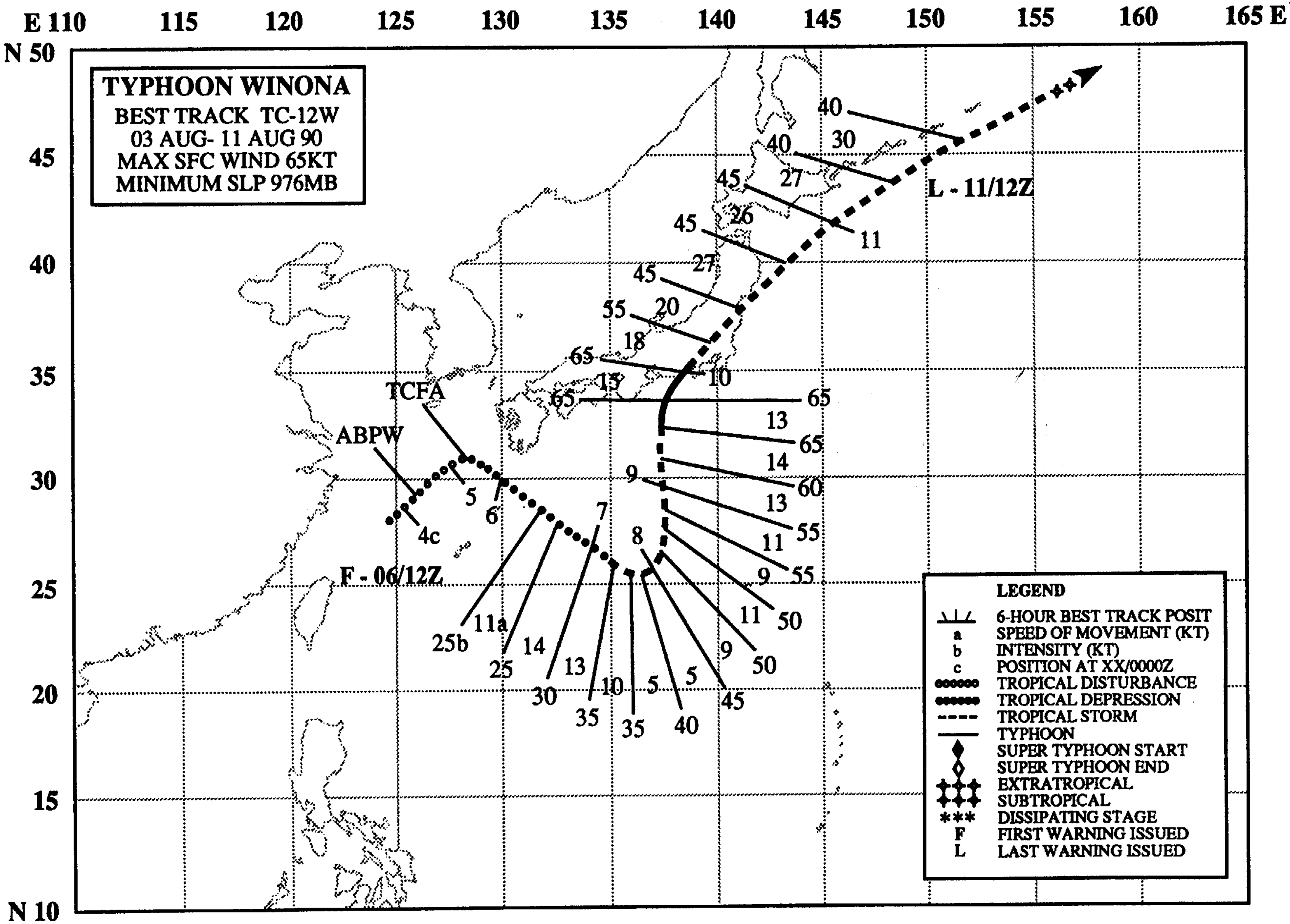
TYPHOON WINONA
BEST TRACK TC-12W
03 AUG- 11 AUG 90
MAX SFC WIND 65KT
MINIMUM SLP 976MB
E 110
115
120
125
130
135
140
145
150
155
160
165 E
N 50
45
40
35
30
25
20
15
N 10
TCFA
ABPW
F - 06/12Z
L - 11/12Z
LEGEND
6-HOUR BEST TRACK POSIT
a SPEED OF MOVEMENT (KT)
b INTENSITY (KT)
c POSITION AT XX/0000Z
TROPICAL DISTURBANCE
TROPICAL DEPRESSION
TROPICAL STORM
TYPHOON
SUPER TYPHOON START
SUPER TYPHOON END
EXTRATROPICAL
SUBTROPICAL
DISSIPATING STAGE
F FIRST WARNING ISSUED
L LAST WARNING ISSUED

TYPHOON WINONA (12W)

I. HIGHLIGHTS

Winona was the first typhoon of 1990 to hit Japan and the only tropical cyclone to form poleward of 25 degrees north latitude. It formed from the remnants of Tropical Storm Tasha (10W) in a monsoon trough displaced northward of its normal location. Winona tracked across the southern portion of the Kanto Plain, was caught in the westerlies, and completed extratropical transition as it swept just south of the Kurils.

II. CHRONOLOGY OF EVENTS

040600Z - First mentioned on the Significant Tropical Weather Advisory as remnants of Tropical Storm Tasha moving off China and reforming as a weak circulation in the East China Sea.

051100Z - Tropical Cyclone Formation Alert issued based on improved convective organization and Dvorak analysis of CI 1.0.

061200Z - First warning issued as a tropical depression. Although both convection and organization had improved, vertical shear from the northwest inhibited further development.

070600Z - Upgraded to tropical storm as vertical shear decreased and circulation center and convection became better aligned.

091200Z - Upgrade to typhoon and peak intensity - 65 kt (33 m/sec)- based on a ragged eye and first intensity estimate of CI 4.0.

100000Z - Landfall on Japan 20 nm (35 km) east of Hamamatsu, a city 110 nm (205 km) southwest of Tokyo. Downgraded to tropical storm.

111200Z - Final warning - extratropical - issued as Winona became embedded in mid-latitude westerlies.

III. TRACK AND MOTION

Winona was unique in regard to both its genesis and its movement. The system formed in the monsoon trough, which was displaced 300 nm (555 km) north of its normal location. The initial southeastward movement almost directly opposed the expected climatological track. Winona typified the complex interaction that can occur among tropical cyclones, the deep monsoon southwesterlies, and the subtropical ridge. Winona later moved north, then northeast, in response to a well-developed mid-latitude trough.

Enhanced convection became prevalent in the East China Sea as the low pressure area associated with the remnants of Tropical Storm Tasha (10W) moved out to sea by 040000Z August. This area of enhanced convection developed into Winona. The system tracked northeastward initially, then southeastward along the edge of the deep monsoon westerlies. The 500-mb analysis at 070000Z (Figure 3-12-1) shows Winona embedded in a complex flow pattern with Tropical Storm Vernon (11W) to the northeast. The subtropical ridge had split, with one cell centered in the Luzon Strait, and the other south of Vernon. Winona tracked toward the neutral point between the two cells.

By 080000Z, Vernon (11W) had tracked northeastward and become extratropical. At the same time, Winona slowed to 4 kt (7 km/hr) and turned sharply northward as the ridge to the southeast built poleward. As Vernon (11W) completed its extratropical transition at 090000Z near the Kamchatka Peninsula, the ridge strengthened north and northeast of Winona in response to the extratropical cyclone's rapid deepening. In response, Winona maintained a northward track until it made landfall near Hamamatsu, Japan. After landfall, it began to accelerate northeastward, and by 101200Z, Winona was embedded in the mid-latitude westerlies, beginning its extratropical transition. Winona finished its extratropical transition by 111200Z as it skirted south of the Kuril Islands.

IV. INTENSITY

Winona developed as the remnants of Tasha (10W) moved off the coast of China into the East China Sea. The disturbance generated persistent convection, but it was subject to strong upper-level northerly flow (Figure 3-12-2). The strong vertical wind shear left Winona's circulation center exposed north of the deep convection.

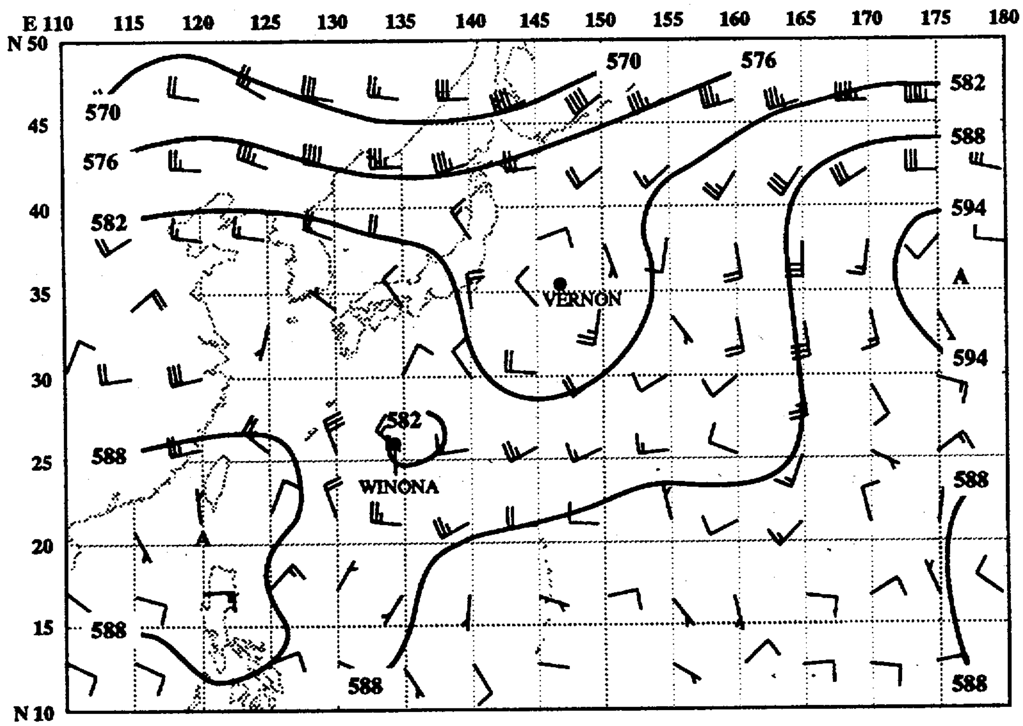

Figure 3-12-1. The 500-mb NOGAPS analysis for 070000Z August depicts Winona tracking between the two subtropical highs. Tropical Storm Vernon (11W) northeast of Winona. Note: heights are in decameters.

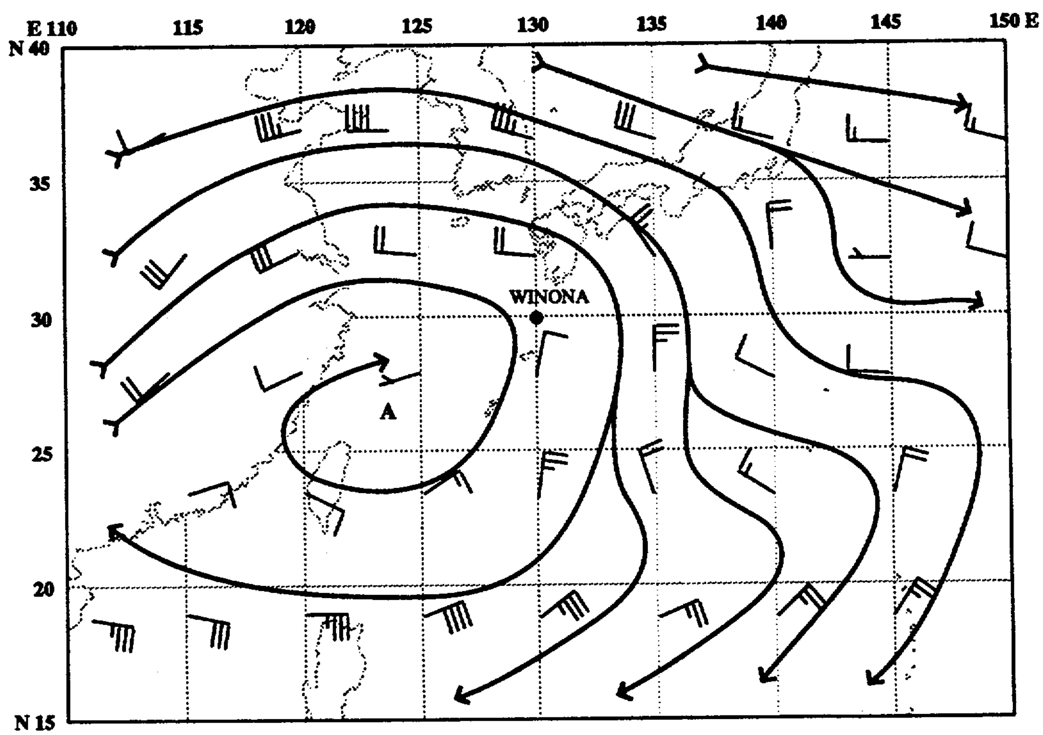

Figure 3-12-2. The 200-mb analysis for 060000Z August shows Winona is under the influence of unidirectional flow from the north.

As the shear decreased, the LLCC moved under the deep convection, and the system began to intensify. On 070000Z, a ship (call sign JFYD) approximately 215 nm (400 km) south of the center reported 35 kt (18 m/sec) southwesterly winds. At 070448Z (Figure 3-12-3), satellite analysts provided the first CI 2.5 Dvorak analysis, and the system was upgraded to a tropical storm. Winona continued to move southwestward toward a col and away from the shear, as it intensified. As Winona tracked northward, after an abrupt turn, it intensified further and developed dual upper-level outflow channels: one to the northeast and southwest. By 091200Z, Winona reached its maximum intensity of 65 kt (33 m/sec) and maintained it until making landfall 12 hours later. Winona weakened but managed to retain some strength and organization throughout its track over land. Yokota Air Base (WMO 47642) received peak winds of 40 kt (21 m/sec) with gusts to 57 kt (29 m/sec) at 100322Z and nearby Camp Zama had gusts up to 63 kt (32 m/sec) recorded at 100250Z. Winona got caught up in the westerlies as it reentered the water east of the Kanto Plain and became extratropical.

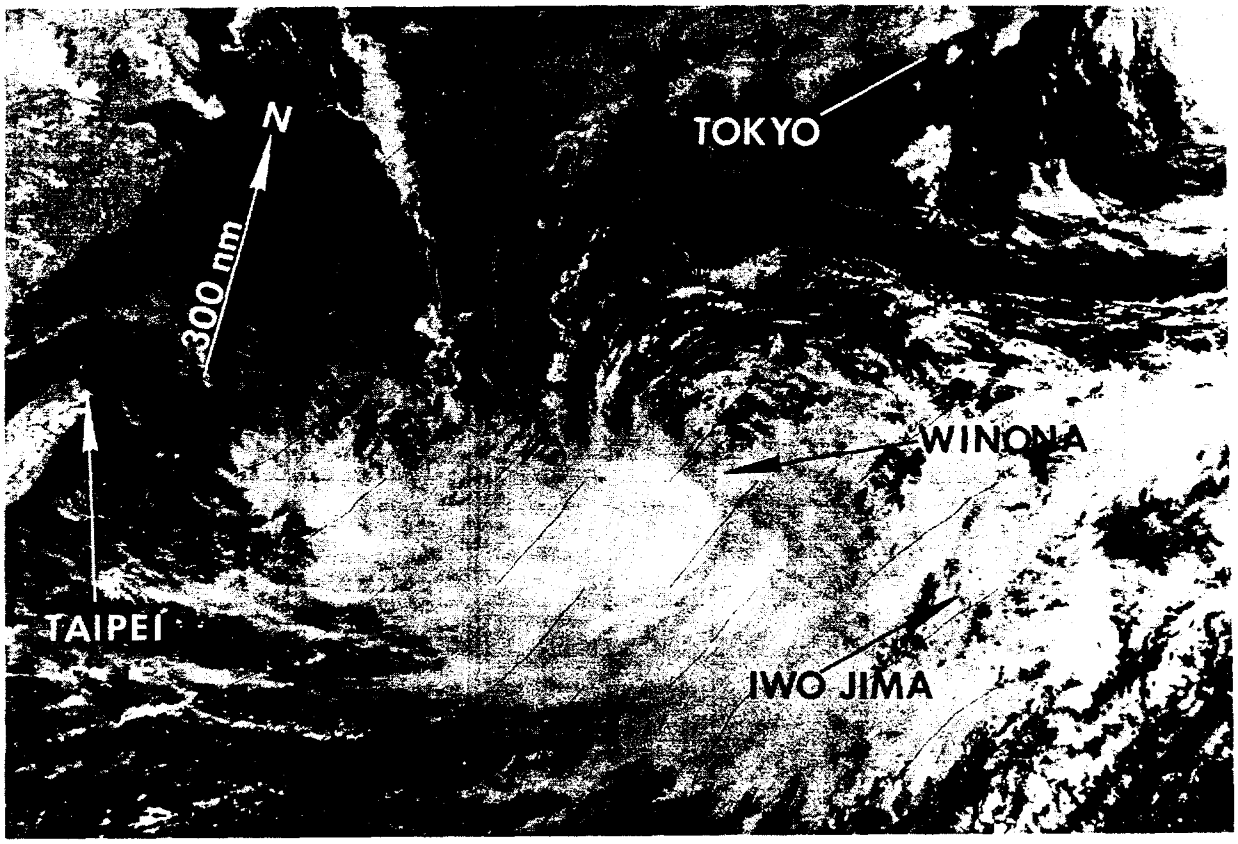

Figure 3-12-3. Winona's low-level circulation center is moving underneath the deep convection. This was the first good indication that Winona would intensify. Vernon (11W) is northeast of Winona (070448Z August NOAA visual imagery).

V. FORECASTING PERFORMANCE

The overall JTWC forecast performance is shown in Figure 3-12-4. The initial forecasts on Winona predicted a weak, disorganized system that would be short lived. Reorganization of the system as the center moved under the deep convection caused the track to be relocated on the third warning. By then, JTWC had a much better handle on the system and correctly forecast the sharp 120 degree turn to the north. This was 12 hours ahead of other agencies. Forecasters were slow in developing the system until it made the turn. After the LLCC moved under the deep convection, JTWC correctly predicted the effect that dual outflow channels would have in rapidly deepening the system. The objective aids FBAM and CSUM had problems with Winona's track. FBAM continued to move Winona south around the ridge until the system made the turn, then it caught on and went due north. CSUM started the turn too early and made it too tight, coming in west of the actual track. NOGAPS correctly built the ridge northward, which caused the push to the north. In addition to the accurate northward forecast, JTWC accurately forecast landfall. Forecasters then expected Winona to track northeastward north of the subtropical high and get caught up in the westerlies. A big decision centered around which way the storm would track around Mt. Fuji-san. JTWC did not predict the ridge flattening overnight and opted for an initial track through central Honshu west of Mt. Fuji-san, then skirting northern Honshu just off the coast in the Sea of Japan. As a short wave trough passed to the north, the ridge damped, and Winona turned sooner than forecast. Both JTWC and the Japan Meteorological Agency brought their tracks further south once it was obvious that Winona would track south of Mt. Fuji-san. Both agencies also kept their forecast tracks over the northeastern edge of Japan, skirting along or just south of the Kurils. Winona tracked just south of these forecasts. Both agencies, however, correctly forecast the acceleration of the system as it became embedded in the westerlies and subsequently became extratropical.

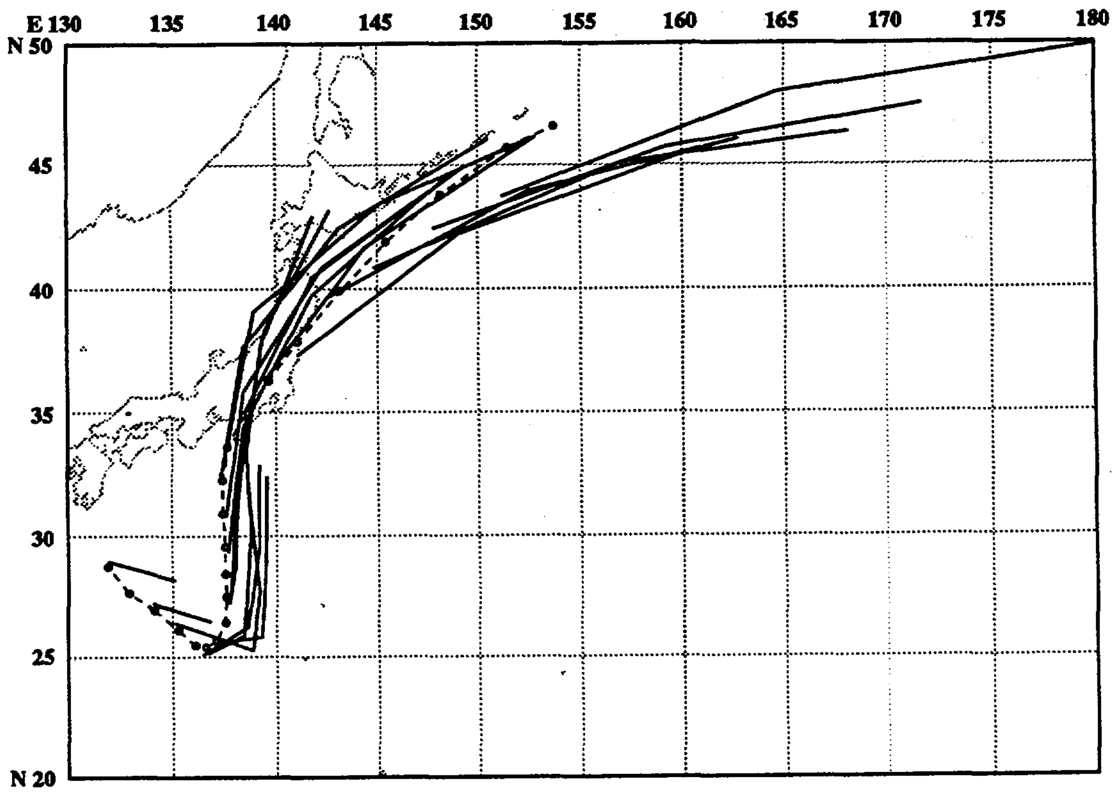

Figure 3-12-4. Summary of JTWC forecasts (solid lines) for Winona is superimposed on the final best track (dashed lines).

VI. IMPACT

Damages to U.S. military installations in Japan were minimal. Trees on bases were uprooted, tiles were blown off roofs, and there were isolated power outages.

The rest of Japan did not fare as well. According to reports from various Japanese newspapers, there were 13 typhoon related injuries but no deaths. In southeast Japan over 7000 homes in the Shizuoka Prefecture cities of Yaizu, Hamamatsu and Shimoda lost electricity as trees fell on the power lines. There were 686 homes flooded and 43 landslides. Transportation was disrupted, and over 500,000 travelers were affected by either the cancellation of 62 domestic flights from Tokyo's Haneda Airport or the many trains that were halted or delayed. All Tokaido Shinkansen bullet trains between Tokyo and Osaka were stopped. The teams scheduled to play in the Tokyo Dome could not find transportation, resulting in the first "rained out" game since the stadium was built in 1987.

The much needed rainfall poured more than 20 million tons of water into Japanese reservoirs, pushing them up to 36 percent of their total capacity. This allowed the lifting of water restrictions which had gone into effect earlier in the year.