3.4 Recent Tropical Cyclones Striking the Philippine Islands

3.4.1 Typhoons striking Luzon

Typhoon Yunya, 11–17 June 1991—including the Mount Pinatubo Eruption

The track of Typhoon Yunya, classified as a "Midget" typhoon, is shown in Fig. 3.1. As the legend indicates, Typhoon Yunya made landfall on Luzon, just south of Baler (see Fig. 1.2) at minimal typhoon strength (65 kt). Figure 3.2 indicates that after the two forecasts on 13 June, the official JTWC forecast accurately predicted the track of Yunya across central Luzon. The figure also shows that the recurvature was more rapid, than forecast, as the tropical cyclone departed Luzon heading toward the Luzon Strait. Additionally, note in Fig. 3.3, that the JTWC (see the track labeled JTWC) forecast accurately predicted the subsequent track over central Luzon as early as 0000Z on 14 June. The JTWC forecast followed the simpler guidance from the climatology aid (CLIM), the Colorado State regression equation model aid (CSUM) and the steering-type dynamical aid (FBAM) (see Table 3.2). It is evident that JTWC had to discount the track forecast from the large dynamic models (OTCM, NGPS (U. S. Navy's FNOC NOGAPS Model), JTYM (Japanese Meterological Agency Typhoon Model) and EGRR (the United Kingdom Meterological Office Model)) all of which predicted premature recurvature. It appears that this problem is endemic to the current generation of vortex-tracking numerical models, i.e., these models have difficulty in describing the interaction between a small TC and its penetration of the subtropical ridge. Despite a slow speed bias of the JTWC forecasts (not shown), the forecasts that Yunya would cross central Luzon provided key warning support helping DoD officials to evacuate Clark Air Base.

This tropical cyclone formed as the surface winds in the South China Sea had changed to southwesterly—i.e., the southwest monsoon had just formed—, with the associated return flow aloft at 200 mb from the northeast. The timing of the arrival of Yunya was most unfortunate. If Yunya had not arrived on 15 June, much of the low-level ash from the Mount Pinatubo volcano would have been advected toward the north (away from U. S. Navy units in Subic Bay) and the upper-level flow would have carried the higher level ash toward the southwest (over the South China Sea and west of Subic Bay). Unfortunately the deep cyclonic circulation of Yunya swept much of the volcanic ash toward Subic Bay and Manila. The heavy rains and the weight of the ash led to the collapse of roofs and the subsequent loss of life (U. S. NOCC/JTWC 1992).

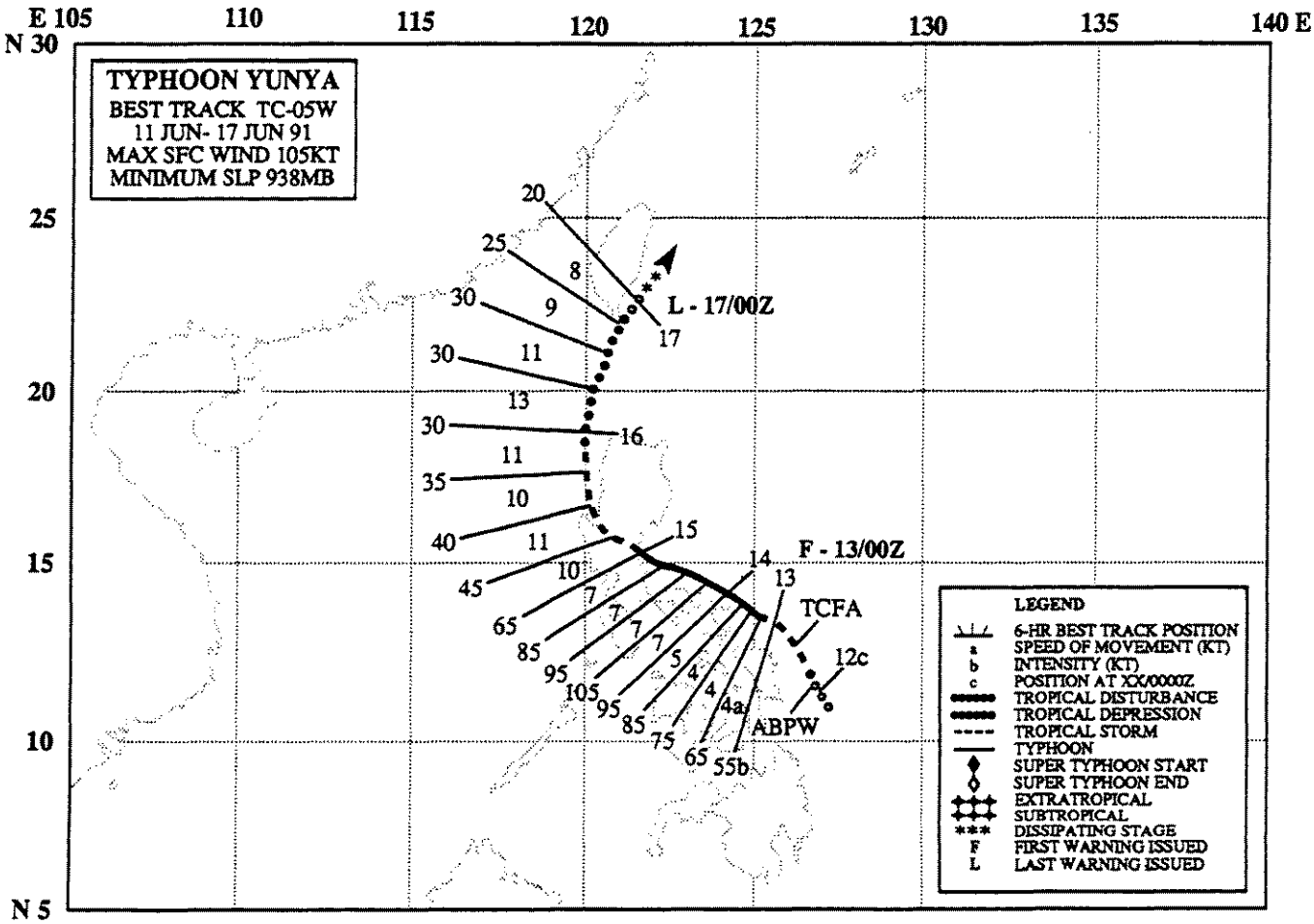

Figure 3.1: Official Best Track of Typhoon Yunya (adapted from U.S. NOCC/JTWC 1992)

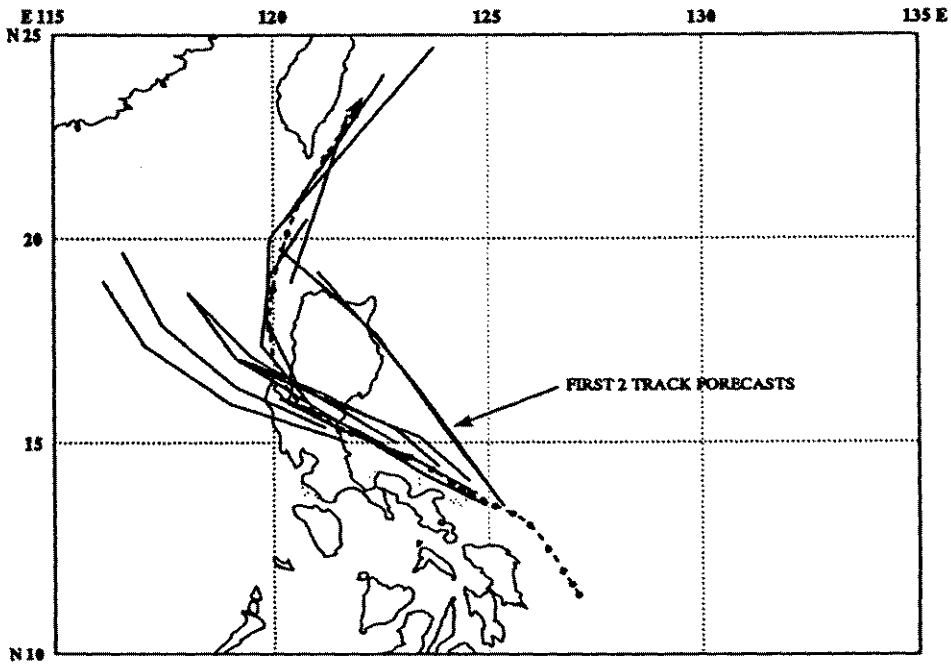

Figure 3.2: Graphics of all JTWC Official Forecasts (solid lines) issued for Yunya superimposed on the Final Best Track (dashed lines)(adapted from U. S. NOCC/JTWC 1992)

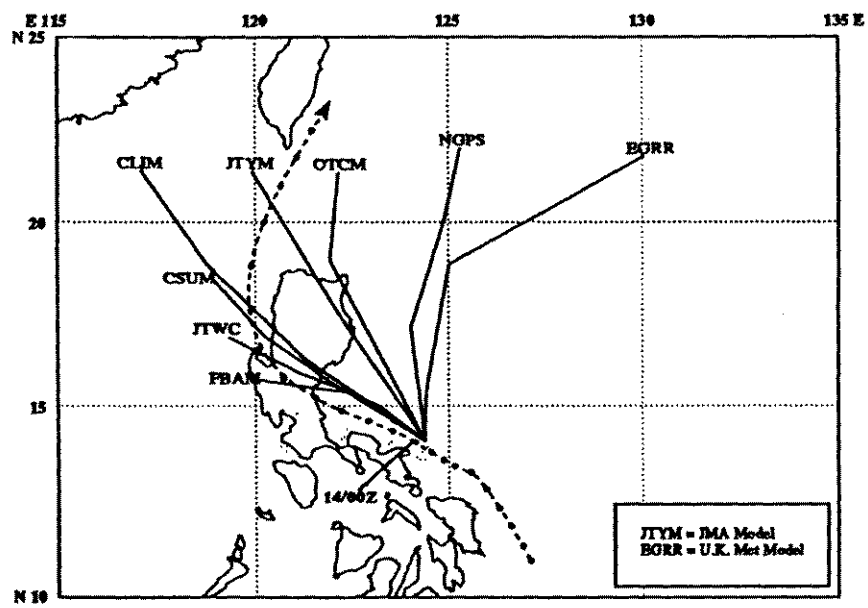

Figure 3.3: Graphics of JTWC Official Forecast and the Associated Objective Forecast Aids at 140000Z June 1991 (adapted from U. S. NOCC/JTWC 1992)

Figure 3.4 shows the eruption of the Mount Pinatubo at 0630 local time on 15 June 1991—although the commencement of this major eruption may have been as early as 0200 local time. Mount Pinatubo, located 40 nautical miles (nm) northwest of Manila, is under the small, dark circular ash cloud at the top of the figure, while much of the other cloudiness is from Typhoon Yunya, just making landfall on eastern Luzon. Note that the whiter upper-air clouds associated with approaching Typhoon Yunya do not have the characteristic circular configuration typical of a typhoon. The southwest-northeast orientation of the cloudiness is the result of strong northeasterly winds associated with the high pressure center aloft over China (and an associated 200-mb ridge extending east over Taiwan (not shown)). This strong shearing in the vertical, acting simultaneously with the frictional effects of land at low levels, quickly weakened the maximum sustained winds of small Typhoon Yunya to 45 kt at its first warning position over Luzon (see Fig. 3.1).

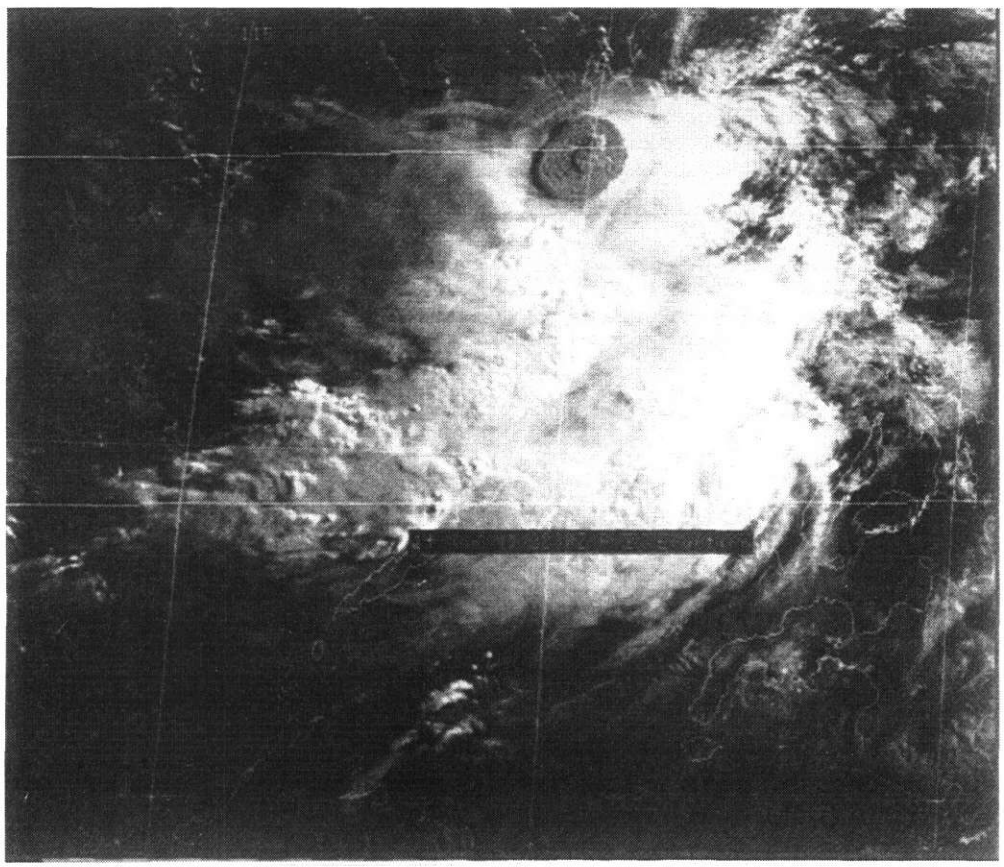

Figure 3.4: Visible Geostationary Satellite Imagery of the Mount Pinatubo Eruption - 0630 Local Time 15 June 1991 (courtesy of ENS Scott Oswalt, USN)

Climatologist were studying the continuing global and climatic effects of the volcanic debris still circling the earth in the stratosphere a year after the June 1991 eruptions. Figure 3.5 shows the ash cloud emanating from Mount Pinatubo 10 hours after Fig. 3.4. Note that the ash cloud already extends out radially more than 200 nm, as far south as Mindoro and north to the Luzon Strait. This image taken at 1630 local time depicts the great height of the ash cloud by the shadows cast to the northeast and east of the cloud.

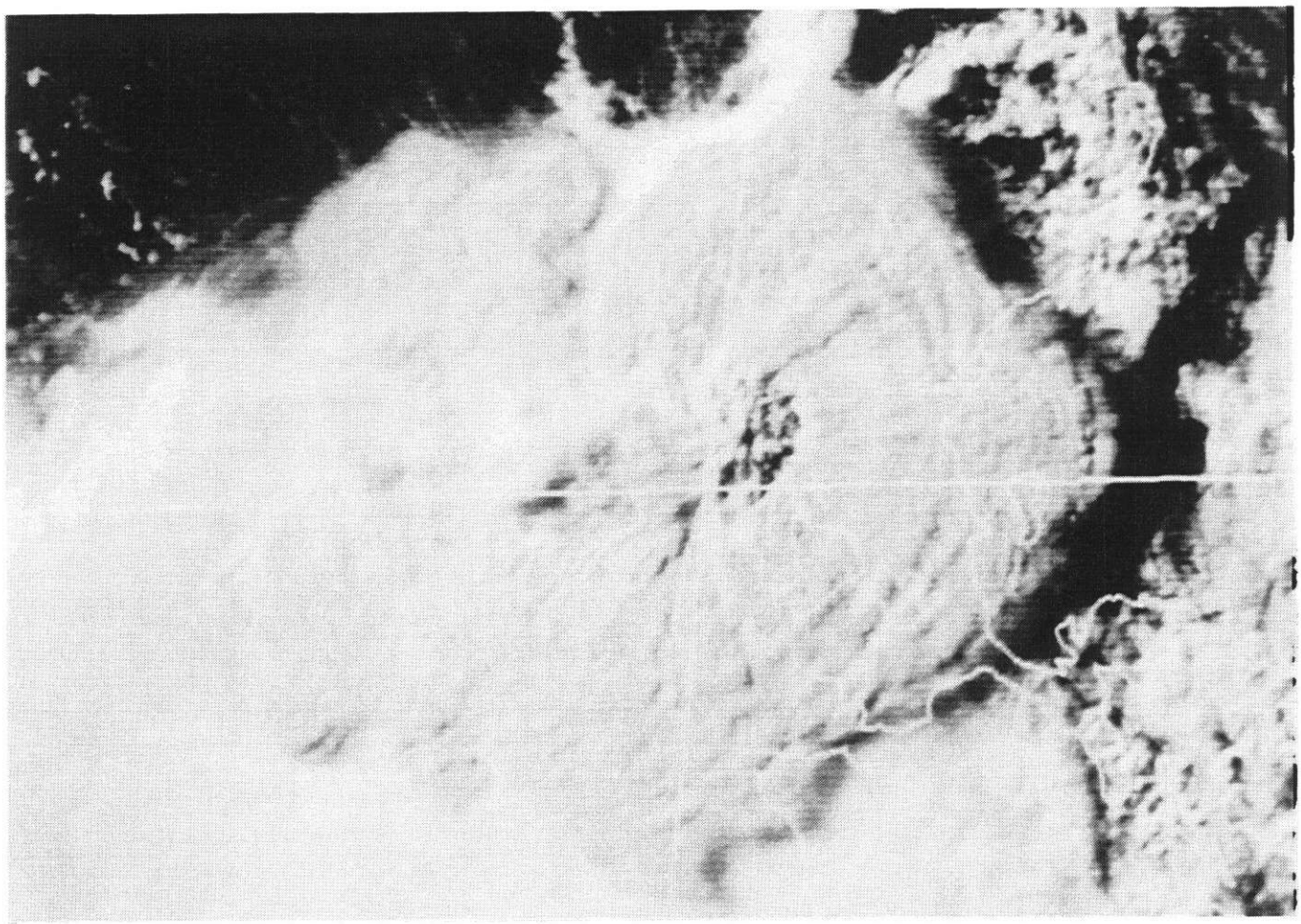

Figure 3.5: Visible Geostationary Satellite Imagery of the Mount Pinatubo Eruption - 1630 Local Time 15 June 1991 (courtesy of ENS Scott Oswalt, USN)

Further evidence of the destructive power of such a major eruption is given by the aerial view in Fig. 3.6. Note that the lush tropical growth on the surrounding mountains appears to be covered by many feet of deposited ash.

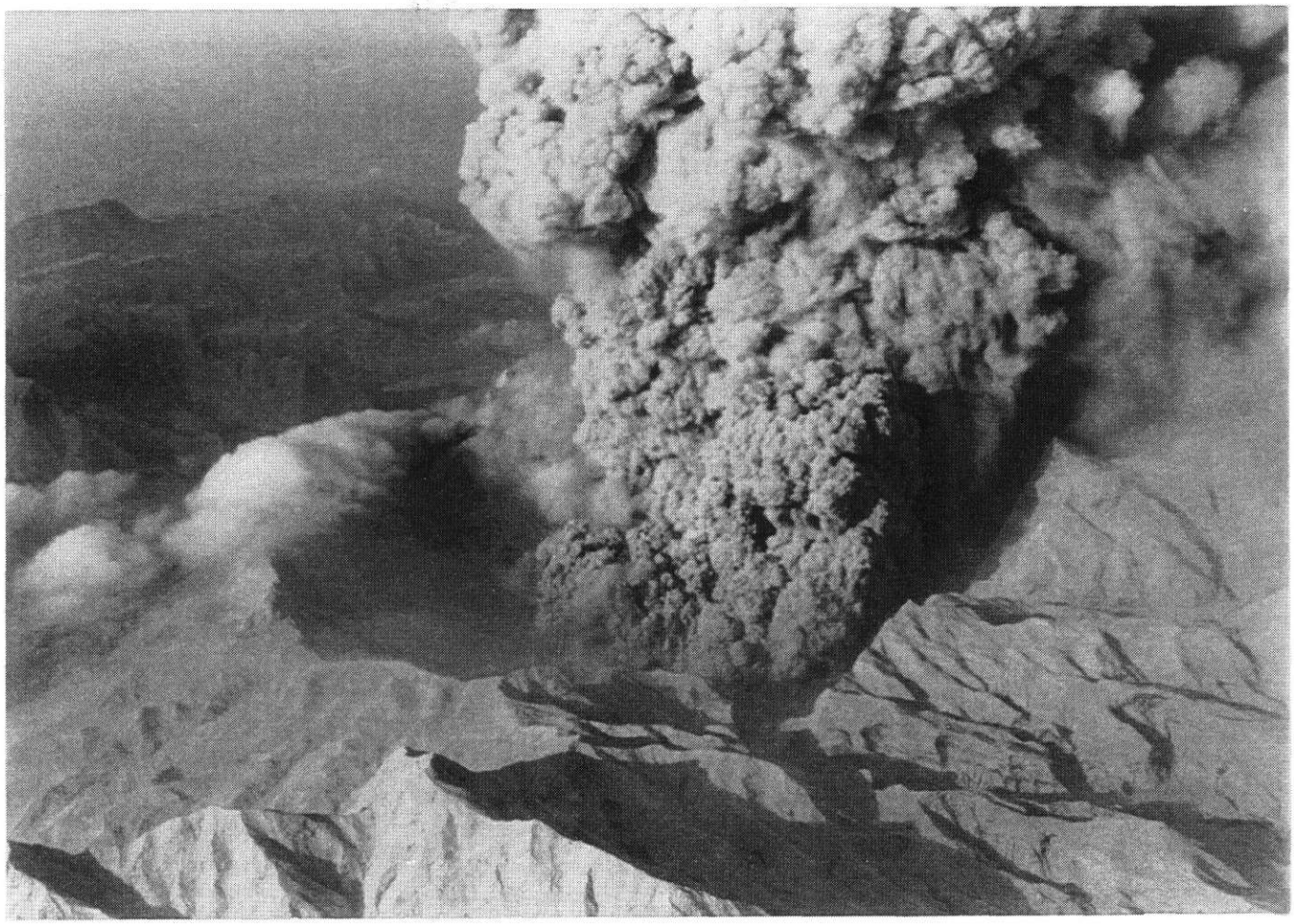

Figure 3.6: Aerial View of Mount Pinatubo after the Eruption (courtesy of ENS Scott Oswalt, USN)

Typhoon Becky, 20–30 August 1990

The tropical disturbance that evenually became Typhoon Becky originated within the surface monsoon trough (not shown), when upper-level divergence (associated with a TUTT to its north) developed. As the final best track in Fig. 3.7 indicates, Typhoon Becky followed a near westward track during its lifetime, although the Philippine forecaster may have anticipated that the typhoon might recurve as it was upgraded to a tropical storm at 0000Z on 25 August (see Fig. 3.7). Sixty hours earlier, the deep layer mean circulation analysis (another product provided to JTWC by FNOC) displayed in Fig. 3.8 showed Becky approaching southerly steering flow over the Philippine Islands with a low center[8] present over southeastern China, west of Taiwan. However, by 1200Z on 25 August (Fig. 3.9) the deep layer mean circulation analysis showed that the trough had moved eastward and filled (weakened), as it became the neutral point, just southwest of Japan. Thus Becky came under the influence of stronger westward steering and accelerated, making landfall on the northern Luzon coast while moving at 12 kt (see Fig. 3.7).

[8]Comparisons between pressure analyses and streamline analysis: (L)ow = (C)yclonic center; (H)igh = (A)nticyclonic center; Col = Neutral point. = Tropical Storm symbol and = Typhoon symbol.

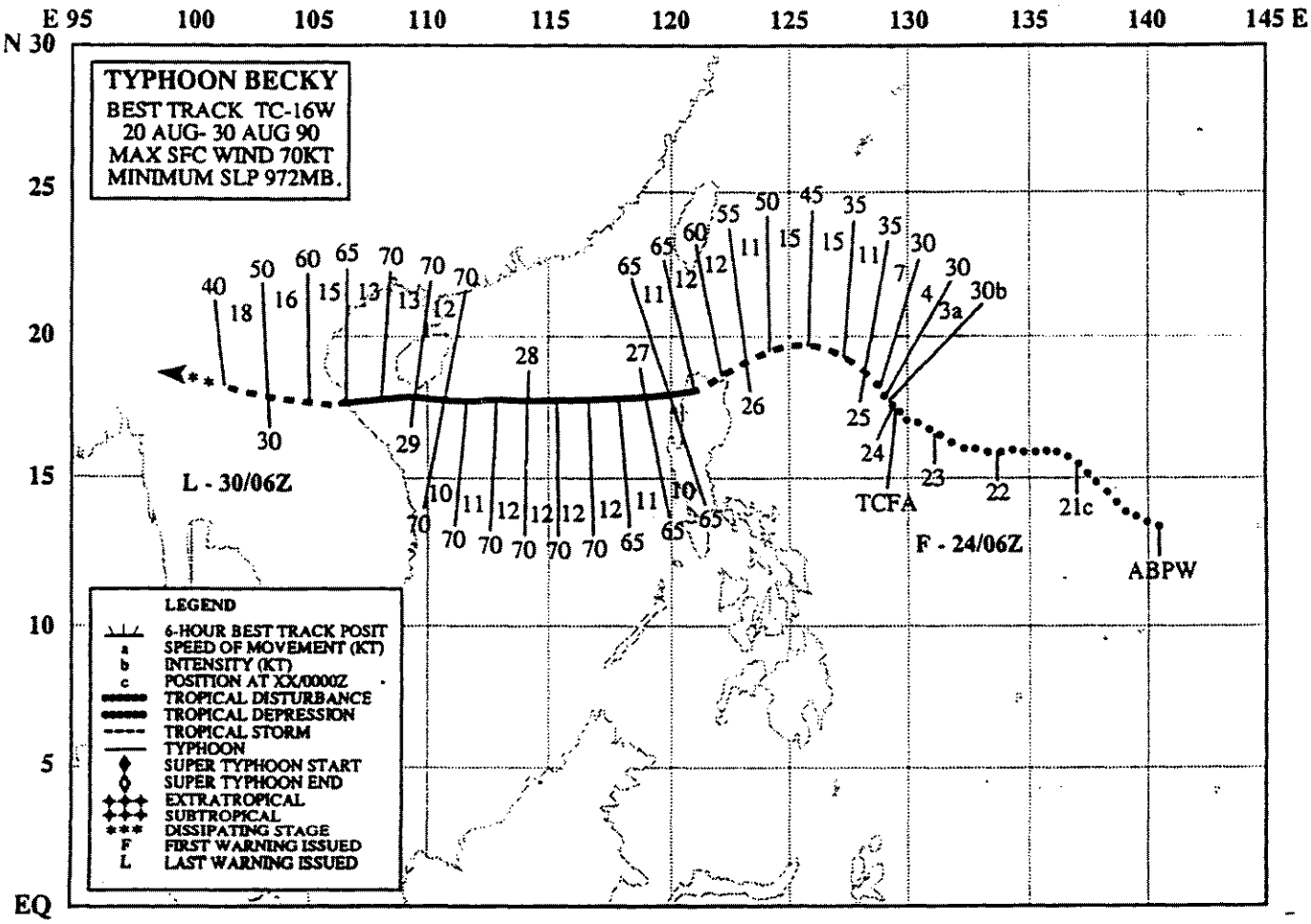

Figure 3.7: Official Best Track of Typhoon Becky (adapted from U.S. NOCC/JTWC 1991)

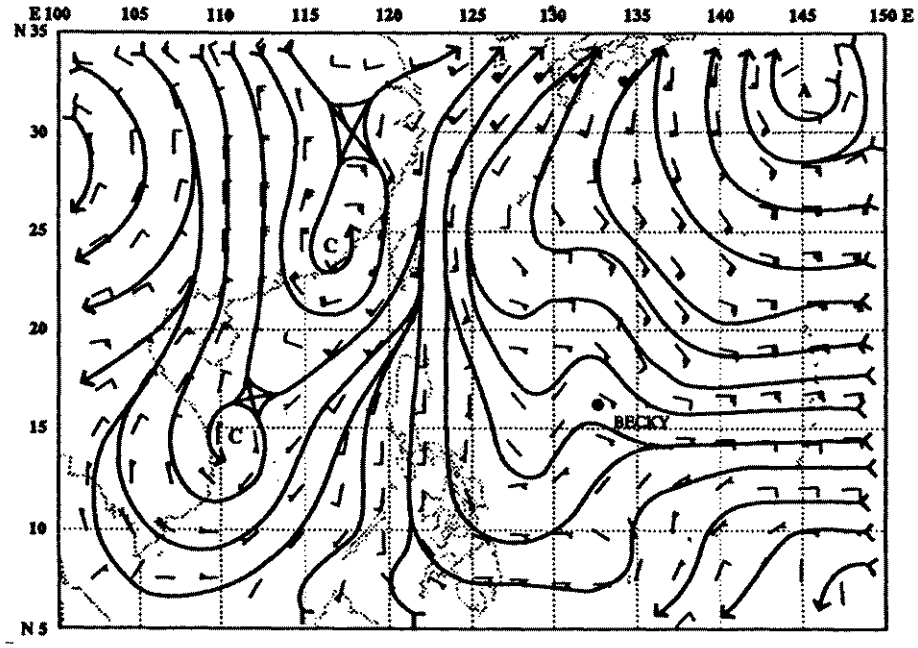

Figure 3.8: Deep Layer Mean Circulation Analysis for 221200Z August 1990 (adapted from U. S. NOCC/JTWC 1991)

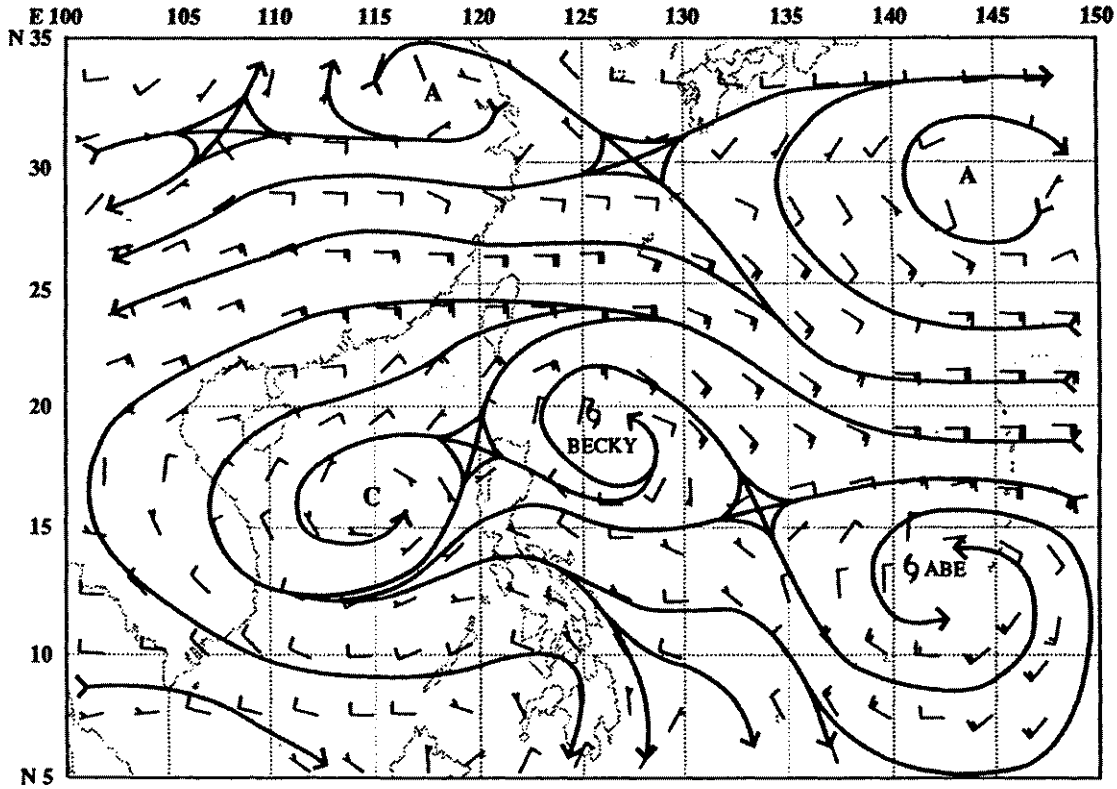

Figure 3.9: Deep Layer Mean Circulation Analysis for 251200Z August 1990 (adapted from U. S. NOCC/JTWC 1991)

A close examination of the best track (Fig. 3.7) reveals that Becky was upgraded to typhoon intensity at 261200Z while over land, based upon the appearance of a 10-nm eye (not shown) (U. S. NOCC/JTWC 1991). However, a contradiction appears to exist since JTWC also reports that Becky had reached minimum typhoon intensity in the Defense Meteorological Satellite Program (DMSP) visible image (Fig. 3.10) earlier at 260039Z. Consequently, there may have been other factors (synoptic reports, etc.) that dictated a delay in the formal upgrade. While this appears contradictory to the expected weakening due to friction at landfall, other environmental factors may have been dominant. Certainly in this case much of the spiral band of cloudiness associated with Typhoon Becky remained over water during its short six-hour track over norther Luzon.

Figure 3.11 displays the summary of all official JTWC warnings for Becky. The JTWC warning tracks were slow in predicting that Becky would track toward the southwest and strike northern Luzon. This failure was probably attributed to an underestimation of the strength of the ridge (which had followed the trough eastward across China, and intensified). Note that the TC performed characteristically as described in Appendix B (Shoemaker 1991), i.e., having approached the PI moving toward the southwest, the TC turned more westward after landfall. The typhoon also followed Shoemaker's rule that TCs moving 15 kt or slower experience little change in speed of motion. Note, however, that Typhoon Becky's time over land was only about six hours.

As a result of Typhoon Becky's passasge, 32 people were reported killed, and thousands were forced to evacuate due to heavy flooding in northern Luzon (U. S. NOCC/JTWC 1991).

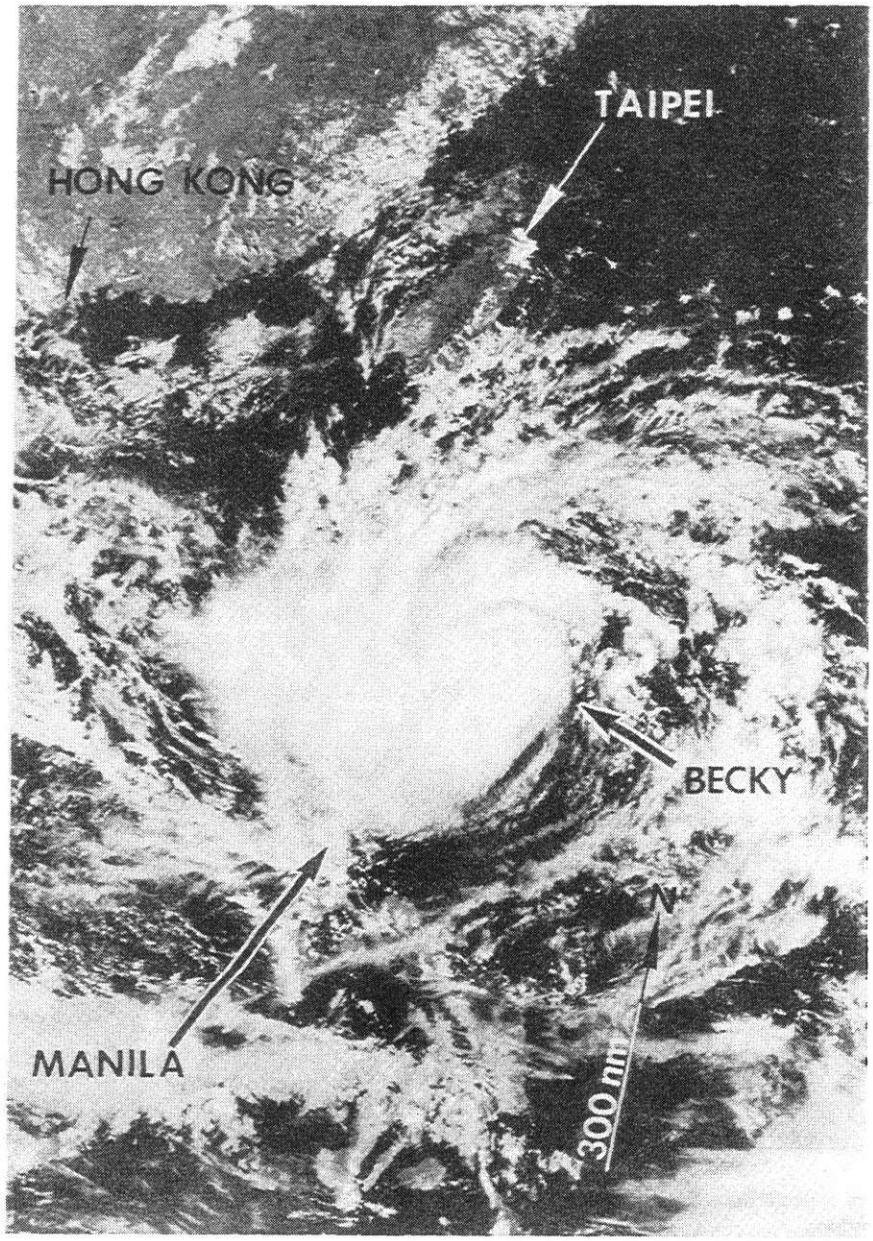

Figure 3.10: Typhoon Becky Reaches Minimum Typhoon Intensity just as it approaches northern Luzon (260039Z August DMSP visible imagery) (adapted from U. S. NOCC/JTWC 1991)

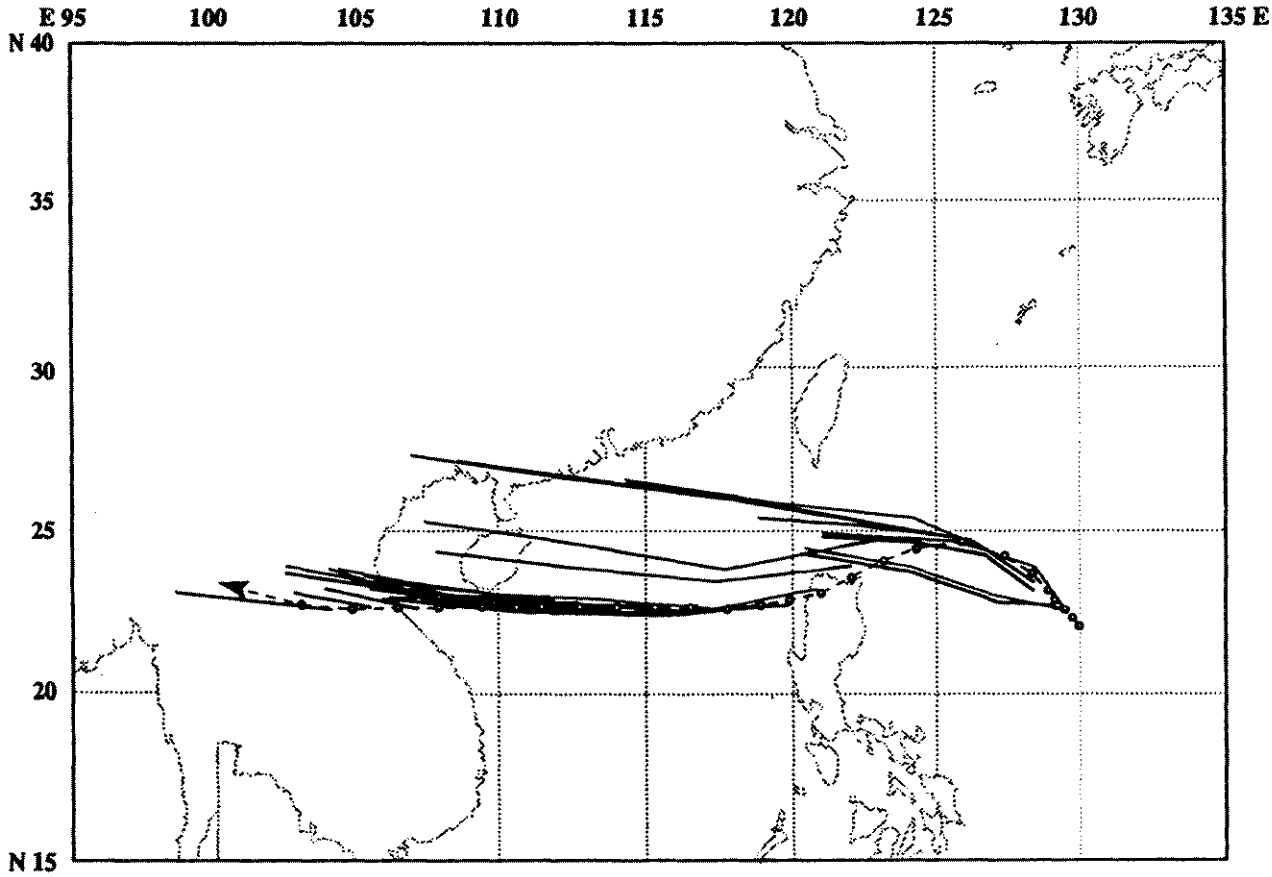

Figure 3.11: Summary of JTWC Forecasts (solid lines) for Becky superimposed on the Final Best Track (dashed lines) (adapted from U. S. NOCC/JTWC 1991)