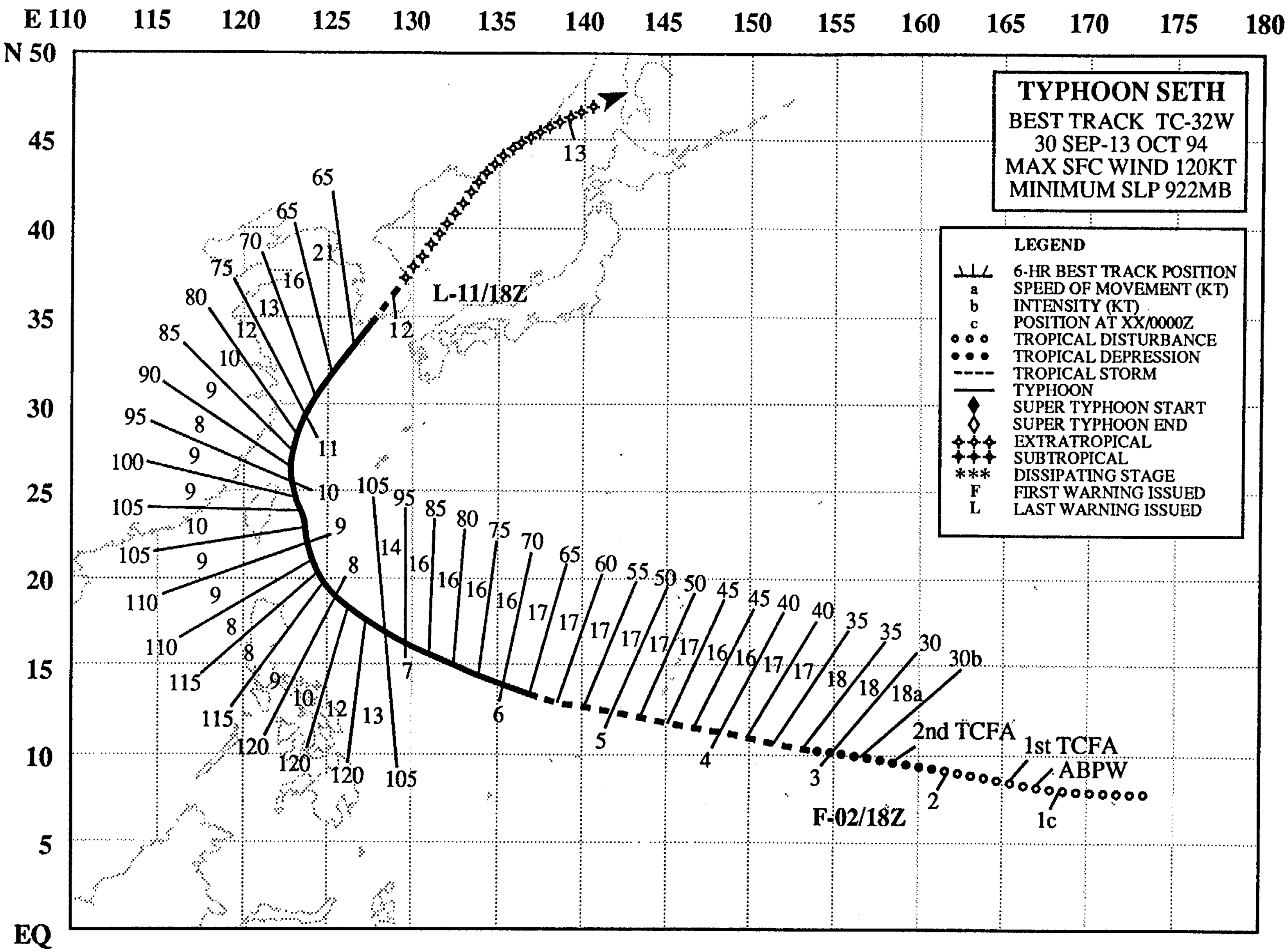

TYPHOON SETH
BEST TRACK TC-32W
30 SEP-13 OCT 94
MAX SFC WIND 120KT
MINIMUM SLP 922MB
LEGEND
6-HR BEST TRACK POSITION
a SPEED OF MOVEMENT (KT)
b INTENSITY (KT)
c POSITION AT XX/0000Z
TROPICAL DISTURBANCE
TROPICAL DEPRESSION
TROPICAL STORM
TYPHOON
SUPER TYPHOON START
SUPER TYPHOON END
EXTRATROPICAL
SUBTROPICAL
DISSIPATING STAGE
F FIRST WARNING ISSUED
L LAST WARNING ISSUED
E 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180
N 50 45 40 35 30 25 20 15 10 5 EQ
L-11/18Z
F-02/18Z
2nd TCFA
1st TCFA
ABPW

TYPHOON SETH (32W)

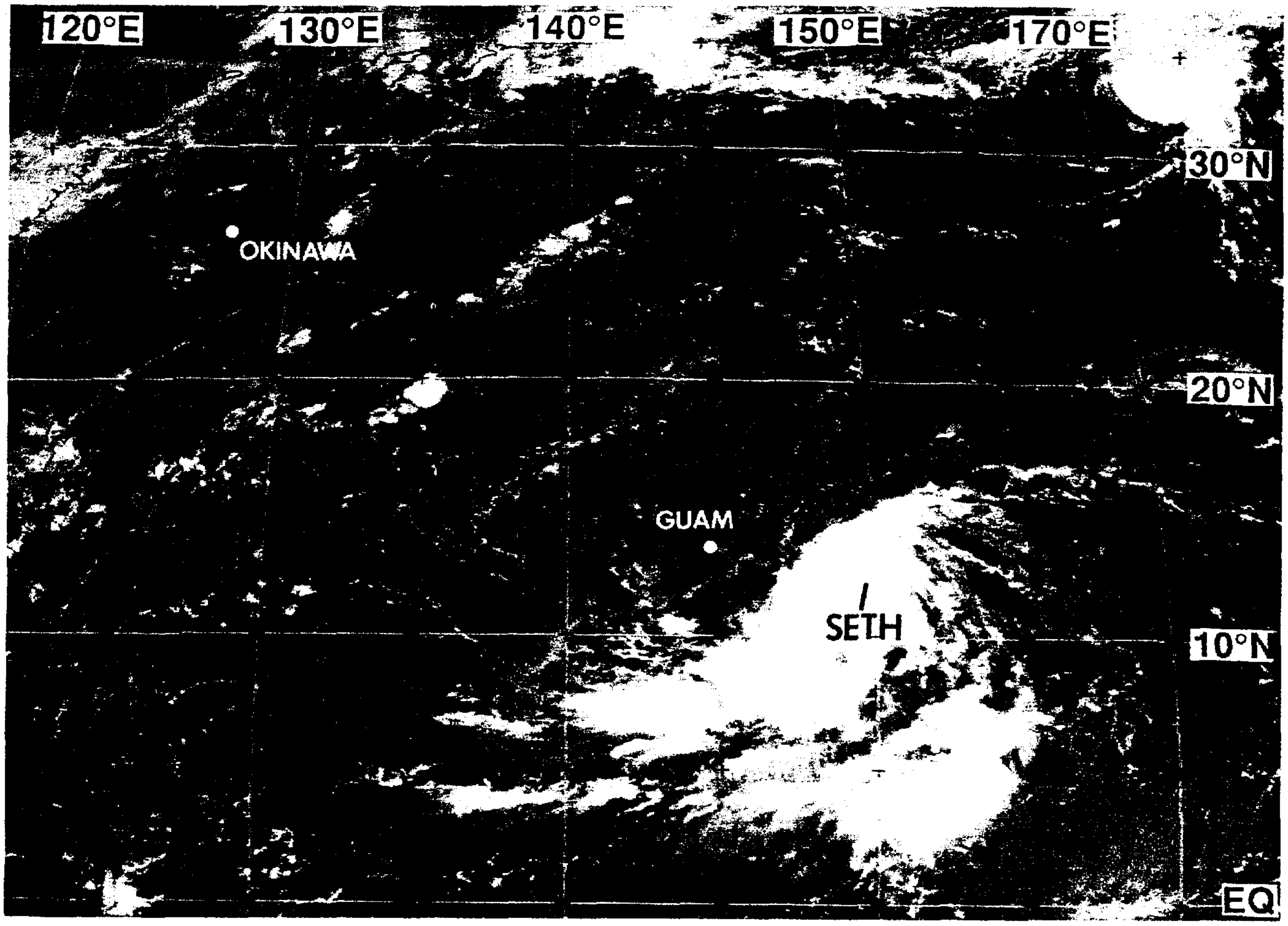


Figure 3-32-1 Seth and accompanying rain bands are seen isolated in an unusually cloud-free tropics (032331Z October visible GMS imagery).

I. HIGHLIGHTS

Seth originated from a tropical disturbance at low latitude in the Marshall Islands and moved on a typical recurving track. After recurving east of Taiwan, Seth moved northeastward and impacted the Korean peninsula. During the period of Seth's extra-tropical transition, as it moved through the Yellow Sea toward Korea, intensity estimates made from satellite imagery were low and illustrate the need for the development of new diagnostic techniques to address extra-tropical transition.

II. TRACK AND INTENSITY

Seth developed from an isolated area of deep convection in the Marshall Islands and tracked across the western North Pacific during a period when the basin was relatively cloud-free, and the monsoon circulation (which had earlier been extremely active) had become very weak (Figure 3-32-1). Synoptic data at 010000Z October indicated that a low-level cyclonic circulation center developed in the Marshall Islands in association with this area of deep convection. This tropical disturbance was first mentioned on the 010600Z October Significant Tropical Weather Advisory. At 011100Z, a Tropical Cyclone Formation Alert (TCFA) was issued by JTWC. Remarks in this TCFA included:

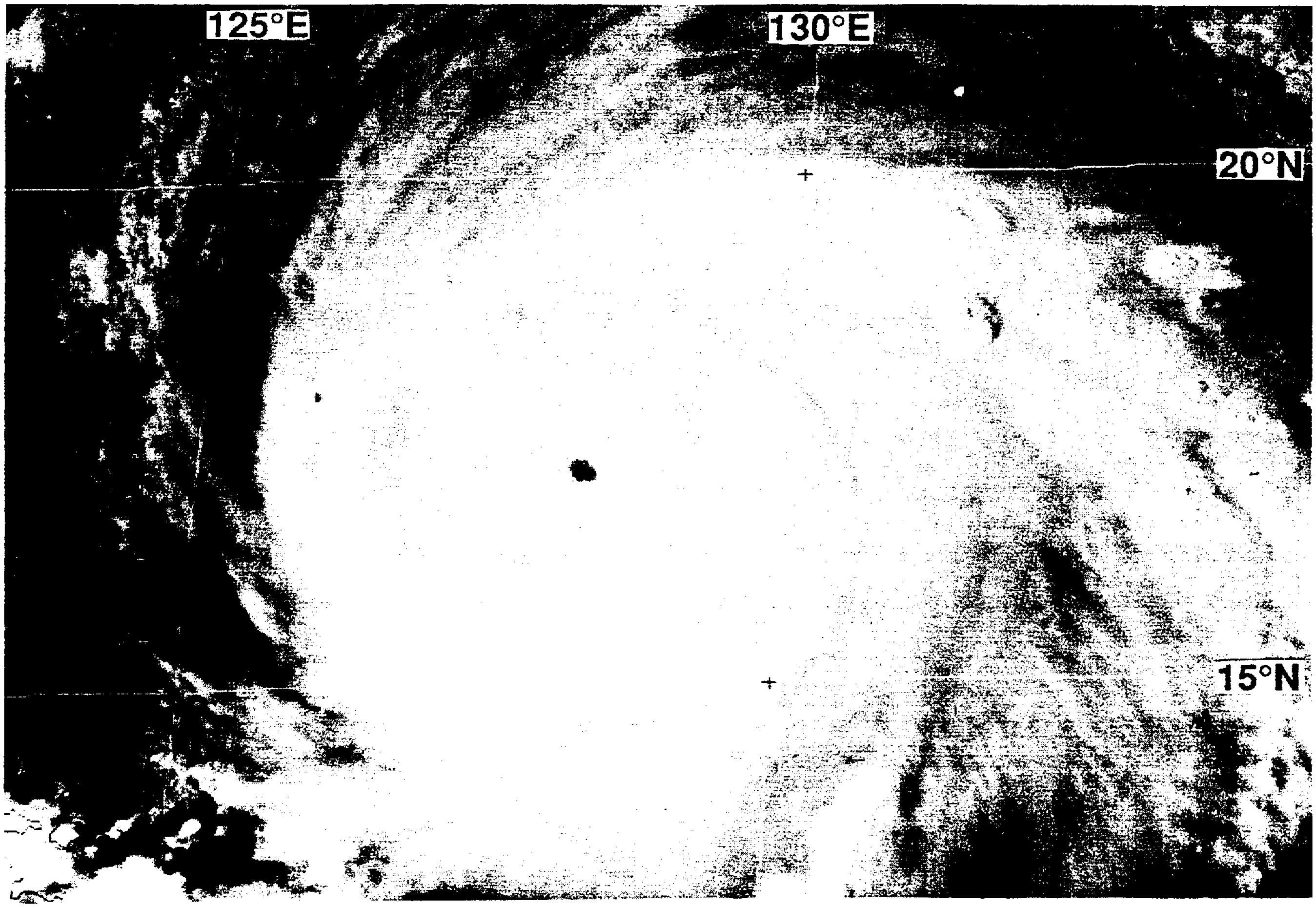


Figure 3-32-2 Nearing its peak intensity, Seth's eye becomes well-defined (070631Z October visible GMS imagery).

"... [The] tropical disturbance passing through the Marshall Islands has exhibited signs of development over the past 12 hours. Satellite imagery and synoptic data indicate a persistent low-level circulation center ... 24 hour pressure falls at Kwajalein were close to three millibars as the system passed by. ... If the system continues moving at its present rapid forward speed, the potential for further development will be reduced. ..."

Failing to intensify, a second TCFA was issued 24 hours later (at 021100Z). The first warning on Tropical Depression 32W was issued at 021800Z when satellite imagery indicated that deep convection associated with the system had increased and become more centralized. A normal rate of intensification of one "T" number per day ensued as Seth moved on a west-northwestward track. Typhoon intensity was attained at 051800Z. Turning gradually to the northwest, Seth steadily intensified (Figure 3-32-2) and reached peak intensity of 120 kt (62 m/sec) at 071200Z. Seth then moved on a broad recurving track, passing to the east of Taiwan and later over the Korean Peninsula. The point of recurvature occurred at 100600Z when Seth was 90 nm (170 km) north-northeast of Taipei. By this time Seth's intensity dropped to 90 kt (46 m/sec). Seth accelerated as it approached the Korean Peninsula. At 111800Z, it passed directly over the island of Cheju Do (located in the Yellow Sea about 100 km south of the Korean Peninsula). Moving at a forward speed in excess of 30 kt (55 km/hr), the system crossed the Korean Peninsula, entering the Sea of Japan shortly after 120000Z. Based upon the acquisition of extratropical characteristics, the final JTWC warning was issued at 111800Z. After entering the Sea of

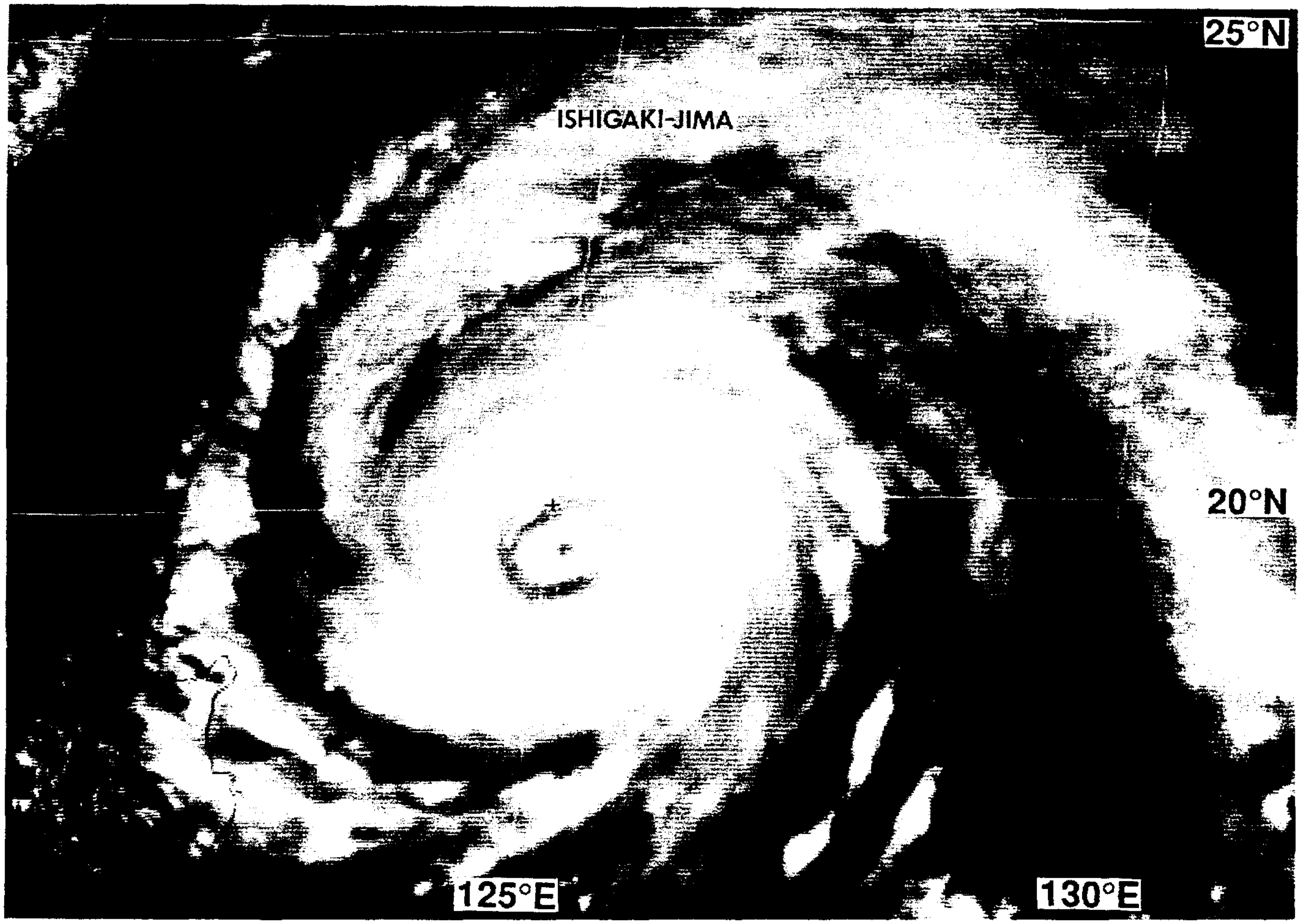


Figure 3-32-3 An eye within an eye. Concentric wall clouds appear as Seth begins to weaken (080331Z October visible GMS imagery).

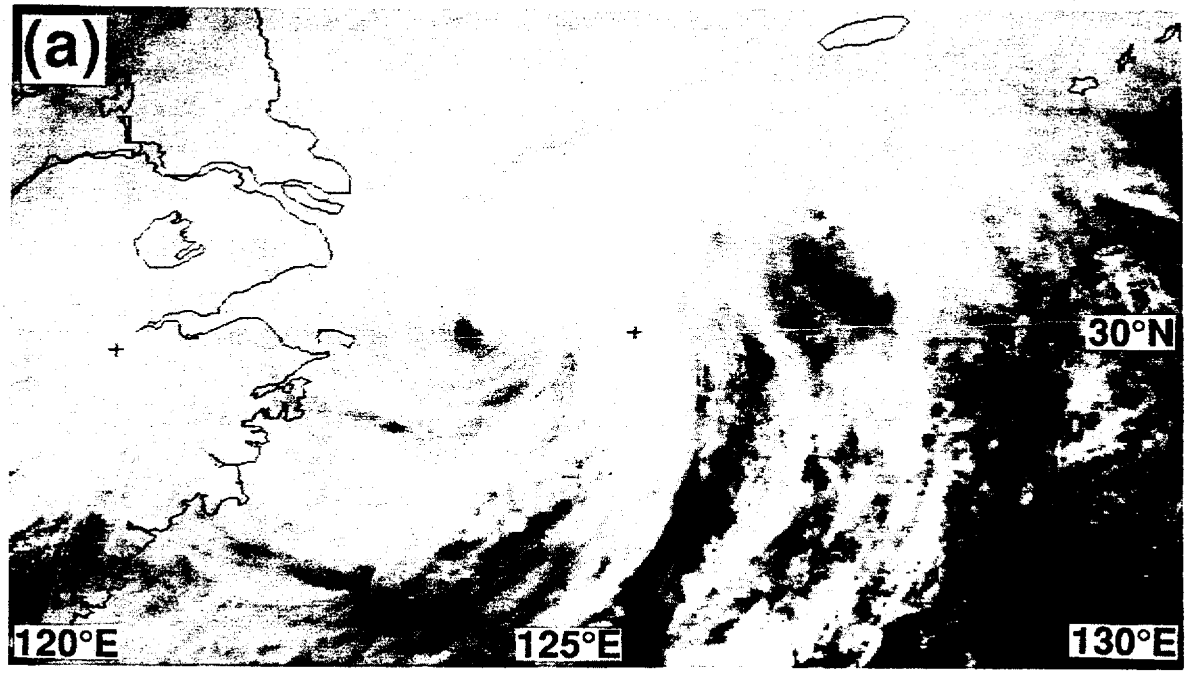
Japan, the system continued to move rapidly northeastward toward the Kamchatka Peninsula with winds in excess of 50 kt (26 m/sec) until 130000Z.

III. DISCUSSION

a. Concentric eye walls

Approximately 30 hours after attaining peak intensity, Seth acquired well-defined concentric eye walls (Figure 3-32-3). After another 24 hours, and with continued weakening, vestiges of the inner eye wall — seen clearly in Figure 3-32-3 — were still present in satellite imagery. At this time (approximately 090000Z), Seth came within range of the Hualien radar. At first, poorly defined concentric eye walls appeared on the radar image (not shown). Then, while moving northward through the southwestern end of the Ryukyu Islands , Seth's eye became quite ragged.

Well-defined concentric eye-walls (Figure 3-32-3) are rarely seen in conventional satellite imagery. The JTWC suspects that they are more common than indicated by their rate of appearance in satellite imagery. For example, even though they were obscured by cirrus in satellite imagery, well-defined concentric eye walls appeared on radar as Gladys (20W) approached Hualien (see the discussion of concentric eye walls in the Gladys summary).



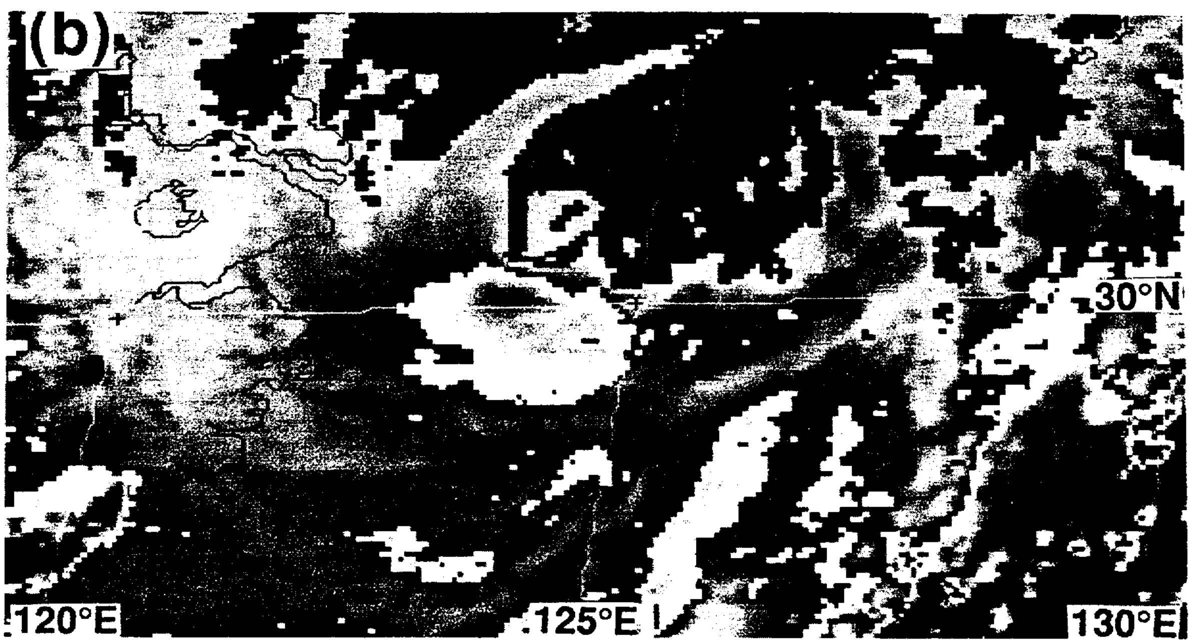


Figure 3-32-4 Satellite intensity estimates begin to decrease as Seth's central dense overcast is sheared away to the north side of the low-level circulation center by southwesterly winds aloft as the process of extra-tropical transition begins: (a) 110131Z October visible GMS imagery, and (b) 110131Z October enhanced infrared GMS imagery. The enhancement is the Basic Dvorak (BD) curve.

b. Extratropical transition

One of the more difficult forecast and warning challenges faced by the JTWC for Seth occurred as the typhoon approached the Korean peninsula. Eighteen hours prior to landfall on the peninsula, Seth began to lose its central deep convection while in the process of transitioning into an extratropical low (Figure 3-32-4a,b). Applying Dvorak's satellite intensity analysis to the transitioning system, the diag-

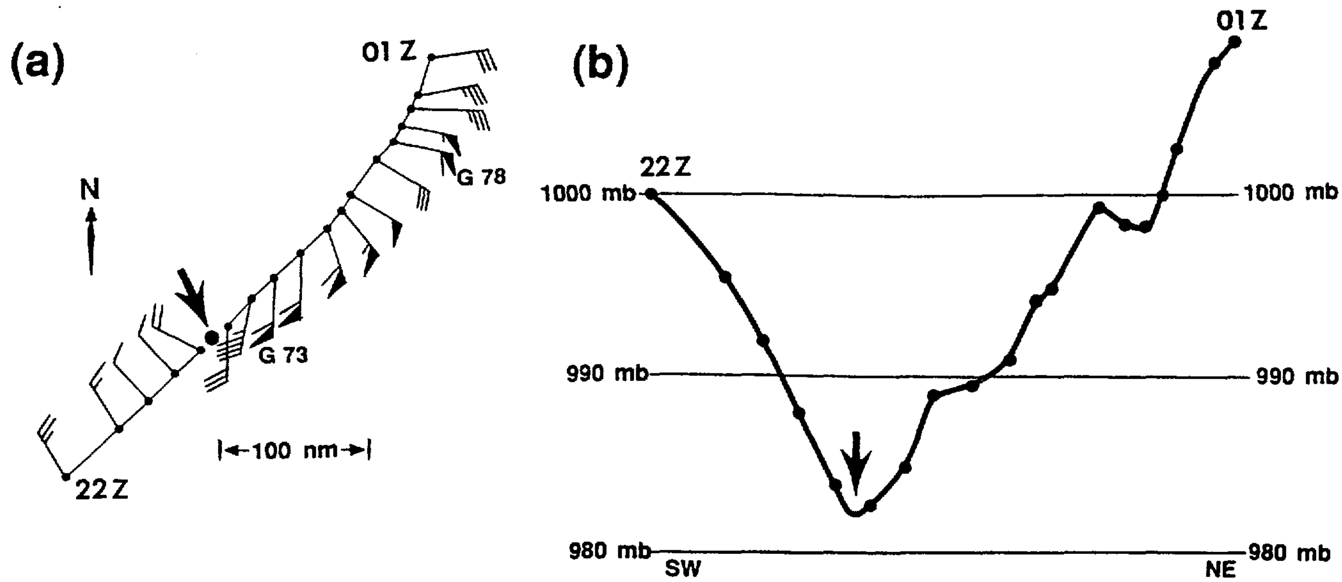


Figure 3-32-5 Schematic depictions of (a) winds and (b) sea-level pressure recorded at Cheju Do (WMO 47187) during Seth's passage. The data are plotted with respect to Seth's center (indicated by an arrow).

nosed intensity began to fall to unrealistically low values (Table 3-32-1). Wind and pressure reports from Cheju Do (WMO 47187) (Figure 3-32-5a,b), and from other stations, indicated that Seth retained typhoon intensity up to its landfall on the southern coast of South Korea.

Application of Dvorak's satellite intensity estimates to Seth as it began to acquire extratropical characteristics yielded values which were as much as three "T" numbers below the real-time intensity (Table 3-32-1). In an attempt to produce more accurate intensity estimates (from satellite imagery) on recurving tropical cyclones that are undergoing extra-tropical transition, the subtropical classification scheme of Hebert and Poteat (1975) has been used. For Seth, this scheme yielded "ST" numbers which corresponded to intensities far lower than those observed. This is not surprising since the scheme developed by Hebert and Poteat was intended to be applied to intensifying midlatitude lows that have acquired organized deep convection. The attempt to use Hebert and Poteat's system in reverse (i.e. on tropical cyclones that are becoming extratropical following recurvature) is most probably a misapplication. Analysts at the JTWC also tried to apply to the recurving Seth, a technique for estimating the intensity of mid-latitude cyclones from satellite imagery (Smigielski and Mogil 1992). Again, it was difficult to derive intensities high enough.

IV. IMPACT

At 041800Z, Seth , with a best-track at an intensity of 50 kt (26 m/sec), passed 102 nm (190 km) south of Guam, where a peak wind gust of 41 kt (21 m/sec) was recorded. No reports of damage or injuries were received. The next region affected by Seth was Taiwan and the southern Ryukyu Islands. A peak gust of 110 kt (57 m/sec) and a minimum pressure of 952 mb was recorded at Yonaguni Jima (WMO 47912) as the western inner edge of Seth's eye-wall cloud passed over. No reports of damage or injuries were received from this region. At Cheju Do (WMO 47187), a peak wind gust of 78 kt (40 m/sec) was recorded as Seth approached from the southwest. Wind gusts to near 70 kt (36 m/sec) and rainfall in excess of 300 mm (11.8 inches) affected portions of South Korea. Torrential rains near the eastern port city of Samchok resulted in flooding that killed one person, forced the evacuation of 550 people, inundated 178 houses and interrupted rail traffic. However, the rain from Seth brought relief to many drought-parched areas of South Korea.

Table 3-32-1 Intensity estimates derived from satellite imagery during Seth's extratropical transition. In the code, T = Dvorak tropical numbers, ST = Hebert and Poteat subtropical numbers, and the number that follows the "/" is the current intensity, which is always held higher in cases when the cyclone is weakening.

Time (Z)	Code	Current Intensity ~~Best Track~~ Intensity (kt)	Best Track Intensity (kt)
102330Z	T 3.0/4.0	65	75
110144Z	T 3.0/4.0	65	70
110232Z	T 3.5/4.0	65	70
110530Z	T 2.5/3.5	55	70
111115Z	T 1.5/2.5	35	65
111130Z	ST 1.5/2.5	35	65
111151Z	T 1.5/2.5	35	65
111300Z	ST 1.0/2.0	30	65
111730Z	ST 1.0/2.0	30	65
112330Z	ST 1.0/2.0	30	60
120125Z	ST 1.0/1.0	25	60
120530Z	ST 1.0/2.0	30	60