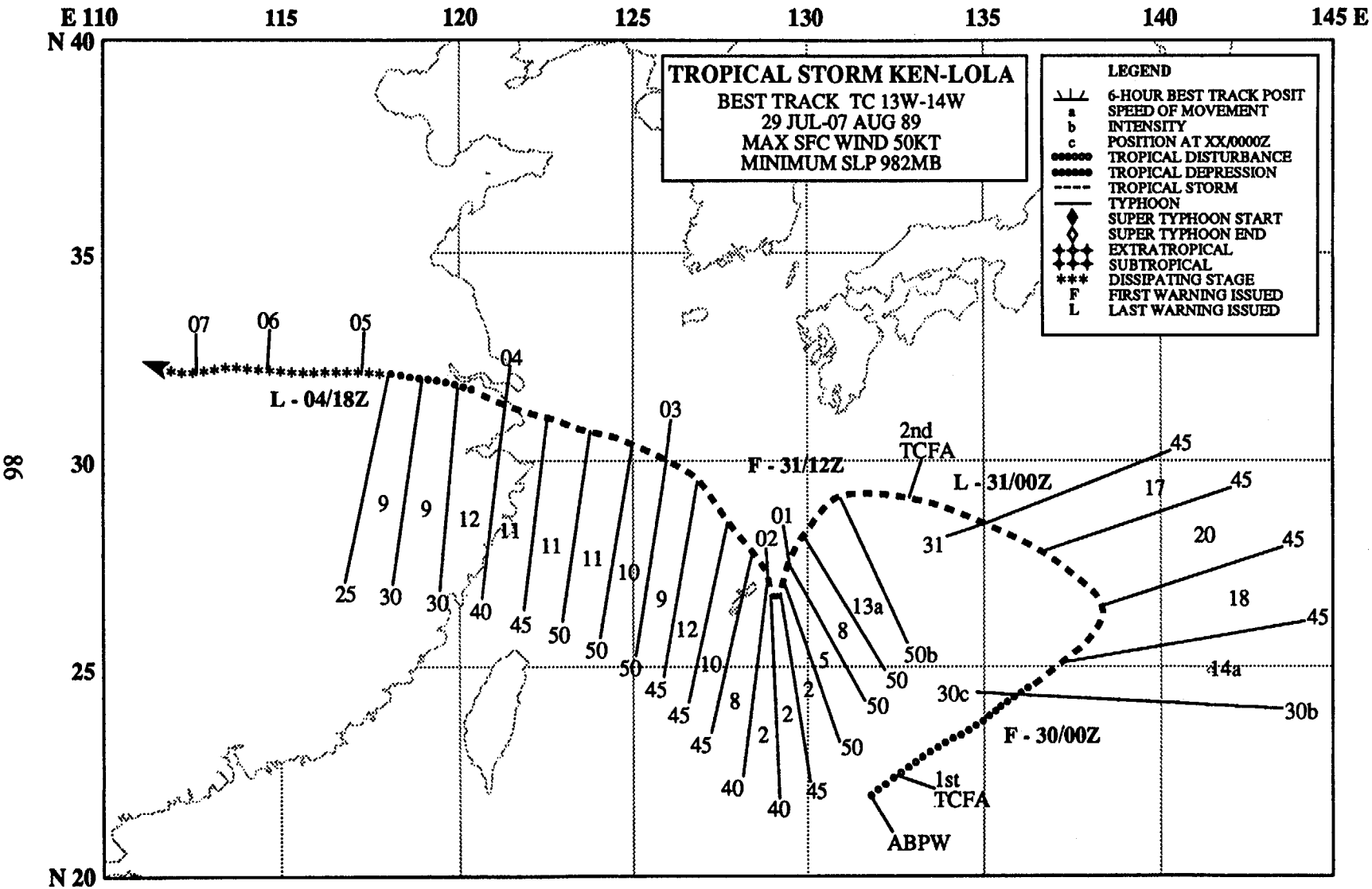
E 110
115
120
125
130
135
140
145 E
N 40
35
30
25
N 20
98
TROPICAL STORM KEN-LOLA
BEST TRACK TC 13W-14W
29 JUL-07 AUG 89
MAX SFC WIND 50KT
MINIMUM SLP 982MB
LEGEND
6-HOUR BEST TRACK POSIT
a SPEED OF MOVEMENT
b INTENSITY
c POSITION AT XX/0000Z
TROPICAL DISTURBANCE
TROPICAL DEPRESSION
TROPICAL STORM
TYPHOON
SUPER TYPHOON START
SUPER TYPHOON END
EXTRATROPICAL
SUBTROPICAL
*** DISSIPATING STAGE
F FIRST WARNING ISSUED
L LAST WARNING ISSUED
07
06
05
04
03
02
01
L - 04/18Z
F - 31/12Z
2nd TCFA
L - 31/00Z
F - 30/00Z
1st TCFA
ABPW
25
30
30
40
45
50
50
50
45
45
45
40
40
31
45
17
45
20
45
18
45
14a
30b
30c
50
50
50
50b
13a
9
9
12
11
11
11
10
9
12
10
8
5
2
2
2
8

TROPICAL STORM KEN-LOLA (13W-14W)

Tropical Storm Ken-Lola underscored the limitations of remote sensing for locating poorly organized systems. Synoptic data proved invaluable in identifying and classifying the system while in warning status and in the post-analysis. While in warning status, JTWC considered the system as two separate tropical cyclones. A detailed post-analysis, even though not absolutely conclusive, strongly suggested that Tropical Storms Ken and Lola were probably the same system. The system generated in the monsoon trough that had already proven itself the most active since July 1973. The system then took an elongated cycloidal track, passing close to Okinawa before making landfall on the coast of eastern China.

In the last week of July, as Tropical Depression 12W tracked through the southern Ryukyu's and Typhoon Judy (11W) dissipated in the Sea of Japan, an active monsoon trough with several small embedded circulation centers extended across Taiwan, eastward to 140° east longitude. A pool of warmer than normal sea surface temperatures engulfed the southern Ryukyu's and extended southeastward to 130° east longitude. On 29 July, synoptic data indicated that a circulation center in the low-level wind field formed over the warm pool about 300 nm (555 km) southeast of Okinawa. While the circulation had a central pressure of 995 mb and winds near the center of only 15 kt (8 m/sec), a broad area of southwesterly monsoonal gales extended 100 to 300 nm (185 to 555 km) south of the center. The first mention of the disturbance appeared on that day's Significant Tropical Weather Advisory as a suspect area having fair potential for development.

Further evaluation of the 290600Z synoptic data and subsequent satellite imagery led to issuance of a Tropical Cyclone Formation Alert at 290930Z even though the low-level cyclonic circulation center was displaced to the north of the associated convection. Improving organization during the subsequent 18 hours prompted the first warning on Tropical Depression 13W at 300400Z. The depression was forecast to move northward, along the periphery of the monsoon gale area, and loop cyclonically around a mid- to upper-level low located between the depression and Okinawa. This low aloft would restrict the depression's outflow and result in slow development and peaking below typhoon intensity. JTWC correctly forecast the overall character of the track and the limited intensity.

At 300900Z, the second warning valid at 300600Z, was amended to upgrade the depression to Tropical Storm Ken, when synoptic data showed the maximum sustained winds were 45 kt (23 m/sec). For the next 18 hours fixes from (mostly nighttime) satellite imagery indicated continued northeast movement until the final warning was issued at 310000Z. JTWC expected Ken to shear apart and follow the monsoon surge around the northern periphery of an exposed low-level circulation that later would be called Lola. Post-analysis suggests that the 310000Z

position was most likely 250 nm (465 km) northwest of the warning position (Figure 3-13-1) and that the low-level system had moved northwestward since 301200Z.

At 310600Z, JTWC issued a Tropical Cyclone Formation Alert for a disturbance located about 300 nm (555 km) northeast of Okinawa. The satellite imagery (Figure 3-13-2) indicated an exposed low-level center with increasing convection to the south. This system now had gales extending several hundred miles north of the center. At 311030Z, an abbreviated warning on Tropical Storm Lola was issued after the **USS Dubuque** (LPD8) reported sustained winds of 50 kt (26 m/sec) at 310300Z followed by 40 kt (21 m/sec) and falling surface pressure three hours later. Also, at 0600Z, another ship (call sign 9MTS) reported westerly winds approximately 90 nm (165 km) south of the **USS Dubuque**. These data demonstrated that the winds reported by the Dubuque were associated with a circulation center and not the tight pressure gradient near Japan (Figure 3-13-3), as initially thought.

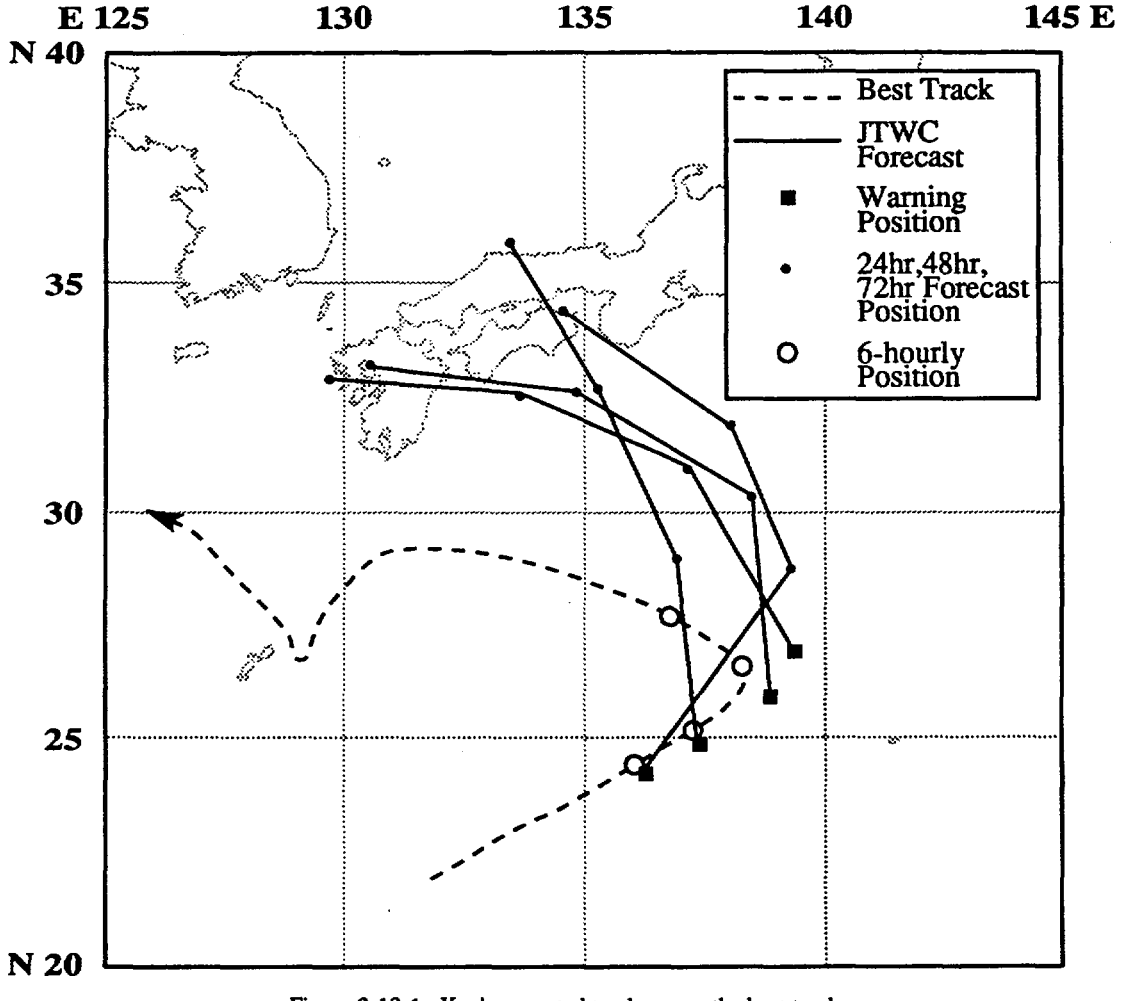

Figure 3-13-1. Ken's expected track verses the best track.

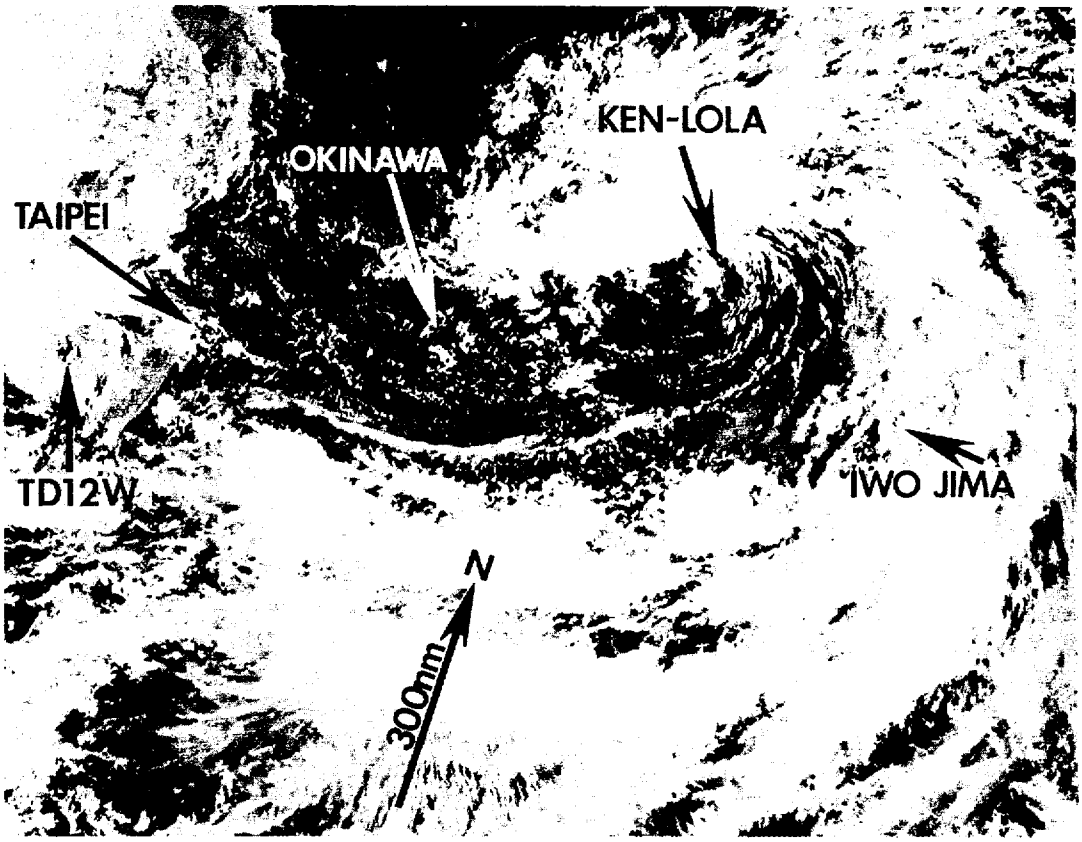

Figure 3-13-2. Imagery supporting the final warning on Tropical Storm Ken and formation of Lola. Note remnants of TD12W in the Taiwan Strait (310025Z July DMSP visual imagery).

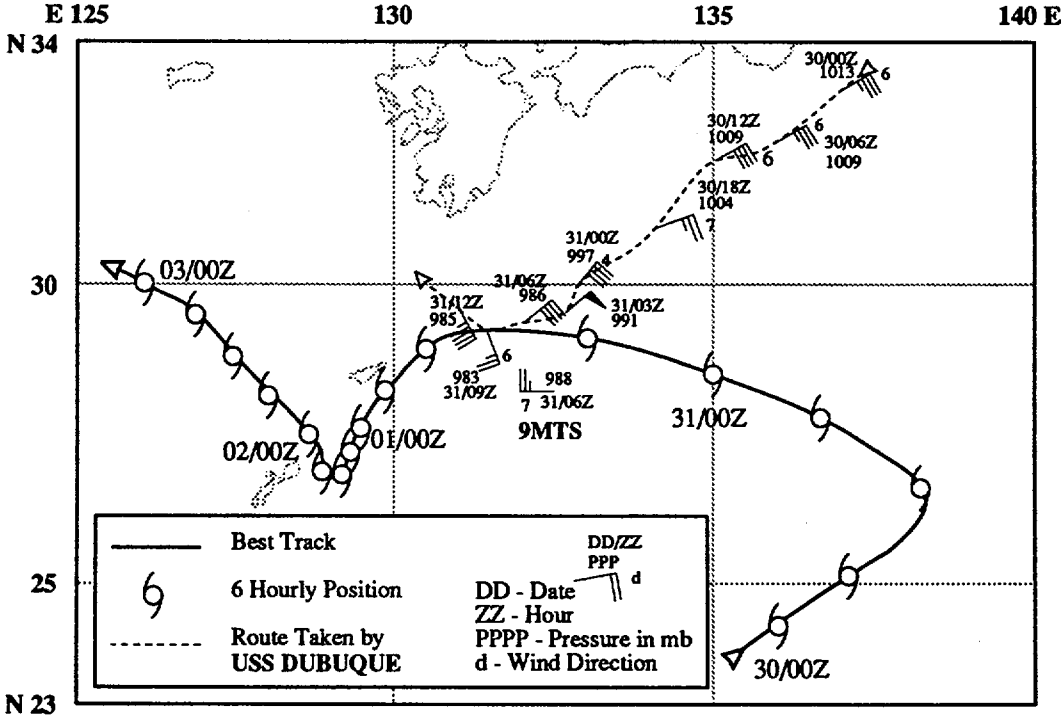

Figure 3-13-3. Wind and pressure reports from the USS Dubuque (LPD8) from 300000Z through 311200Z July with a report from ship 9MTS at 310600Z help define the circulation center. Tropical storm symbols represent six-hourly best track positions for Tropical Storm Ken-Lola.

The first 72-hour forecast for Lola followed at 311200Z. The problems that aggravated this initial warning were the inconsistencies between fix platforms. Radar fixes were displaced to the west of the satellite fixes and suggested the system was moving rapidly southwestward. In contrast, the satellite fixes, based on cold cloud tops on infrared imagery, implied slow westward movement. Based on the prevailing northeasterly steering flow, the system was forecast to track west-southwestward and pass about 100 nm (185 km) northwest of Okinawa.

In a short time an understanding of the track became clearer. The radars were tracking a band of convection that was spiraling around the mid-level low. Also, the pressure at Kadena AB (WMO 47931) on Okinawa was not falling rapidly indicating Lola probably was not tracking rapidly to the southwest as had been suggested by the radar fixes. As a consequence, JTWC slowed the forecast speed of movement and angled the track towards Taiwan.

The mid-level cyclone appears to have been the major influence on Ken-Lola's track (Figure 3-13-4). In fact Ken-Lola's path described a elongated cycloid with the storm representing a point on the rotating "rim" of the westward moving 500 mb "wheel". The track made a cusp near Okinawa as the 500 mb center passed to the west of the system. The mid-level low pulled Ken-Lola northward and then westward into the East China Sea.

Kadena AB (WMO 47931) recorded peak winds of 30 kt (15 m/sec) as the system

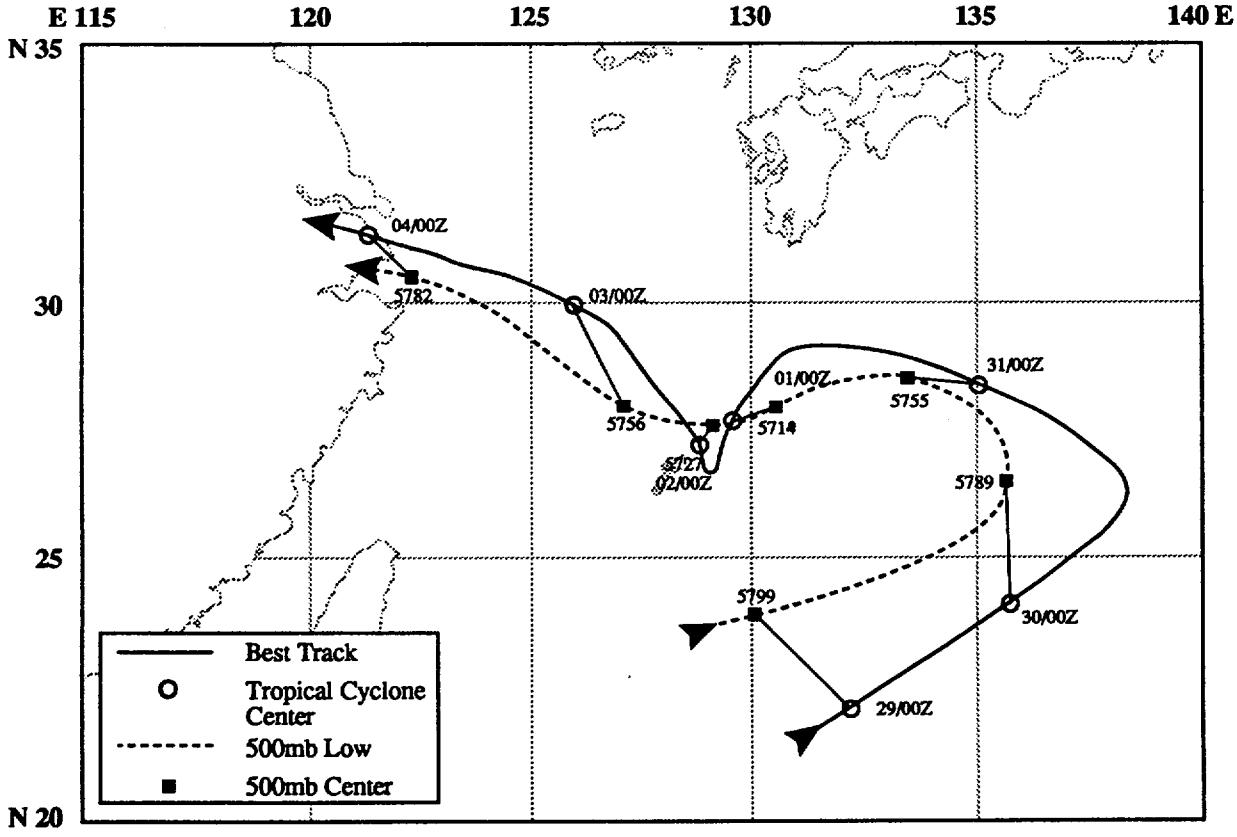

Figure 3-13-4. Spatial relationship between the tropical cyclone and accompanying 500 mb circulation center. Minimum 500 mb heights are in meters. Positions are for 0000Z from 29 July through 4 August.

passed within 80 nm (150 km) between 011800Z and 020000Z (Figure 3-13-5). The **USS Dubuque (LPD 8)**, which remained near Okinawa, reported 35-kt (18- m/sec) winds at 020600Z that decreased to 24 kt (12 m/sec) by 021200Z.

On 3 August, a building ridge over Manchuria caused Ken-Lola to take a more westward track toward Shanghai. Due to concern that a trough, approaching eastern China could reverse the tropical cyclone's track and take it northeastward into the Yellow Sea and Korea, the warnings continued until 041800Z when it was more than 250 nm (465 km) inland. The low relief and wetlands of the Yangtze River Valley allowed the weak circulation to maintain itself inland for several days. No reports of damage were received.

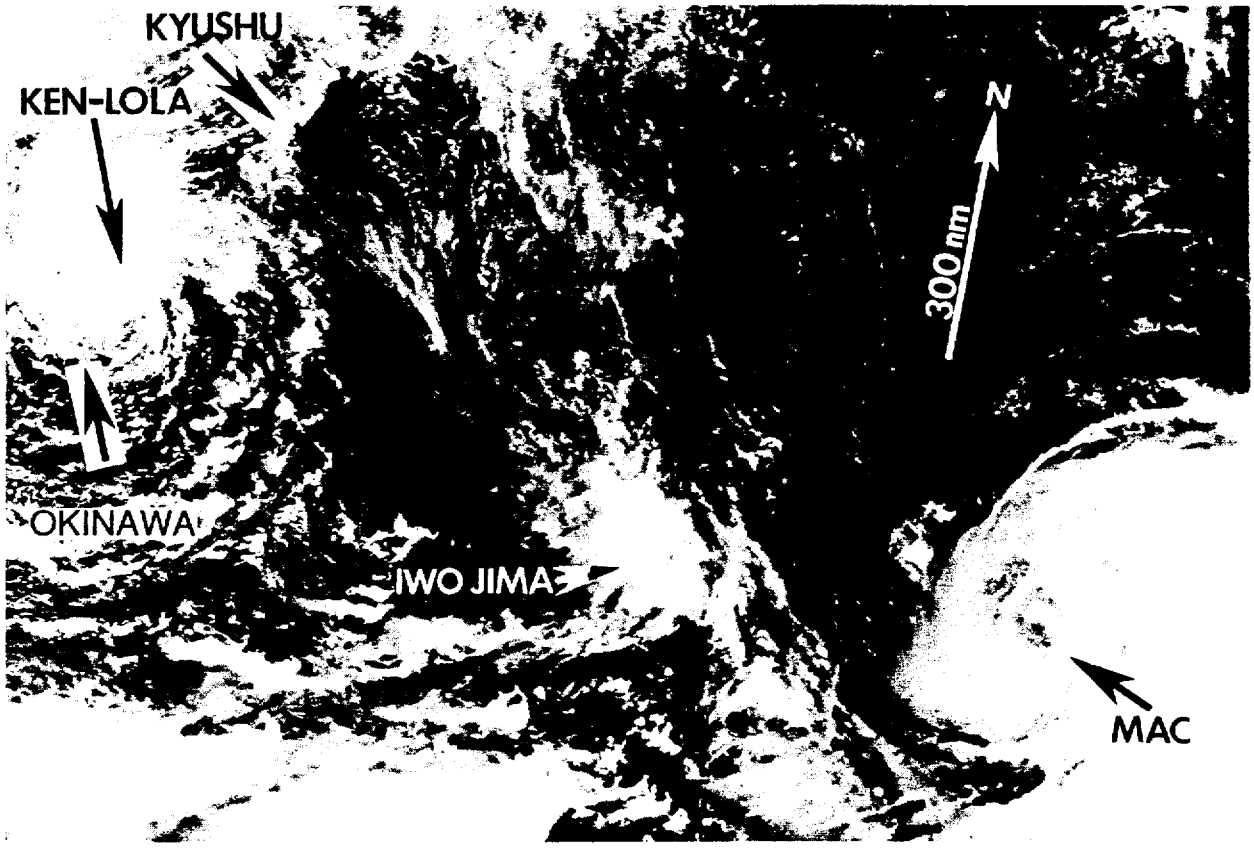

Figure 3-13-5. Ken-Lola nears Okinawa. Typhoon Mac (15W) is at the lower right (012344Z August DMSP visual imagery).