3B.1 THE IMPACT OF TAIWAN TOPOGRAPHY ON TYHPOON NARI AS LANDFALLING FROM THE HIGH RESOLUTION SIMULATION

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1. INTRODUCTION

The topographic induced lee-side secondary low during landfall of typhoon Nari was investigated. Typhoon Nari, with the unique track, moved southwestward slowly and made landfall at 1300 UTC 16 Sep 2001 as show in Fig. 1. The slow passage over Taiwan (~49 hours) made considerable disastrous flooding. A pronounced secondary low, shown in Fig. 1 (Wang et al. 2001), was formed over southeastern Taiwan during Nari moving through west of the Central Mountain Range (CMR). In general, the scale of the lee-side secondly low is significantly smaller than that which can be produced by an interaction of the mean steering flow and the CMR. However, Fig. 1 showed that the secondary low propagated to the north and had the tendency to upscale developed. The secondary low in Fig. 1b and 1c had larger scale than the typhoon center located at west of Taiwan. The MM5 model was used to perform the high-resolution simulation (5-km) and to investigate the structure of the secondary low.

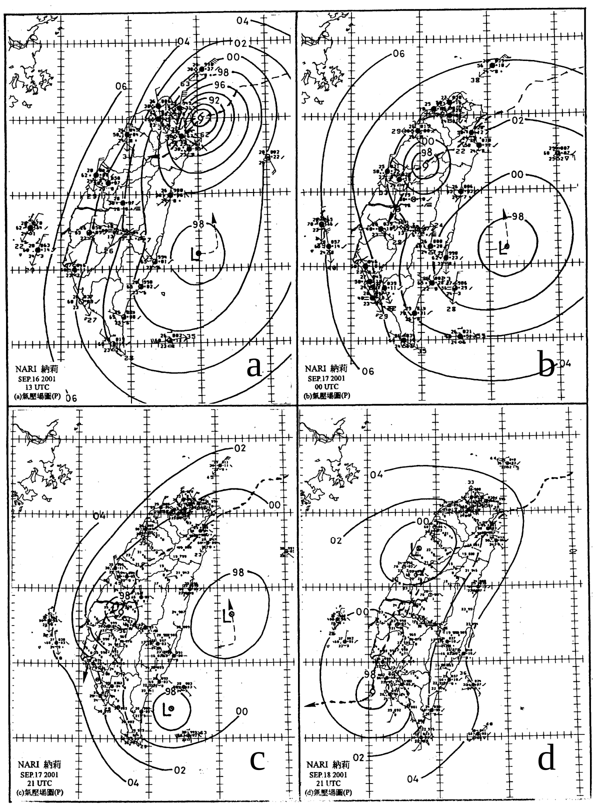

Fig. 1. Surface analysis of typhoon Nari as landfalling at (a)1300 UTC 16 Sep, (b)0000 UTC 17 (c) 2100 UTC 17 Sep, and (d) 2100 UTC 18 Sep 2001 (Wang et al. 2001).

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2. RESULTS

The simulation was initiated at 1200 UTC 15 Sep 2001 and produced good results for the track and the evolution of the lee side secondary low. Fig.2 was the 30-hr forecasts and showed that the typhoon center was located over northwestern Taiwan. The secondary low was occurred over southeastern Taiwan and propagated to the north. The life of the model secondary low could be classified as initial stage and mature stage. The initial stage of the secondary low as shown in Fig. 2 was comparable to Fig. 1a both in location and strength. The figure showed that the secondary low was clearly due to the persistent subsidence warming from the Nari's outer circulation across the southern part of CMR.

Fig. 3 was the A-A′ cross section of the secondary low. The figure showed that the strong downward motion and gravity waves were occurred on the lee side. The low, revealed as the potential vorticity field, was located over the subsidence-warming region with strongest potential vorticity at surface layer. The vertical development of the low was limited below 500 m and characterized by the warm core and upward motion.

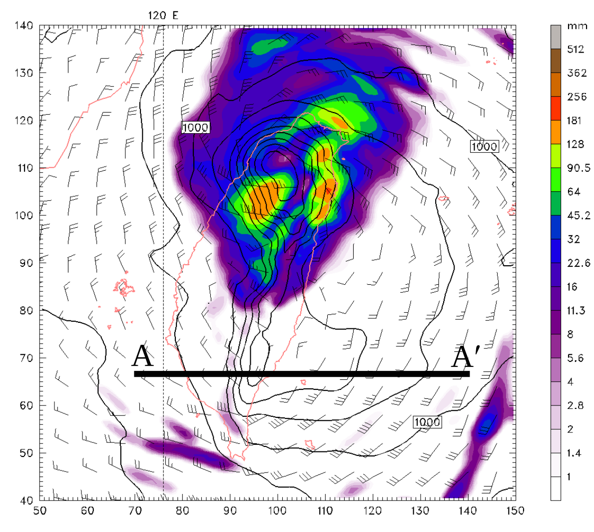

Fig. 2. 30-h forecast of sea level pressure (2-hPa interval), wind field at σ=0.995, and 3-hr accumulated rainfall (shading). The forecast is valid at 1800 UTC 16 Sep, 2001. A-A′ is the cross section shown in Fig. 3.

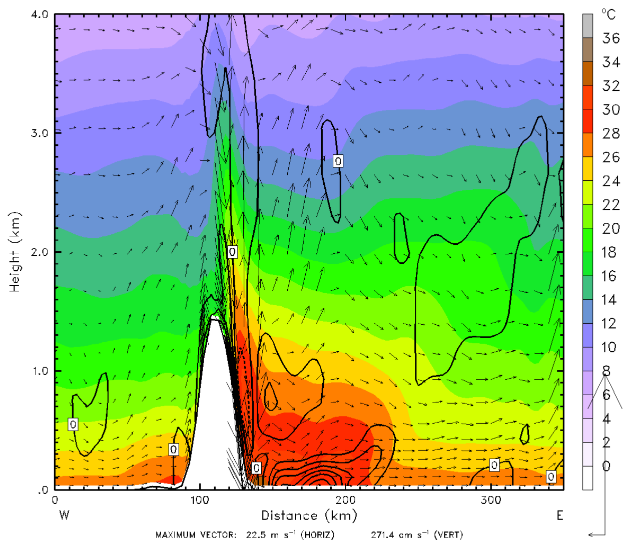

Fig. 3. A-A′ cross section depicting the circulation vector, potential vorticity (2 PVU interval), and the temperature (shading) at 1800 UTC 16 Sep 2001.

Fig. 4 was the mature stage of the secondary low valid at 1200 UTC 17 Sep 2001. The figure showed that the typhoon circulation was destroyed by the CMR; however, the typhoon center could be identified and located over central CMR. Similar to the observation (Fig. 1c): 1, the persistent low induced by the subsidence warming was located around southeastern Taiwan. 2, the secondary low moved northward and upscale developed with closed circulation. The northward motion of the secondary low could be due to the advection by the southwest wind associated with Nari's outer circulation. 3, the circulation associated with the secondary low was more evident than that associated with the typhoon center and the former was possible to drive the typhoon center to the south further more.

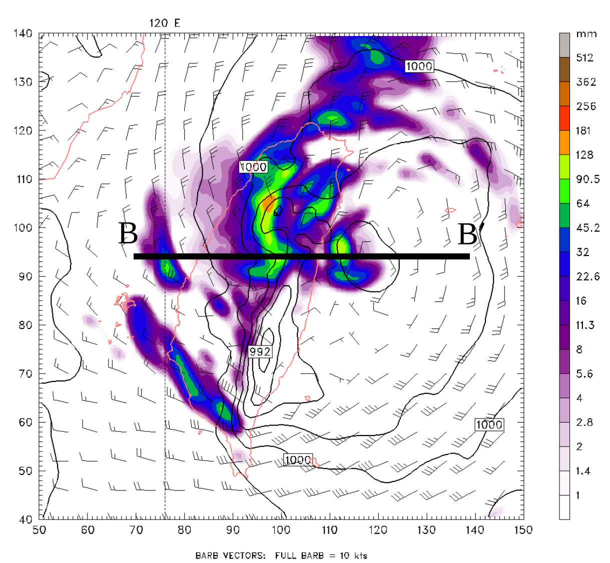

Fig. 4. Same as Fig.2 but for 48-h forecast that is valid at 1200 UTC 17 Sep 2001. B-B′ is the cross section shown in Fig. 5.

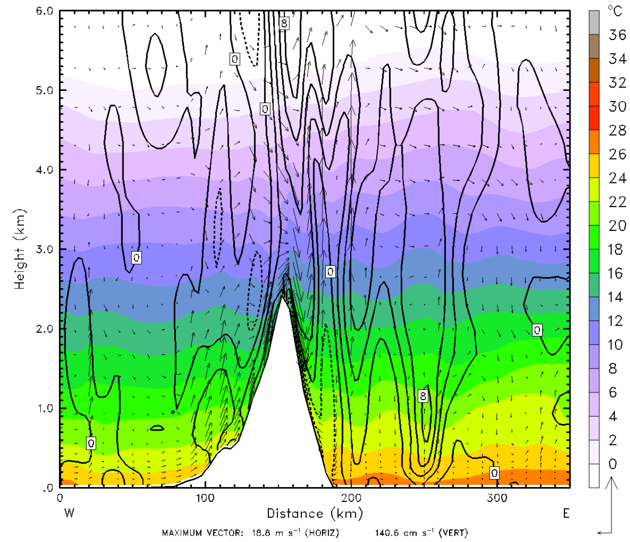

Fig. 5. Same as Fig.3 but for B-B′ cross section that is valid at 1200 UTC 17 Sep 2001.

Fig. 5 was the B-B′ cross section. The figure showed that the structure of the secondary low was significant different from the initial stage. The strong downward motion and gravity wave was still occurred on the lee side. The low was characterized by the weak upward motion and upscale developed up to 5 km in the vertical with the strongest potential vorticity at 1-km height.

3. DISCUSSION

The occurrence of the secondary low clearly depended on the typhoon's size and position relative to the CMR. However, not every low could upscale develop. The transition of the low from initial stage to mature stage is an interesting issue. The slow passage of Nari might be a critical factor to drive the secondary low away from southeastern Taiwan and to the north. After the low drift to the north, the geostrophic adjustment under the environment with small Rossby radius of deformation within typhoon center was possible favor to the development of the low. The further PV budget analysis will be helpful to better understand the mechanism of the upscale development.

ACKNOWLEDGMENTS

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