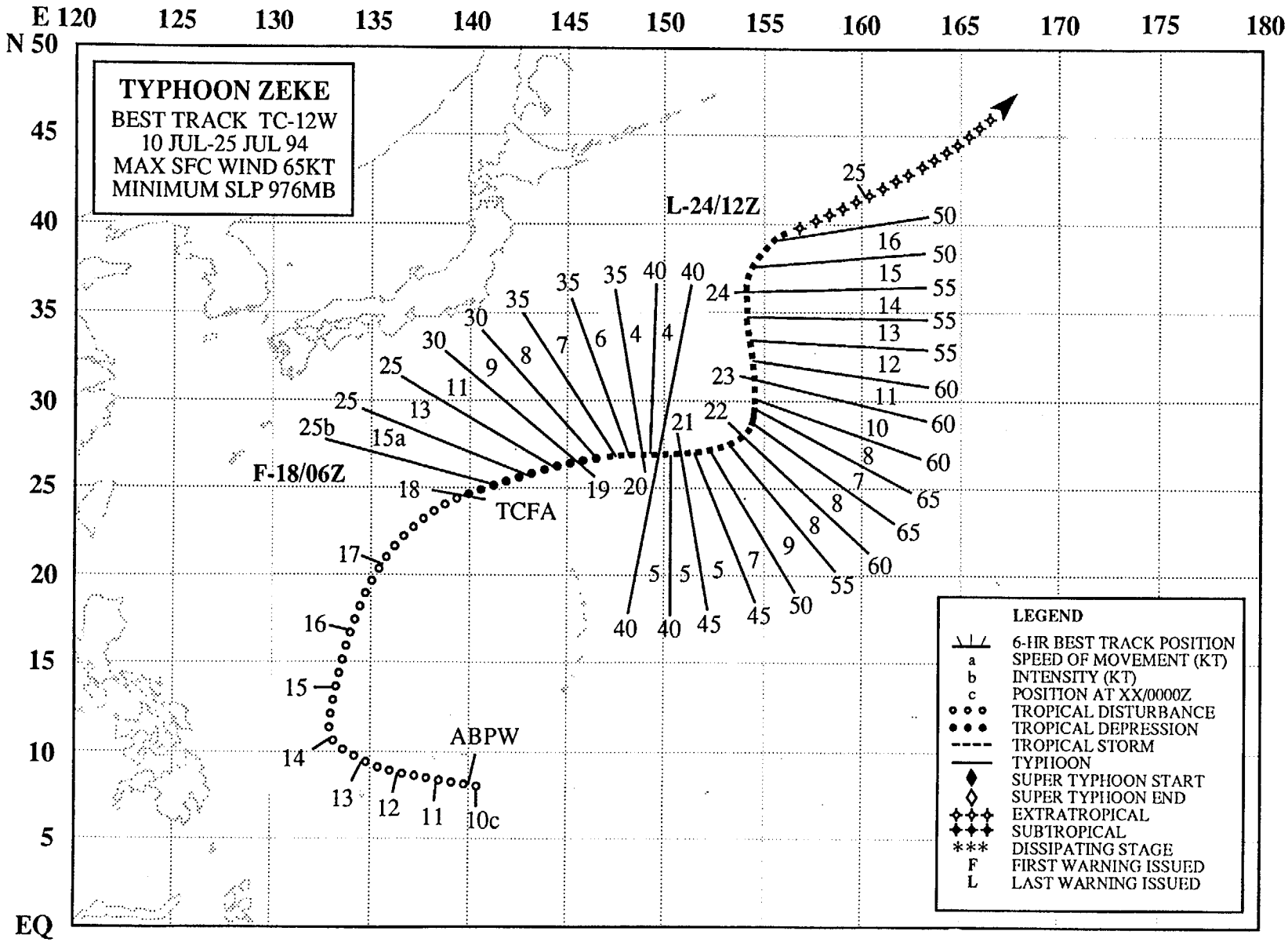
TYPHOON ZEKE
BEST TRACK TC-12W
10 JUL-25 JUL 94
MAX SFC WIND 65KT
MINIMUM SLP 976MB
E 120
125
130
135
140
145
150
155
160
165
170
175
180
N 50
45
40
35
30
25
20
15
10
5
EQ
L-24/12Z
F-18/06Z
TCFA
ABPW
LEGEND
6-HR BEST TRACK POSITION
a SPEED OF MOVEMENT (KT)
b INTENSITY (KT)
c POSITION AT XX/0000Z
TROPICAL 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 ZEKE (12W)

I. HIGHLIGHTS

Zeke was a small tropical cyclone that formed along the axis of a reverse-oriented monsoon trough. It was the easternmost of three tropical cyclones along this trough (see Figure 3-10-1 in Walt's (10W) summary). Zeke exhibited unusual "S" track motion which is almost exclusively associated with tropical cyclones embedded in a reverse-oriented monsoon trough (Lander 1995a). Zeke's brief attainment of typhoon intensity was verified by ship observation. Satellite imagery at the time of typhoon intensity winds was atypical: ragged, but tightly coiled spirals of relatively warm-topped convection, and alone did not support typhoon intensity.

II. TRACK AND INTENSITY

During early July, the axis of the monsoon trough extended across much of Micronesia at rather low latitudes (5° - 7°N). Most of the deep convection associated with this monsoon trough resided south of 10°N. On 14 July, two persistent cloud clusters had consolidated in the Philippine Sea to the east of Luzon. The westernmost cloud cluster became Walt (10W), while the easternmost later became Zeke. The first mention of the incipient tropical disturbance that would become Zeke appeared on the 140600Z July Significant Tropical Weather Advisory. This tropical disturbance was followed for several days as it moved first northward, then northeastward. During this time, Walt (10W) formed to the east of Luzon, southwest of the pre-Zeke tropical disturbance. Concurrent with Walt's (10W) low-latitude turn toward the northeast and the gradual turn to the northeast of the pre-Zeke disturbance, a long band of deep convective cloud clusters, that included the cloud systems of Walt (10W), Yunya (11W) and the pre-Zeke disturbance, had acquired a SW-NE (i.e., reverse) orientation. This reverse-oriented monsoon trough was the first of three reverse-oriented monsoon troughs during 1994, and stretched from 15°N in the South China Sea to 30°N near the international date line.

As the pre-Zeke tropical disturbance moved northeastward, it slowly intensified. At 180000Z, a Tropical Cyclone Formation Alert was issued. This alert stated, in part:

" . . . satellite and synoptic data indicate an active area of convection northeast of Tropical Storm Walt (10W) is showing signs of development. The disturbance is located beneath an area of light upper level winds with a TUTT cell located to the northwest of the system. . . ."

Based upon improved banding of the deep convection and the appearance of well-defined cyclonically curved low-level cloud lines, the first warning on Tropical Depression 12W was issued at 180600Z. Upper-level shear from the west seemed to be preventing intensification, and the system remained at tropical depression intensity until 191200Z. During the early morning of 20 July, tropical depression warning number 7 (191200Z) was amended to tropical cyclone warning number 7A. The amended warning stated, in part:

" . . . visual satellite imagery indicates Tropical Storm Zeke (12W) has a well defined low level circulation beneath an area of active convection . . . For this reason, TD 12W has been upgraded to tropical storm intensity and named 'Zeke'. . . ."

Moving eastward until 220000Z, Zeke then slowed and turned to the north. Shortly after turning northward, about 220600Z, synoptic data indicated that Zeke possessed winds of 65 kt (33m/sec), and at 220600Z, Zeke was upgraded to a typhoon. Zeke's life as a typhoon was short-lived, however, and at 221800Z it was downgraded to a 60 kt (31 m/sec) tropical storm. Moving on a track slightly west of north until 240000Z, Zeke gradually weakened. Turning gradually to the northeast after 240000Z, and

accelerating, Zeke began to acquire extratropical characteristics, and the final warning was issued at 241200Z.

III. DISCUSSION

a. Unusual motion

Zeke's track is a good example of the "S" motion, which is defined by Lander (1995a). This north-oriented motion features eastward movement at low latitude, a later bend to the north or northwest, and then eventually north-eastward motion as the system enters the mid-latitude westerlies. Of the 103 north-oriented tracks during the period 1978 to 1993, thirty five (34%) could be categorized as "S" motion. Of the 35 cases of "S" motion during the period 1978 to 1993, twenty eight cases (80%) occurred in association with a reverse-oriented monsoon trough, five cases occurred in association with a monsoon gyre, and two cases were associated with other environmental flow patterns. For a more thorough discussion of the characteristics of a reverse-oriented monsoon trough see Walt's (10W) summary.

b. Unusual satellite signature for a typhoon

During the morning of 22 July, the cloud signature of Zeke rapidly improved as a spiral band of cold-

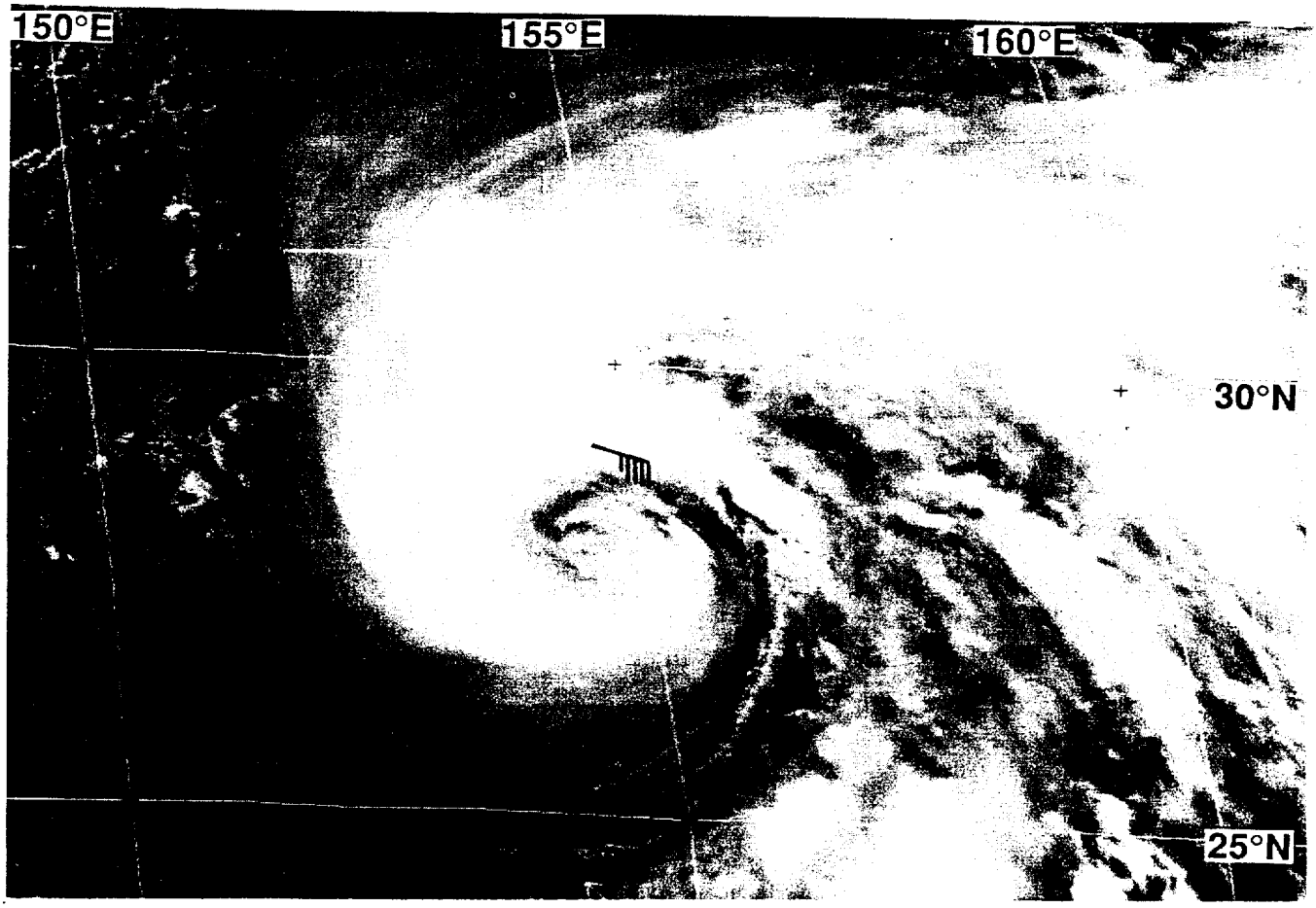

Figure 3-12-1 The deep convection begins to coil tightly around Zeke's low-level center (220031 July visible GMS imagery).

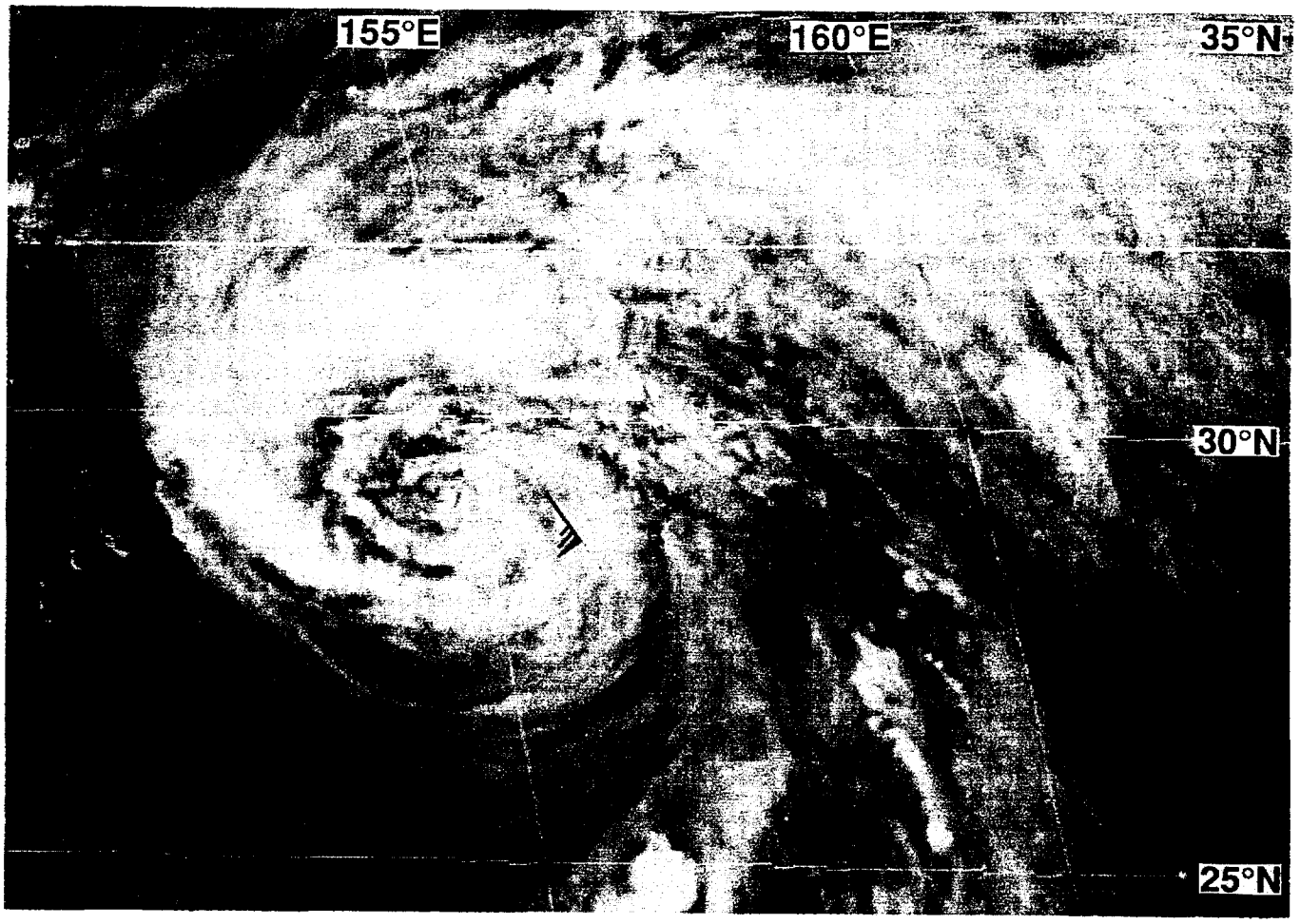

Figure 3-12-2 Bands of towering cumulus and relatively shallow convection are tightly wound and multi-coiled when a ship near Zeke's center reported typhoon intensity wind (220531Z July visible GMS imagery).

topped deep convection began to coil tightly around the exposed low-level center (Figure 3-12-1). At this time, a ship located north of the center of Zeke reported 45 kt (23 m/sec) sustained winds. Towards the evening of July 22, the single, cold-topped spiral of deep convection had evolved into a multi-coiled spiral of ragged warmer-topped convection (Figure 3-12-02). At the time of the imagery in Figure 3-12-2, the aforementioned ship had progressed into the eastern semi-circle of Zeke's circulation and reported typhoon-force winds. A satellite intensity estimate made at 220424Z July (an hour before the satellite imagery shown in Figure 3-12-2) indicated an intensity of T2.5 (minimal tropical storm intenisty), and remarks on this fix stated:

. . . "Zeke is becoming extratropical. Only a little deep convection remains near the center . . ."

If not for the 65 kt (33 m/sec) ship report, it is doubtful that the JTWC would have upgraded Zeke to a typhoon.

c. Forecast performance

Overall, the official forecasts for Typhoon Zeke were quite good. Similar to problems with the objective guidance described in the summary of Walt (10W), the track forecast extracted from the NOGAPS model (the objective aid, "NGPS", received at the JTWC) and the forecast low-level wind fields made

by the NOGAPS model had two periods of difficulty during the lifetime of Zeke. First, early in Zeke's life, the NOGAPS model over-developed its circulation into a very large tropical cyclone. Zeke, however, remained small for its entire life. Rather, it was Walt (10W) which became the largest and most intense of the three named tropical cyclones (Walt (10W), Yunya(11W), and Zeke) which were aligned SW-NE along the axis of a reverse-oriented monsoon trough. The erroneous initial over-development of Zeke caused the model to subsume Walt (10W) into Zeke's artificially large circulation by the 48-hour point of the forecast. The second problem occurred later in Zeke's life when the NOGAPS model over-developed the size of Walt's circulation. This, along with the model's loss of the eastern reaches of the reverse-oriented monsoon trough, contributed to NOGAPS forecasts of Zeke's motion too far to the north and west during the period 200000Z through 230000Z.

IV. IMPACT

Typhoon Zeke remained over open ocean its entire life, and no reports of fatalities or significant damage were received.