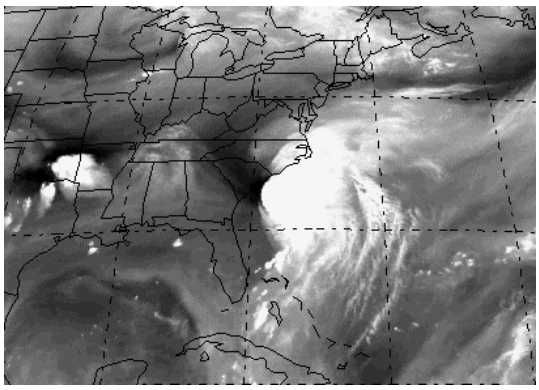

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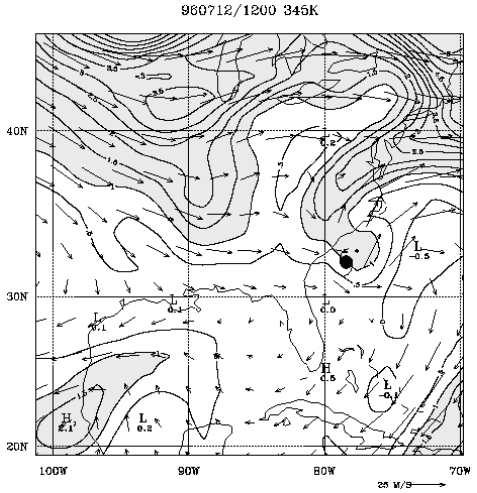

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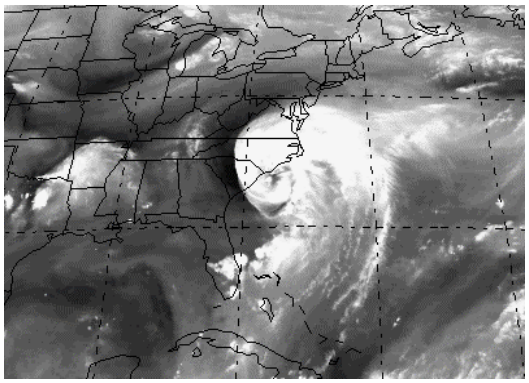

(f)

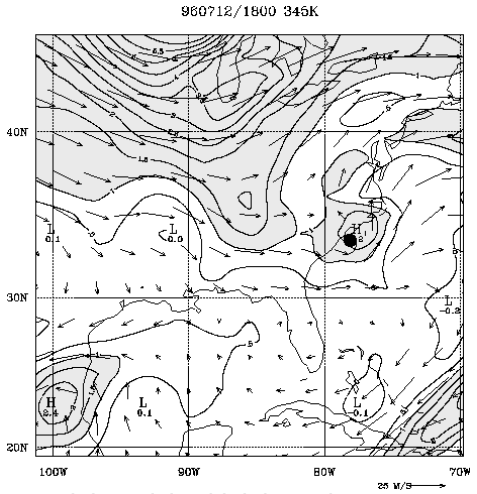

Figure 1. *GOES-8* water vapor images (left) and horizontal plots of potential vorticity (right) on the 345 K surface for the following times: 0600 UTC July 12 1995 (a,b); 1200 UTC 12 July 1995 (c,d); and 1800 UTC 12 July 1995 (e,f). Values of PV greater than 1 PVU are shaded. The center position of Hurricane Bertha is identified by the tropical storm symbol.