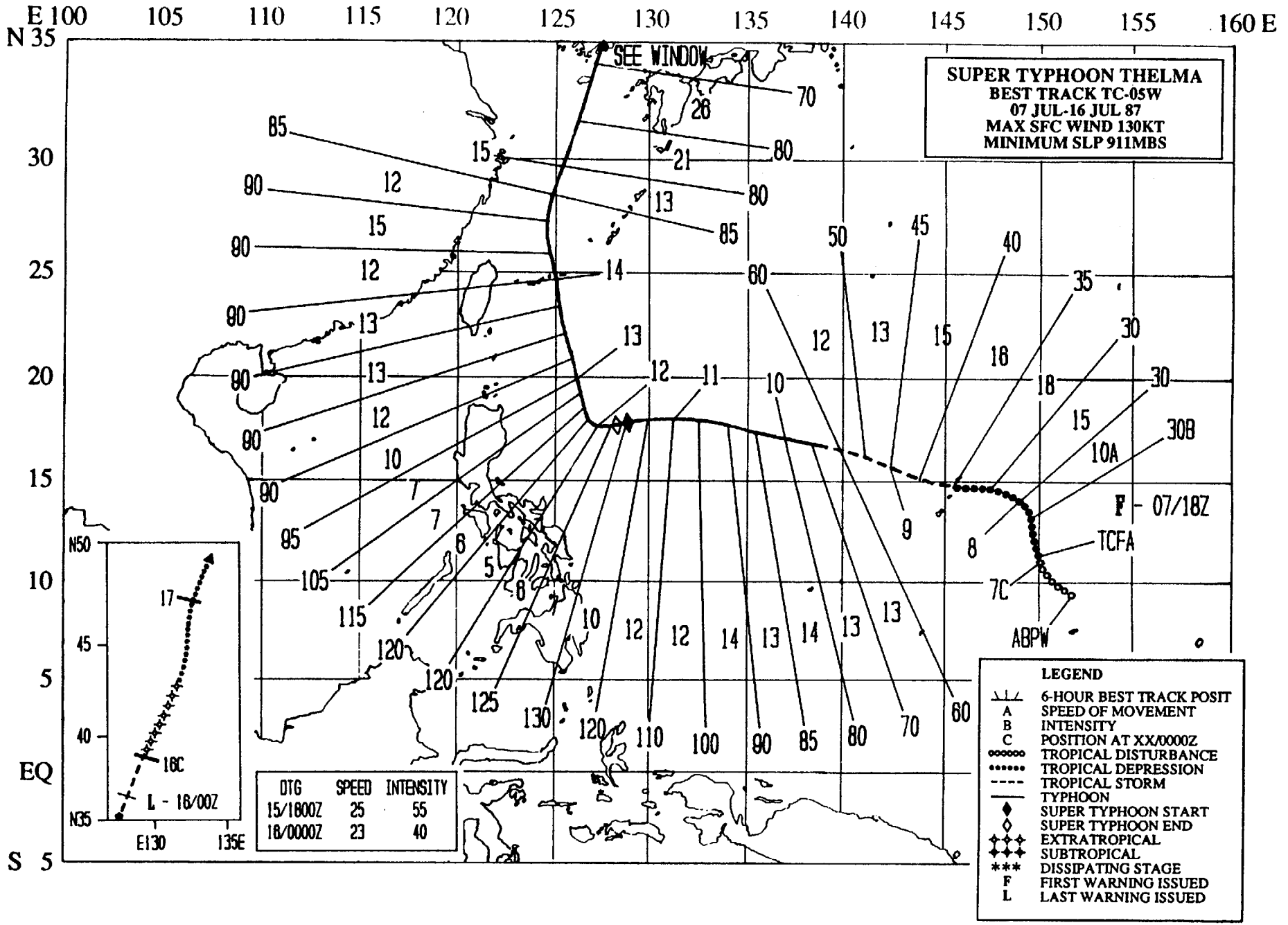
SUPER TYPHOON THELMA
BEST TRACK TC-05W
07 JUL-16 JUL 87
MAX SFC WIND 130KT
MINIMUM SLP 911MBS
SEE WINDOW
F - 07/18Z
TCFA
ABPW
LEGEND
6-HOUR BEST TRACK POSIT
SPEED OF MOVEMENT
INTENSITY
POSITION AT XX/0000Z
TROPICAL DISTURBANCE
TROPICAL DEPRESSION
TROPICAL STORM
TYPHOON
SUPER TYPHOON START
SUPER TYPHOON END
EXTRATROPICAL
SUBTROPICAL
DISSIPATING STAGE
FIRST WARNING ISSUED
LAST WARNING ISSUED
DTG SPEED INTENSITY
15/1800Z 25 55
16/0000Z 23 40
L - 16/00Z

# SUPER TYPHOON THELMA (05W)

Thelma was the first of four significant tropical cyclones to develop in July and the first super typhoon of 1987. Forecasting the timing and location of recurvature presented a problem for JTWC. After recurvature, Thelma slammed into Korea causing extensive damage and the loss of many lives.

As a tropical disturbance, Thelma's initial intensification was slow, but once the system became organized it developed at very near the normal Dvorak rate (Dvorak, 1984) of one "T-number" per day from 25 to 130 kt (13 to 67 m/sec). Thelma originated in the monsoon trough as a broad area of convection with slight curvature. Dvorak analysis estimated an intensity of 25 kt (13 m/sec), while synoptic data indicated a cyclonic surface circulation was present along with upper-level divergence. As a result, the area was mentioned on the Significant Tropical Weather Advisory (ABPW PGTW) at 060600Z. Over the next eight hours, the amount of convection and its organization increased. In addition, an aircraft reconnaissance investigative mission early on the 7th was able to close off the low-level circulation center and found a minimum sea-level pressure (MSLP) of 1003 mb. They also reported maximum sustained surface winds of 20 kt (10 m/sec). At 070300Z, JTWC issued a Tropical Cyclone Formation Alert.

The first warning on Tropical Depression 05W was issued at 071800Z when the system demonstrated a steady increase in convection and organization, and satellite intensity analysis estimated 30 kt (15 m/sec) sustained surface winds. The forecast philosophy called for movement toward the north for 24-hours through a weakness in the 700 mb ridge. The ridge was then expected to strengthen and drive the system toward the west. This did occur, but at speeds nearly triple those forecast.

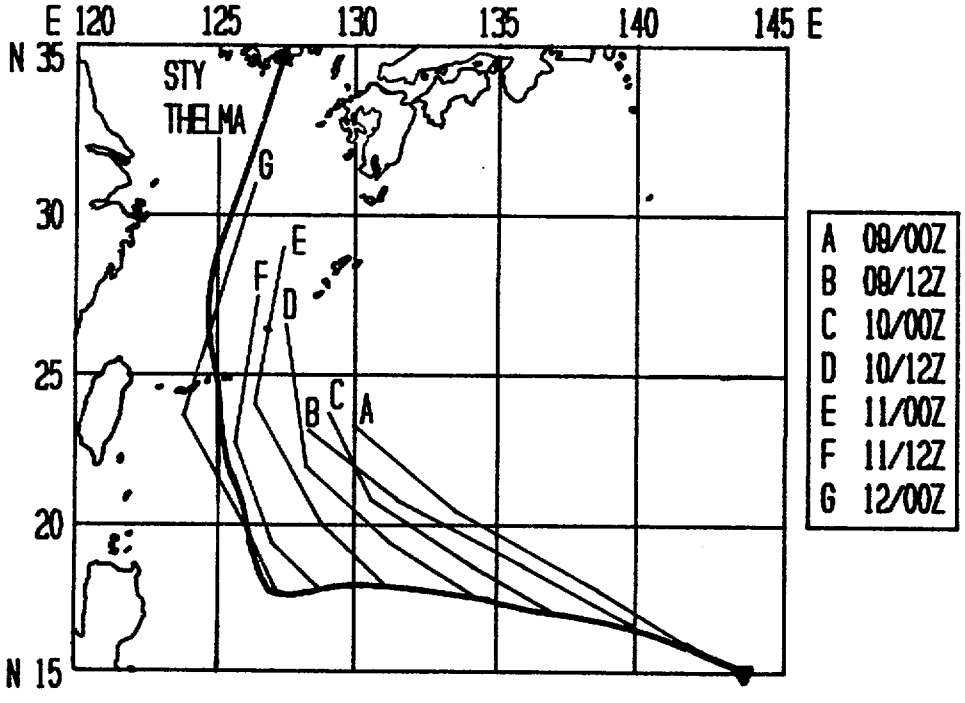


*Figure 3-05-1. Plot of OTCM guidance. The OTCM, JTWC's primary dynamic aid, repeatedly indicated recurvature.*

Initially, Thelma did not develop as quickly as expected. Once the first warning had been issued on Tropical Depression 05W, the system became broader and less organized. Aircraft reconnaissance scheduled for 080000Z was unable to close off a surface center. Thirteen hours later, the poorly organized system passed about 60 nm (111 km) to the north of Guam. Finally at 090000Z (on warning number six), the system was upgraded to tropical storm intensity. The upgrade was based on aircraft reconnaissance data at 090029Z which reported a MSLP of 996 mb and maximum sustained surface winds of 50 kt (26 m/sec). (Post-analysis indicated that the intensification had most probably occurred 12-hours earlier.)

JTWC's primary aid, the One-Way Interactive Tropical Cyclone Model (OTCM), preferred a northwesterly track or hinted at recurvature in the 48- to 72-hour time frame beginning with the guidance for warning number 3 (080600Z July) (see Figure 3-05-1). Recurvature forecasts started with warning number 3, valid at 080600Z. Although Thelma continued tracking in a westward direction, JTWC mistakenly continued to forecast recurvature for the next 30-hours (spanning six warnings).

At 091200Z, Thelma began developing a banding eye. Warning number 10, valid at 100000Z, upgraded the system to a typhoon. This action was based on the aircraft reconnaissance data at 092138Z and 100011Z that indicated an extrapolated MSLP of 974 mb and estimated maximum sustained surface winds of 80 kt (41 m/sec). Typhoon Thelma reached its maximum intensity at 111200Z, after a 36-hour pressure fall of 66 mb (and a 12-hour pressure fall of 25 mb) down to 911 mb. During this time, Dvorak intensity estimates kept pace from approximately 77 kt (40 m/sec) to approximately 127 kt (65 m/sec). At 111200Z, Thelma became the season's first super typhoon. Afterward, infrared satellite imagery indicated a warming of the cloud tops which indicated that Thelma had peaked in intensity. Satellite

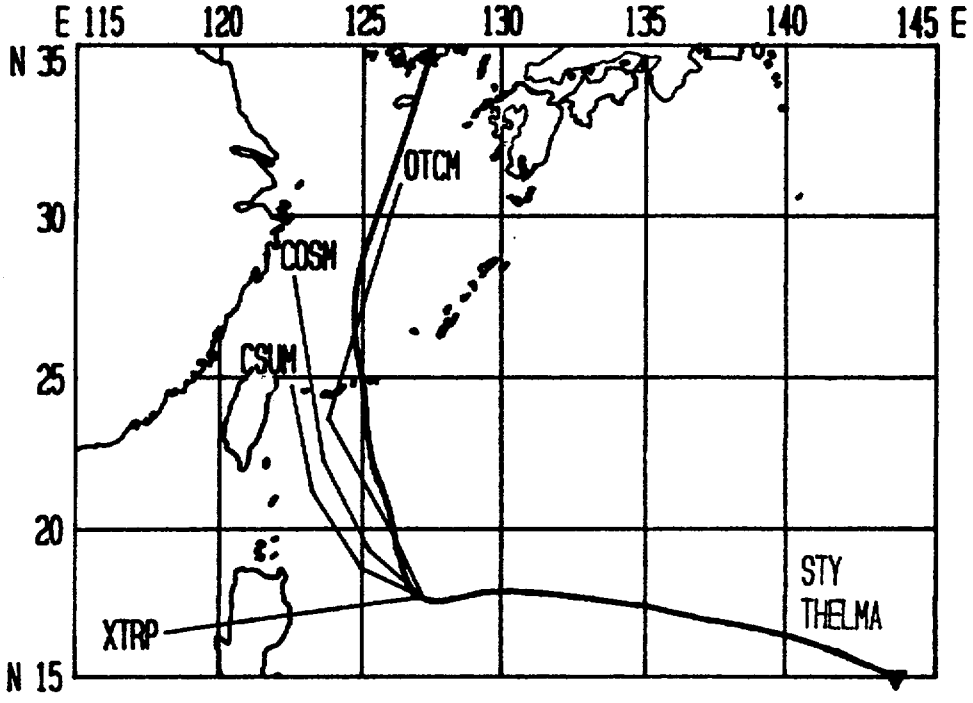


*Figure 3-05-2. Plot of statistical aids (CSUM and COSMOS), dynamic numerical aid (OTCM), and persistence (XTRP) along with the final best track at 120000Z, at the point of the abrupt track change toward the north.*

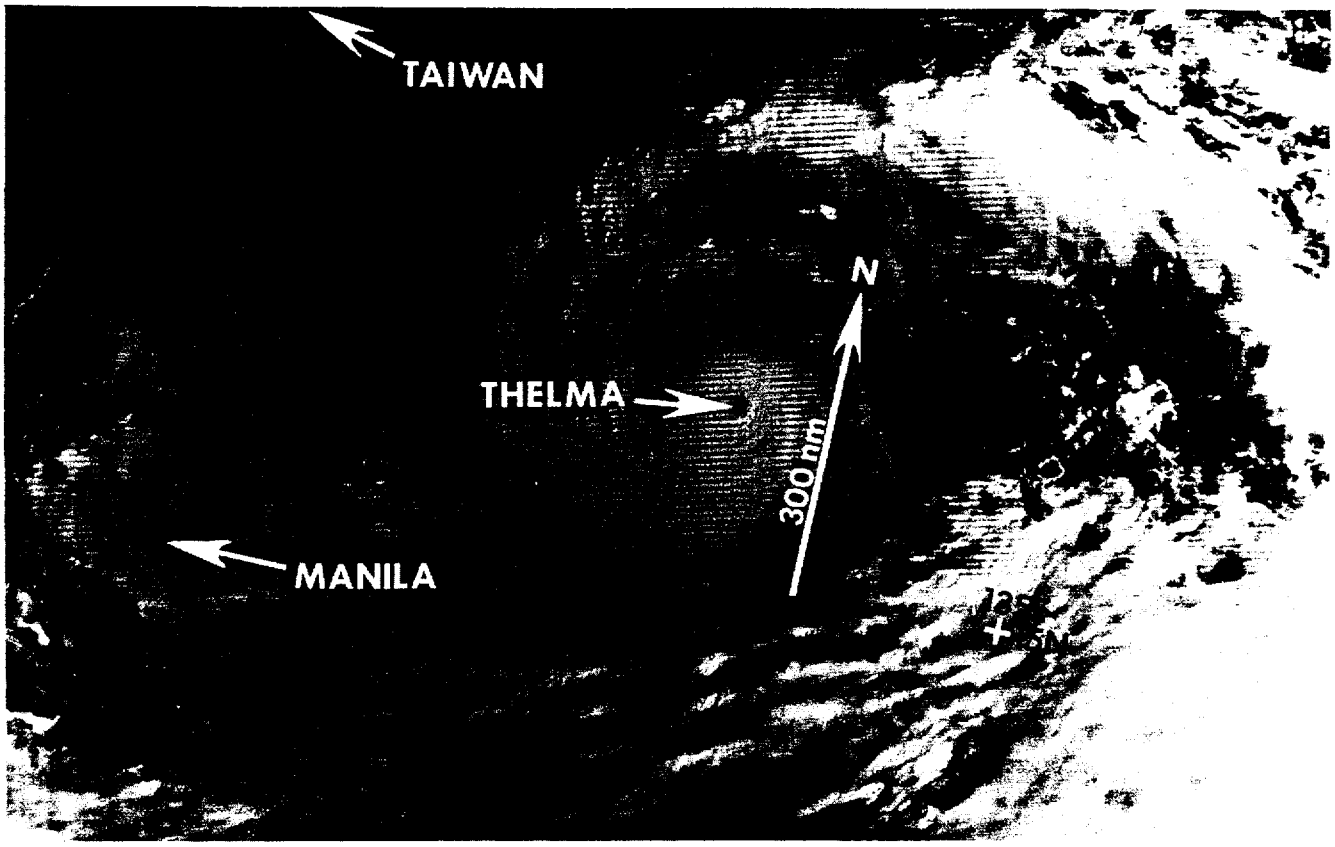


*Figure 3-05-3. Visual satellite imagery showing Typhoon Thelma after reaching maximum intensity. Note how the upper-level outflow has become restricted to the north (110632Z July NOAA visual imagery).*

imagery also indicated the system's upper-level outflow had become restricted to the north (see Figure 3-05-3). Aircraft reconnaissance at 112353Z found that the eye was open to the north and was becoming elliptical.

Typhoon Thelma began a sharp turn toward the north at 120000Z. Earlier, the dynamic forecast aid OTCM had repeatedly forecast movement toward the north or northwest (see Figure 3-05-2), but the typhoon continued to track westward. By 121200Z, Thelma was heading just west of north and the OTCM guidance was on track.

Even though Thelma's abrupt course change occurred 300 nm (556 km) east of northern Luzon, heavy rains and high seas resulted in at least twelve fatalities in the Philippine Islands. The northerly track took the typhoon west of the island of Okinawa, Japan, and resulted in the evacuation of military aircraft. Commercial airlines also interrupted service, which stranded thousands of air travelers as Thelma passed by.

Finally Typhoon Thelma slammed into South Korea, where widespread flooding caused death and destruction. Floods from Thelma covered thousands of houses, ruptured reservoirs, and destroyed roads, railroad tracks and embankments. News coverage from Korea reported that Thelma killed at least 123 people with 212 additional people listed as missing. The missing were largely seamen and fisherman, who were caught offshore. Officials estimated losses at more than $124 million from damaged or destroyed houses, crops, and water craft.