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# Kinematic structure of Hurricane Isabel (2003) near landfall from the Morehead City WSR-88D

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## 1. INTRODUCTION

This paper presents the low-level wind structures of Hurricane Isabel (2003) near its landfall around 1700 UTC, 18 September 2003 observed by the Morehead City WSR-88D (KMHX). The tangential wind structure is deduced from the ground-based velocity track display (GBVTD) technique (Lee et al. 1999). A total of three hours of data (~30 volumes) were processed and presented in this paper. The hurricane circulation centers are determined using the GBVTD-simplex algorithm (Lee and Marks 2000). Hurricane Isabel was a category-2 hurricane before it made landfall in North Carolina. The best track of Isabel is shown in Fig. 1. The maxima Doppler velocities consistently exceeded 50 $ms^{-1}$ at the 0.5° elevation angle scans during the analysis period. Isabel possessed an unusually large eyewall exceeding 60 km in radius associated with the primary wind maxima. This, in conjunction with the relatively small standard WSR-88D unambiguous range between 140 and 170 km, make the GBVTD analysis extremely difficult due to the poor geometry. The analyses presented are between 1500 and 1600 UTC on 18 September 2003 and the circulation center of Isabel at 1500 is marked by the hollow hurricane symbol in Fig. 1.

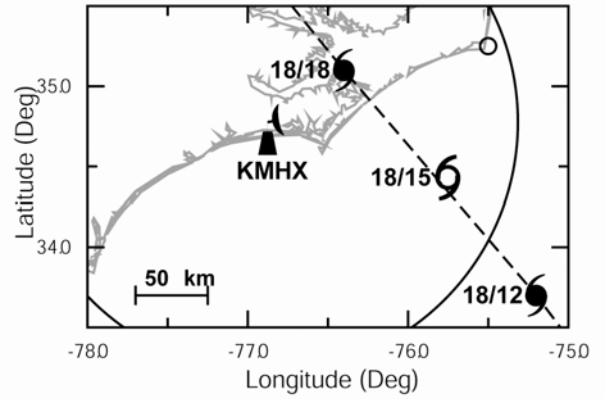


**Figure 1. Hurricane Isabel's best track near landfall on 18 September 2003. The hollow hurricane symbol represents the circulation center of the GBVTD analysis at 1500 UTC. The open circle is Cape Hatteras.**

## 2. Hurricane Isabel

The axisymmetric structures of reflectivity, tangential, radial, vertical velocity and perturbation pressure at 1506 UTC are shown in Fig. 2. The maximum axisymmetric tangential wind of 49 $ms^{-1}$ was located at R=~65 km, just inside the maximum

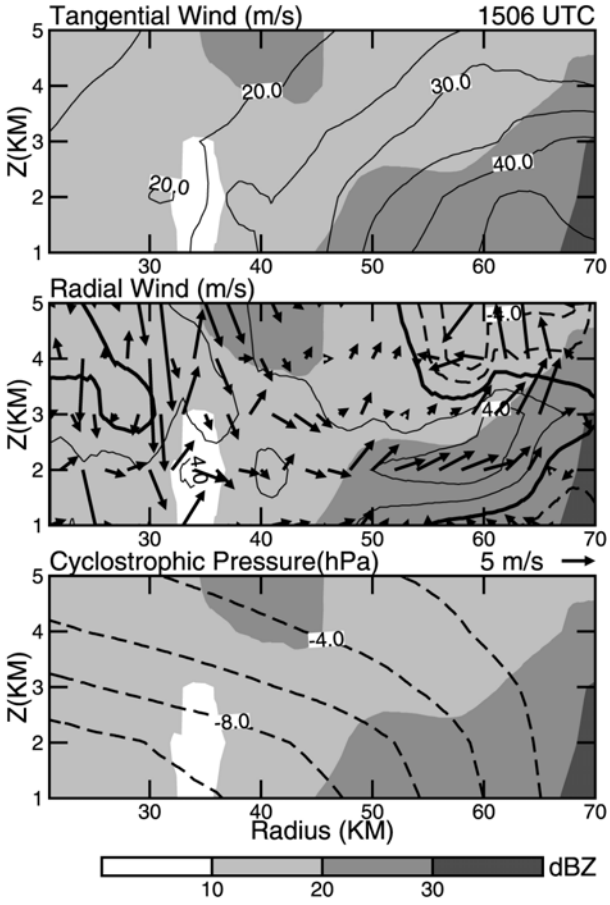


**Figure 2. The axisymmetric structure of Isabel at 1506 UTC. The reflectivity factor is presented in gray scale. Top, middle and lower panels show tangential wind, radial wind and perturbation pressure deficit. The vectors represent the secondary circulation of Isabel. Positive (Negative) quantities are presented as solid (dash) contours.**

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reflectivity in Fig. 2a. The eyewall can only be partially resolved and it was quite flat. It is evident that radial outflow and downdraft dominated inside the eyewall and met with inflow from the environment near the RMW and turned into updraft (peak magnitude ~4 $ms^{-1}$, note that the figure is exaggerated 5 times in the vertical). The perturbation pressure deficit was 13.3 hPa at 1 km altitude between the hurricane center and R=70 km.

The evolution of Isabel between 1500 and 1600 UTC is illustrated using the Hovmoller diagram (Fig. 3). The intensity of Isabel weakened from 49 $ms^{-1}$ to 45 $ms^{-1}$ in this hour while the RMW is located ~62 km. The intensity decreases with height as the tangential wind at 4 km was below 30 $ms^{-1}$. The nearby surface pressure at Cape Hatteras at 1600 UTC was 971 hPa (interpolated from the report from the National Hurricane Center). Isabel was located ~79 km from Cape Hatteras and the central pressure was ~957 hpa. At 1557 UTC, the retrieved perturbation pressure deficit was 11 hPa at 1 km altitude (not shown) that is consistent with the observed pressure deficit.

There was an incomplete ring of radar reflectivity (~30 km in radius) resided in the eye, resemble an inner eyewall. However, the GBVTD-simplex algorithm could not identify a relative vorticity maximum in the proximity of the radius of this "inner eyewall". The NOAA P3 eye penetration around 1430 Z (one minute average flight level data, not shown) shows the tangential wind steadily decreased from R=70 km toward the center. Hence, Isabel might not possess a double-eyewall structure as indicated in the reflectivity structure near its landfall.

**REFERENCES:**


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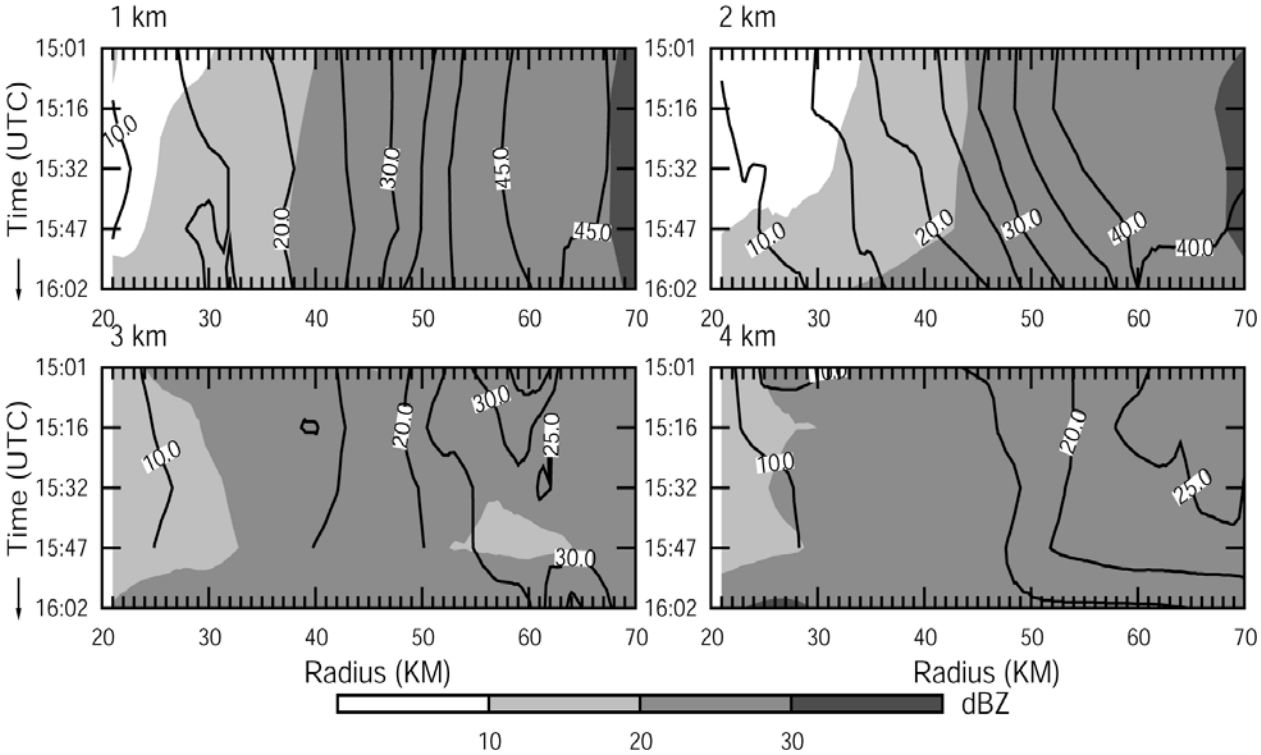


**Figure 3. Hovmoller diagrams of Hurricane Isabel's reflectivity factor (gray scale) and axisymmetric tangential wind (contour) from 1 to 4 km altitude between 1500 to 1600 UTC. The structure inside R=20 km is not shown.**