2A.8

OROGRAPHIC EFFECTS ON TYPHOON HERB (1996)

TaiChi Chen Wang, Jen-Hsin Teng and Yi-Fen Sun

Department of Atmospheric Sciences
National Central University (NCU),
Chung-Li, Taiwan 320.

1. Introduction

In average, there is at least one typhoon passing through the northern Taiwan every year and causing tremendous damage. From 1996, a dual Doppler radar set up with a baseline of 50 km started to operate routinely. The northern dual Doppler lobe is mainly over the open sea while the southern one is over land with high mountains (Fig.1). A new terrain following coordinate Doppler wind synthesis algorithm is adopted (Teng et al. 2000), hence the detail kinematic and thermodynamic structure changes during the landfall can be revealed even over the complicated topography.

2. Structure change of the rainband by the orographic effects

While the principal rainband approaching the mountain, near the foothill the tangential wind relative to the typhoon center decreased, the radial wind actually increased to maintain the gradient wind balance as the friction increased. The inflow from the out skirt became stronger and thicker, but the inflow from eye direction was disturbed by the terrain. The forced upward motion along the slope redistributed the vertical motion. The 40 m/sec isotach of tangential wind near 3km height over the ocean was elevated to the 6km height near the 2000 meter high mountain peak. We also compared the vertical distribution of the total wind over the ocean and mountain. It clearly shown not only the wind speed at the low and middle levels changed, at upper level near 9 km height the total wind also decreased.

3. Structure change of the eyewall by the orographic effects

The reflectivity distribution at 2135 was shown in Fig. 2. LT1 was the radial cross section across Northwest Ocean from typhoon center; LL2 was a radial cross section across mountain area. Fig.3 show the contours of the reflectivity and the wind vectors of the radial wind and vertical wind on the two cross sections. Updrafts with vertical motion about 5m/sec were associated with the eye wall. As the eye wall was split into several bands at the mountain area, more complicated updrafts structure were observed. As the circulation of eye wall met the mountain, at the lowest level the strongest tangential wind decelerated from 50 m/sec to 30m/sec at 2135, 15 minutes later it decreased to 20 m/sec near the foothill. The retrieval of horizontal pressure field shown that the mountain ridge served as a high pressure and it blocked the strong typhoon wind (figure not shown). In Fig. 4, we also noticed that dramatically change also happened at upper levels. When the towering circular strong tangential wind band near the rim of the eye wall in northern domain moved into southern domain, it collapsed. The 40m/sec isotach at 10 km height descended to the 4km height. The speed of outflow in radial direction at upper levels increased as the tangential wind decreased (Fig. 3). The erected and concentrated tangential wind maximum pattern near the eye wall became horizontally layered along the mountain slope. The vertical wind shear at low level was also reverted due to the friction.

4. Conclusion

At the early stage of a strong typhoon encounter the land and high mountain; within the northern domain over the open sea, the rain bands and the eye wall structures are quite similar to the phenomena documented in literatures. In this paper, the structure changes of rain band and eye wall were illustrated over the sea and over the terrain. The tangential wind near ground decelerated about 40 %. The upslope wind and forced convection along the mountain slope transport the horizontal momentum upward. Hence the horizontal layered wind pattern was elevated along the mountain. Within the southern domain, due to the friction, blocking and the forced convection on the slope, the three dimensional circulation and reflectivity structures change dramatically. The terrain following synthesis algorithm provided more understanding of orographic effects during typhoon landfall.

5. Reference

Teng, J.-H.,C.-S. Chen, and T.-C. C. Wang 2000: Orographic Effects on a Squall Line System over Taiwan. *Mon. Wea. Rev*. **128,** 1123-1138

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Corresponding author address: Dr. Tai-Chi Chen Wang, Dept. Atmos. Sci., Nat'l Central U., Taiwan, email: taichi@atm.ncu.edu.tw

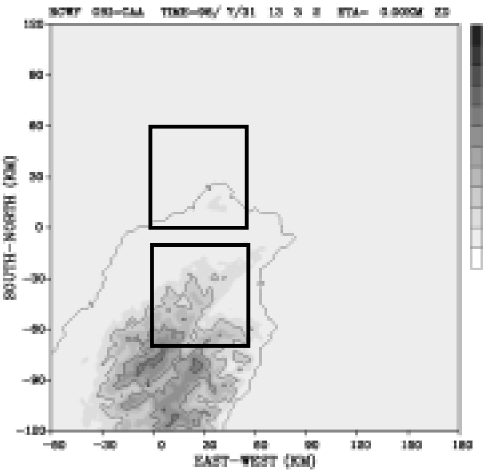

Fig.1 The topography of northern Taiwan and the dual Doppler analysis domains.

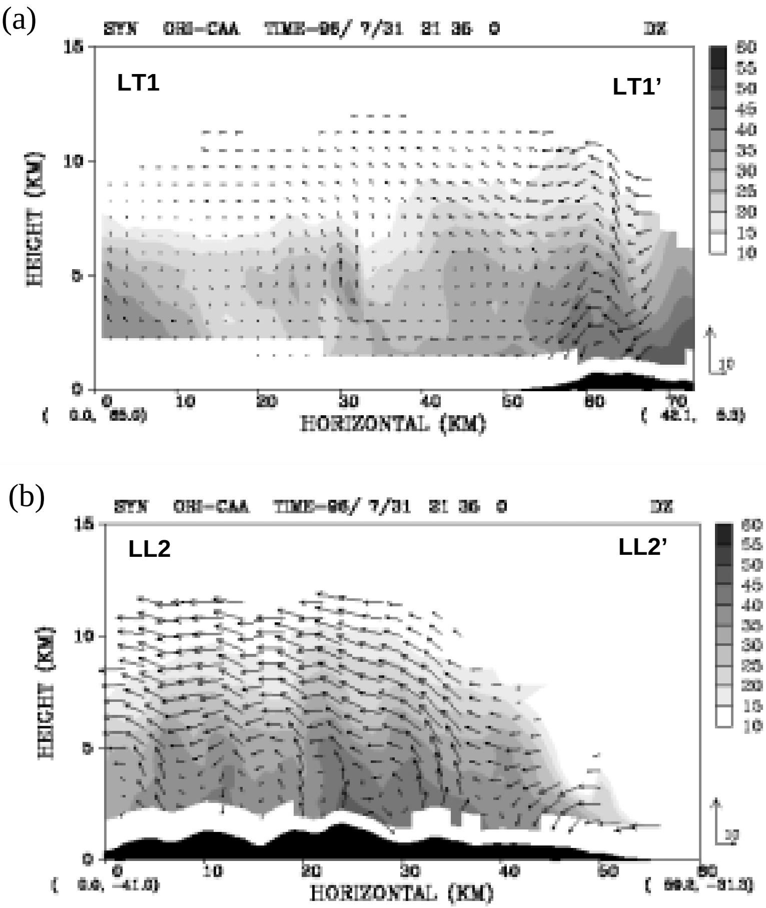

Fig.3 The reflectivity field and radial wind and vertical wind vector field. (a)LT1-LT1' cross section (b) LL2-LL2' cross section.

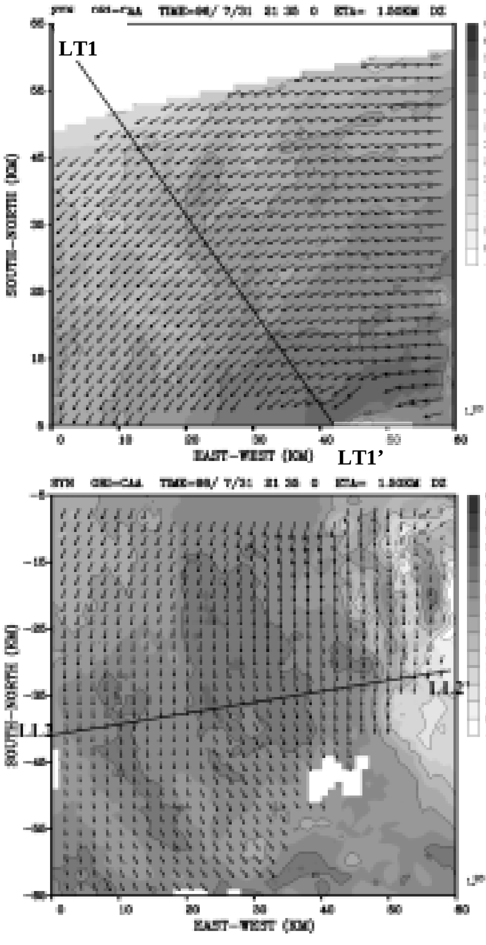

Fig.2 The relative horizontal wind and reflectivity field at 1.5km above surface at 2135 LST, Two radial cross sections through typhoon center, which will be shown in Fig.3 and Fig.4 were labeled.

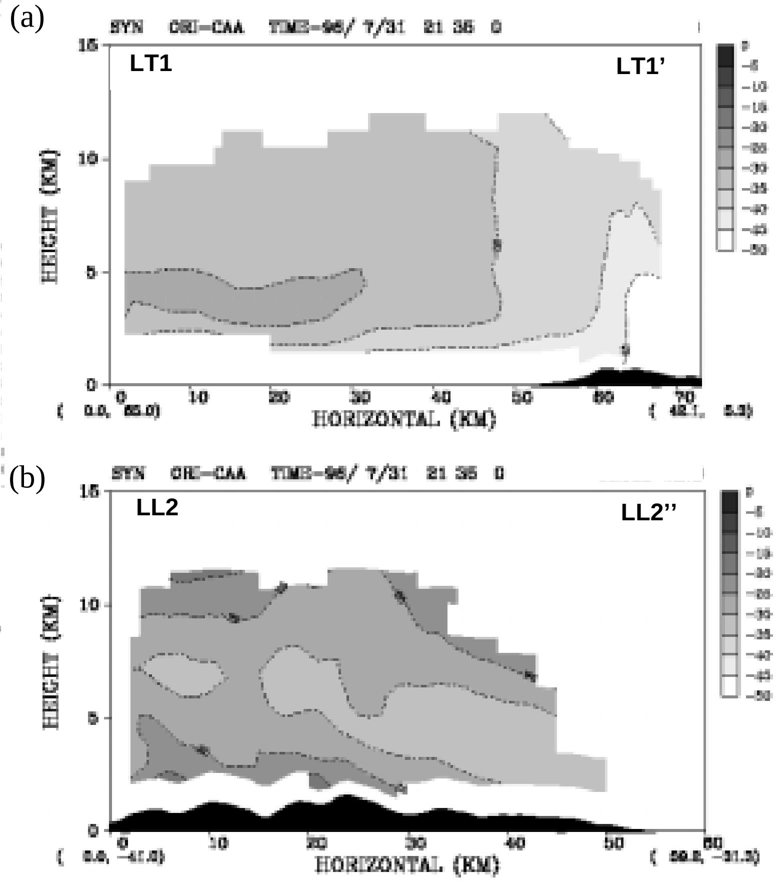

Fig.4 The tangential wind isotach. (a) LT1-LT1' cross section. (b) LL2-LL2' cross section. The dark shading was the topography.