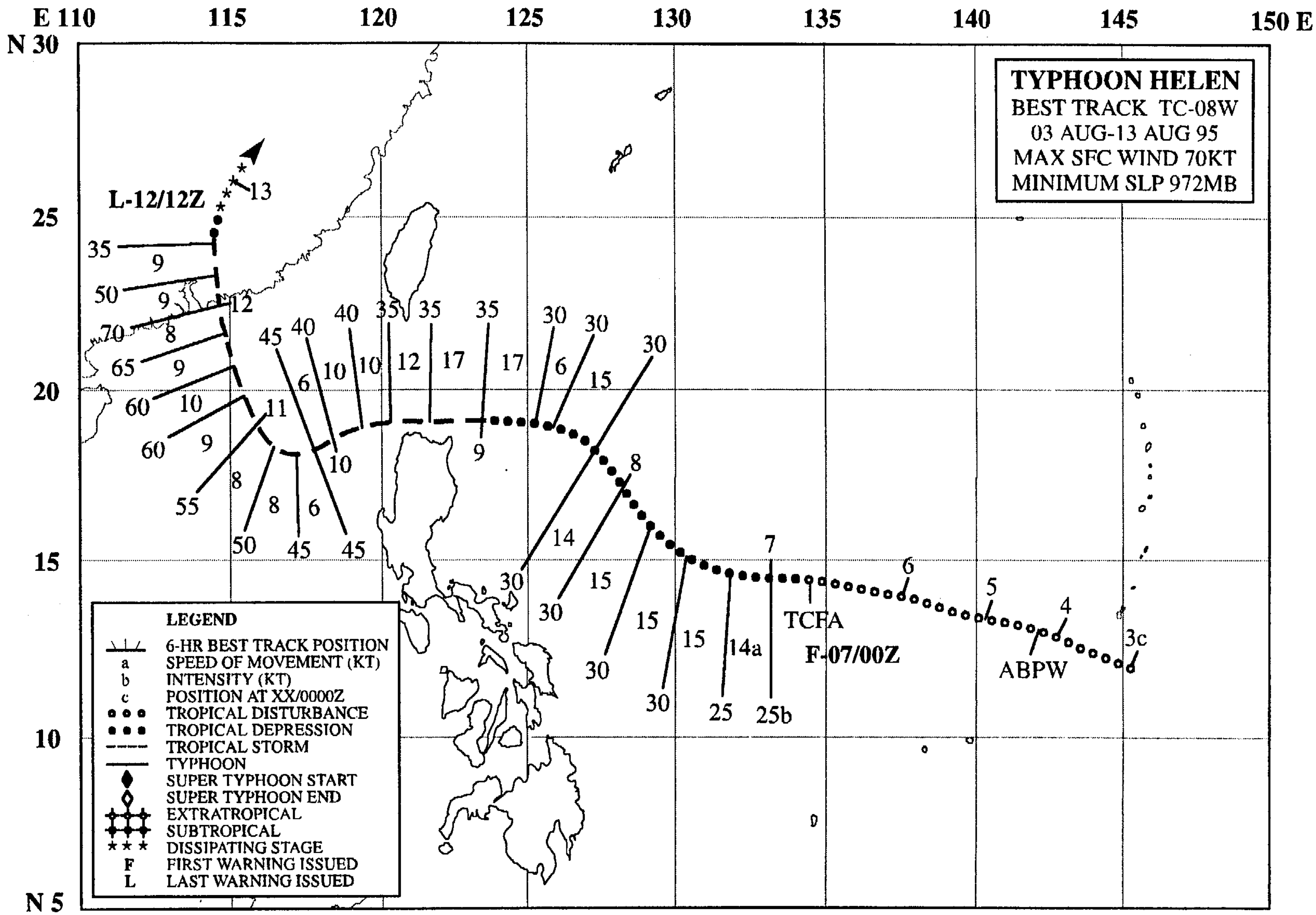
TYPHOON HELEN
BEST TRACK TC-08W
03 AUG-13 AUG 95
MAX SFC WIND 70KT
MINIMUM SLP 972MB
E 110
115
120
125
130
135
140
145
150 E
N 30
25
20
15
10
N 5
L-12/12Z
F-07/00Z
TCFA
ABPW
LEGEND
6-HR BEST TRACK POSITION
a SPEED OF MOVEMENT (KT)
b INTENSITY (KT)
c POSITION AT XX/0000Z
TROPICAL DISTURBANCE
TROPICAL DEPRESSION
TROPICAL STORM
TYPHOON
SUPER TYPHOON START
SUPER TYPHOON END
EXTRATROPICAL
SUBTROPICAL
DISSIPATING STAGE
F FIRST WARNING ISSUED
L LAST WARNING ISSUED

TYPHOON HELEN (08W)

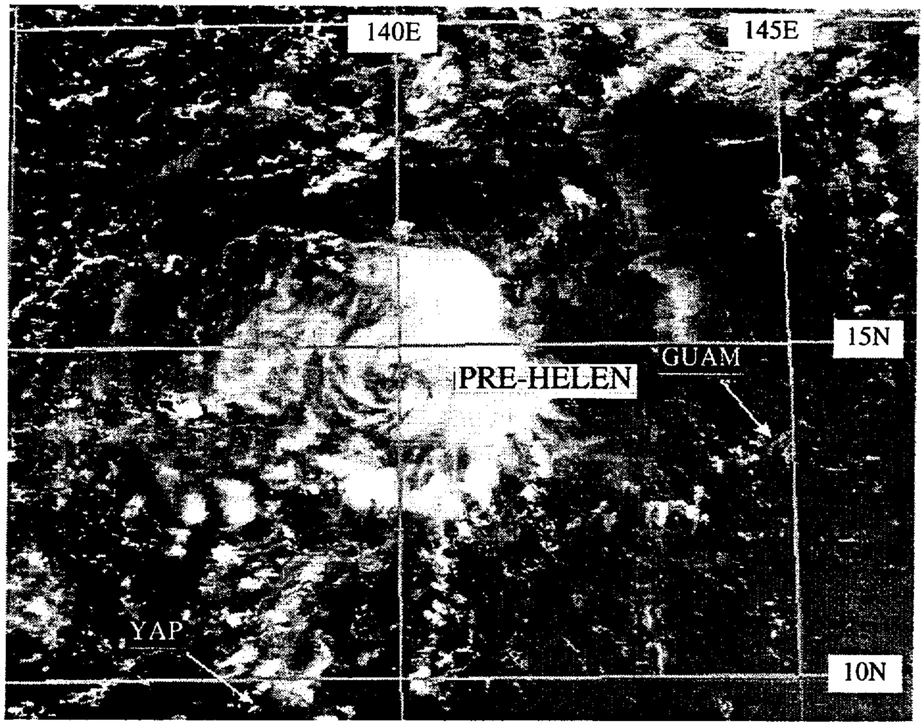

Figure 3-08-1 This vortical cloud pattern was observed about 300 nm (550 km) to the west of the region where, a day earlier, a large MCS had grown and collapsed. Appearing well-organized, it later dissipated, and new deep convection in the pre-Helen tropical disturbance developed further to the south and west (050131Z August visible GMS imagery).

I. HIGHLIGHTS

Helen (08W) was upgraded to typhoon intensity in postanalysis based on data obtained from the Royal Observatory Hong Kong. Originating near Guam, the tropical disturbance that became Helen was slow to develop, taking six days to reach tropical storm intensity. Helen skirted northern Luzon and, after moving into the South China Sea, dipped toward the west-southwest for a day prior to turning to the north-northwest and intensifying. Helen reached a peak intensity of 70 kt (36 m/sec) just before making landfall east of Hong Kong.

II. TRACK AND INTENSITY

Despite the persistent easterly low-level winds that dominated the western North Pacific through early August, a weak low-level cyclonic circulation developed to the south of Guam on 03 August. Scatterometer data from the ERS-1 satellite indicated that the surface circulation had an intensity of 15 kt (8 m/sec). For the next three days, the disturbance moved to the west-northwest and remained poorly organized. A large mesoscale convective system (MCS) that formed over Guam on 04 August, collapsed by the early morning of 05 August and left behind a well-defined, but short-lived, vortical cloud pattern (Figure 3-08-1). The vortical cloud pattern dissipated by the evening of 05 August, and one can not establish a direct link between it and the subsequent development of Helen (see the discussion section for more details on the generation of mid-tropospheric vortices by MCSs and their possible association with tropical cyclogenesis).

Organized convection began to persist by 06 August and a Tropical Cyclone Formation Alert was issued valid at 061830Z. The first warning on Tropical Depression 08W was issued, valid at 070000Z, as the tropical disturbance intensified. During the evening of 07 August, TD 08W turned to the northwest, as monsoon winds to its southwest strengthened and deepened. On 08 August, the tropical depression turned to the west in response to easterly wind flow south of the mid-tropospheric subtropical ridge. Based on intensity estimates made from satellite imagery, Tropical Depression 08W was upgraded to Tropical Storm Helen on the warning valid at 090000Z. On 09 August, Helen moved westward about 30 nm (55 km) north of Luzon. After the system cleared the northwest tip of Luzon and entered the South China Sea, it slowed and took a dip to the west-southwest for about 24 hours.

At approximately 101800Z, Helen turned abruptly to the north-northwest and accelerated to an average speed of 9 kt (17 km/hr). This turn was most probably due to the modification of the steering flow by the deepening southerly flow of a surging monsoon to the southwest of the tropical cyclone. Such sudden track changes that are caused by the interaction of a tropical cyclone with the monsoon flow are described by Carr and Elsberry (1994).

Helen intensified after turning to the north-northwest (Figure 3-08-2). During postanalysis, wind observations from Waglan Island (WMO 45007), which were obtained from the Royal Observatory in Hong Kong, revealed that Helen reached typhoon intensity before making landfall in southern China early on 12 August (for further details about the postanalysis upgrade of Helen to typhoon intensity see the discussion section). The JTWC issued the final warning valid at 121200Z as Helen dissipated over the mountains of southern China.

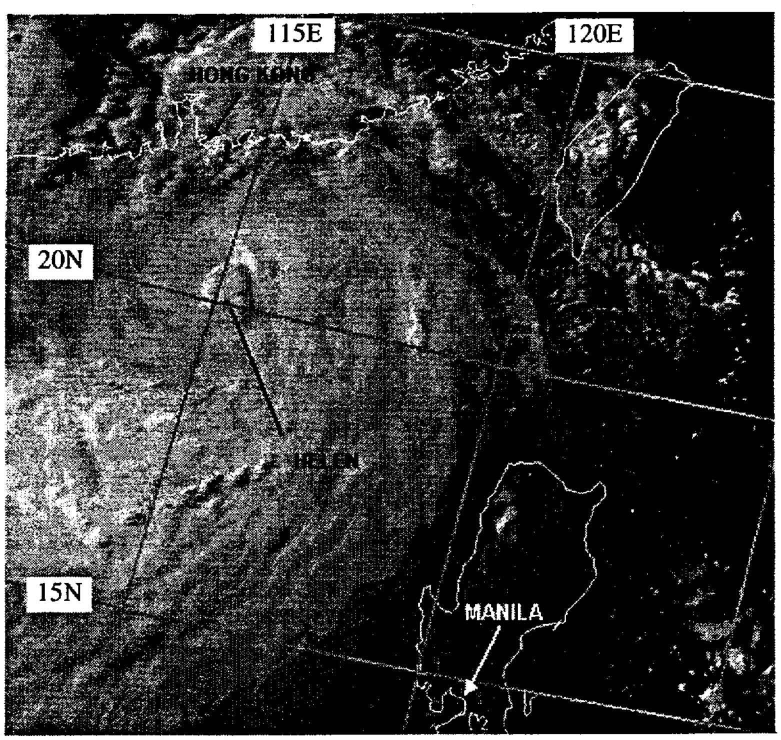

Figure 3-08-2 An intensifying Tropical Storm Helen is located about 150 nm (275 km) south of Hong Kong. The intensity is estimated to be 60 kt (31 m/sec) (110854Z August visible DMSP imagery).

III. DISCUSSION

a. *On the use of microwave imagery to modify the Dvorak intensity estimate*

Between 110000Z and 120000Z, most of the satellite intensity estimates for Helen made by applying Dvorak's techniques to visible (e.g., Figure 3-08-2) and infrared satellite imagery had a magnitude of T3.0 (45 kt) to T3.5 (55 kt), while analysts at the AFGWC assigned it a T4.0 (65 kt). The higher T number assigned to Helen by the AFGWC was based upon additional information about the structure of the tropical cyclone as revealed by microwave imagery. Able to see through the overlying cirrus with the microwave sensor, they noted a well-developed circular eye and wall cloud. Thus, the AFGWC analysts upped their intensity estimates by one-half a T number to arrive at the T4.0 estimate for the 111525Z and 120230Z DMSP satellite fixes. Confirmation of Helen's typhoon status was later obtained from wind observations at Waglan Island where one-minute average sustained winds were 65 kt (33 m/sec) at 111740Z. Seventy-five knot (39 m/sec) gusts were recorded at 111751Z and 120158Z. These winds were recorded on the west side of Helen while it was moving at 9 kt (17 km/hr) toward the north. Allowing for the speed of translation, the final best track intensity was adjusted to 70 kt (36 m/sec).

b. *JTWC forecast performance*

JTWC track forecasts for Helen were very good at the longer time periods. Average forecast errors were 122 nm (226 km), 172 nm (319 km), and 117 (217 km) for 24, 48, and 72 hours. While NOGAPS handled the transition from westward to northward motion in the South China Sea on 11 August quite well, it indicated the northward turn earlier than actually observed. According to Carr (personal communication), this is a common NOGAPS trait. JTWC intensity forecasts were also very good, with an average error of 10 kt (5 m/sec) or less at all forecast periods. The largest intensity forecast errors were produced during the 10 August period, where the intensity was under-forecast by as much as 30 kt (15 m/sec).

c. *Tropical cyclogenesis initiated by a mesoscale convective system*

A recent hypothesis concerning the mechanism of TC genesis is that TCs originate from a mid-level cyclonic vortex that is the product of a mesoscale convective system (MCS). Bartels and Maddox (1990) and Frank and Chen (1991) have provided theoretical and observational evidence that the formation of a mid-tropospheric mesoscale vortex is favored in the large stratiform-rain region of a mature MCS. It has been further proposed that the mid-level mesoscale cyclonic vortices formed via this mechanism can develop into tropical cyclones (e.g., Frank and Chen 1991; Zehr 1992; and Emanuel 1992). The problem lies in linking such mid-level mesoscale vortices to the generation of a surface circulation with organized deep convection. Zehr (1992) postulates a two-stage process whereby a mid-level mesoscale vortex generated by an MCS becomes a TC. In the first stage, a mature MCS creates a mid-level mesoscale vortex which persists after the MCS collapses. The second stage occurs when the remnant mid-level mesoscale vortex works its way to the surface and becomes the site for renewed deep convection resulting in the creation of a TC.

That mid-tropospheric mesoscale vortices are produced during the life cycle of both continental and maritime MCSs is beyond dispute. The results of the TCM-92 and TCM-93 field experiments (Mckinley and Elsberry 1993) and of the TEXMEX field experiment (Bister and Emanuel 1995) confirmed the generation of mid-level mesoscale vortices by tropical maritime MCSs. There remains some controversy as to how the mid-level vortex produced by MCS works its way into the low levels; although Zehr (1992), and Bister and Emanuel (1995), have shown convincing observational evidence that the mesoscale vortices created during the life cycle of an MCS have later become the site of TC development. In Helen's case, there is insufficient evidence to determine if the well-defined mesoscale vortex that appears in Figure 3-08-1 played a direct role in Helen's development. At best, the formation of this mesoscale vortex is a good example Stage One of Zehr's two-stage pathway to tropical cyclogenesis (i.e., the formation of a mid tropospheric mesoscale vortex by an MCS). However, since this well-defined mesoscale vortex dissipated, it is difficult to establish a direct link between it and Helen's subsequent development.

IV. IMPACT

Twenty-three deaths were reported by the Chinese media. In Hong Kong, one person was reported killed and two were reported missing. Although Waglan Island reported sustained (one-minute average) winds of 65 kt (33 m/sec) with gusts to 75 kt (39 m/sec) between 111740Z and 111751Z August (see Figure 3-08-3), winds were weaker over Hong Kong proper. Helen caused about 100 landslides and deposited about 24 inches (600 mm) of rain on Hong Kong during its four days of influence. Damage was slight as implied by a small number of insurance claims.

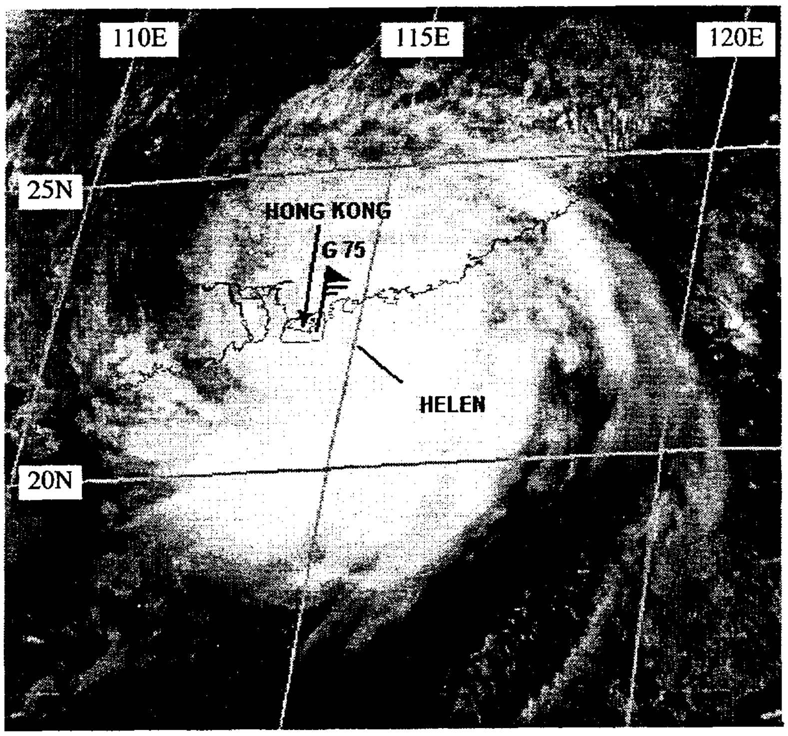

Figure 3-08-3 Typhoon Helen brushes by to the east of Waglan Island, Hong Kong (120131Z August visible GMS imagery). The 120000Z 65 kt (33 m/sec) one-minute averaged sustained wind and the peak 75 kt (39 m/sec) wind gust observed at Waglan Island are indicated (wind data courtesy of the Royal Observatory Hong Kong).