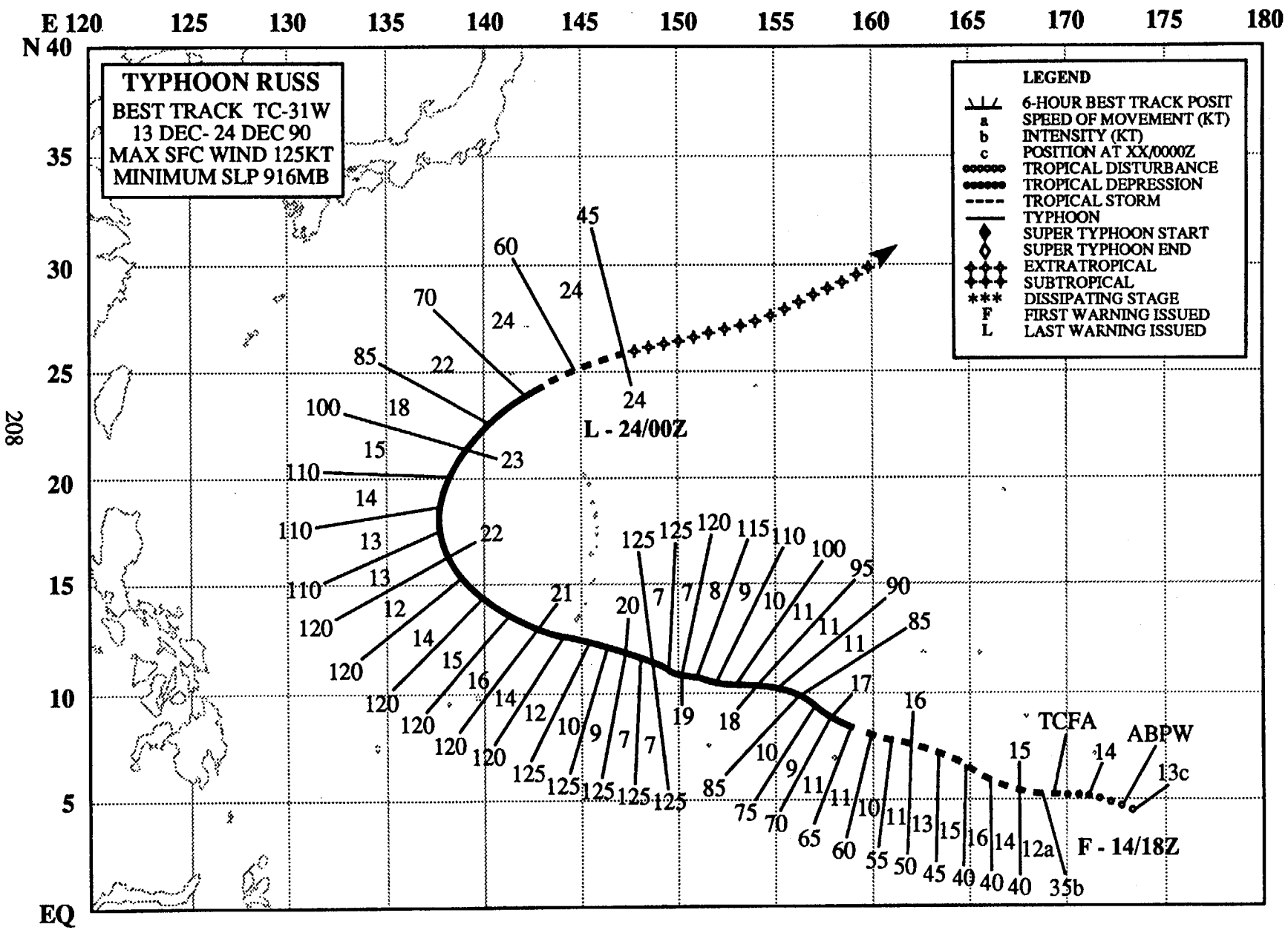
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EQ
208
TYPHOON RUSS
BEST TRACK TC-31W
13 DEC- 24 DEC 90
MAX SFC WIND 125KT
MINIMUM SLP 916MB
LEGEND
6-HOUR BEST TRACK POSIT
a SPEED OF MOVEMENT (KT)
b INTENSITY (KT)
c POSITION AT XX/0000Z
TROPICAL DISTURBANCE
TROPICAL DEPRESSION
TROPICAL STORM
TYPHOON
SUPER TYPHOON START
SUPER TYPHOON END
EXTRATROPICAL
SUBTROPICAL
*** DISSIPATING STAGE
F FIRST WARNING ISSUED
L LAST WARNING ISSUED
L - 24/00Z
TCFA
ABPW
F - 14/18Z

TYPHOON RUSS (31W)

I. HIGHLIGHTS

Russ, the last western North Pacific tropical cyclone of 1990, was the most severe to strike Guam in 14 years. Damage was estimated as high as 120 million dollars. Russ formed in the Marshall Islands, tracked west-northwestward and intensified to near super typhoon intensity as it approached Guam. The typhoon passed within 30 nm (55 km) of the southern tip of Guam and brought typhoon force winds which caused extensive damage, especially to the southern portion of the island. After leaving Guam, Russ slowly weakened, recurved and became an extratropical cyclone.

II. CHRONOLOGY OF EVENTS

130600Z - First mentioned on a Significant Tropical Weather Advisory as an area of persistent convection associated with a low-level cyclonic circulation and an estimated minimum sea-level pressure of 1004 mb. The potential for significant tropical cyclone development was assessed as poor.

140600Z - Second mention on a Significant Tropical Weather Advisory due to persistent convection with an anticyclone developing aloft. Potential for development upgraded to fair.

141330Z - Tropical Cyclone Formation Alert issued based on increased curvature in the spiral cloud bands and a 35 kt (13 m/sec) surface wind report from Jaluit Atoll (WMO 91369).

141800Z - First Warning issued and Russ upgraded to tropical storm intensity prompted by rapid increase in amount and organization of the central convection.

161800Z - Upgraded to a typhoon based on anticipated appearance of an eye and a satellite intensity estimate of 65 kt (35 m/sec).

190600Z - Peak intensity - 125 kt (65 m/sec) - followed observation of further drying and warming within the 30 nm (55 km) diameter eye and a satellite intensity estimate of 125 kt.

240000Z - Final warning issued with Russ downgraded to tropical storm intensity and transitioning to an extratropical cyclone after the loss of its persistent central dense overcast.

III. TRACK AND MOTION

Russ developed in the near-equatorial trough in the southern Marshall Islands. The tropical cyclone followed a basic recurvature track, passing just south of Guam and recurving through the axis of the subtropical ridge to the northwest of Guam. Although Russ maintained an essentially west-northwestward direction of motion as it approached Guam, significant changes in speed of motion occurred. Beginning on 18 December, Russ began to decelerate in response to the passage of a mid-latitude short wave passing to the north of the subtropical ridge. By 19 December, the typhoon had slowed to 7 kt (13 km/hr) - almost half the 13 kt (24 km/hr) speed expected from climatology. Once the short wave passed to the northeast, the subtropical ridge and the steering flow strengthened, and on 20 December, Russ started to accelerate. Fortunately for Guam, this reduced the time of exposure to Russ' damaging winds. By the time Russ entered the Philippine Sea, another short wave had moved eastward from Asia and caused a break in the subtropical ridge to the northwest of Guam. Russ recurved through this break, accelerated and became an extratropical cyclone on 24 December.

IV. INTENSITY

Russ' initial intensification was surprisingly rapid. As a result, Russ was at minimal tropical storm intensity when the first warning was issued. Although satellite imagery showed poorly

organized convection with multiple circulations (Figure 3-31-1), surface wind reports from Jaluit Atoll (WMO 91369) in the southern Marshall Islands of 35 and 40 kt (17 and 20 m/sec) at 141200Z and 150000Z respectively, revealed that the tropical cyclone was consolidating. After this sudden initial development (Figure 3-31-2), Russ intensified (Figure 3-31-3) at a normal rate until it reached 125 kt (64 m/sec) at 190600Z. The passage of a mid-latitude short wave trough, which weakened the subtropical ridge and caused Russ to slow down, aided intensification by enhancing the typhoon's

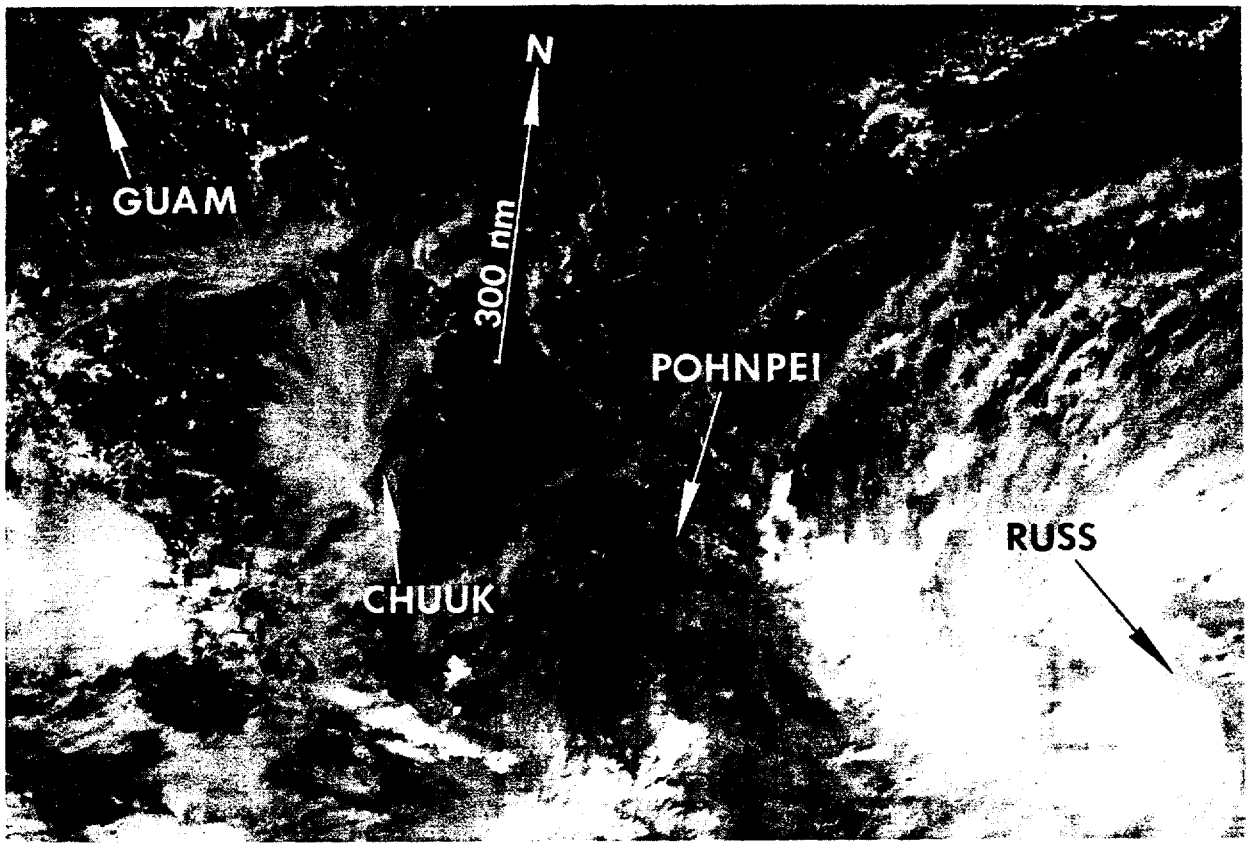

Figure 3-31-1. Russ after reaching tropical storm intensity. Central convection and outflow are well organized (142250Z December DMSP visual imagery).

outflow aloft into the polar westerlies (Figure 3-31-4). The tropical cyclone remained near its peak intensity for three days. During this time, it passed within 30 nm (55 km) of the southern tip of Guam (Figure 3-31-5). The closest point of approach at 201700Z (210300 local time on Guam) was reflected in the lowest pressure (Figure 3-31-6), increased wind (Figure 3-31-7), and increased seas (Figure 3-31-8). Maximum sustained winds experienced on the island, which is only 30 nm (55 km) in length, varied from minimum typhoon intensity in the north to almost double that in the south (Figure 3-31-9).

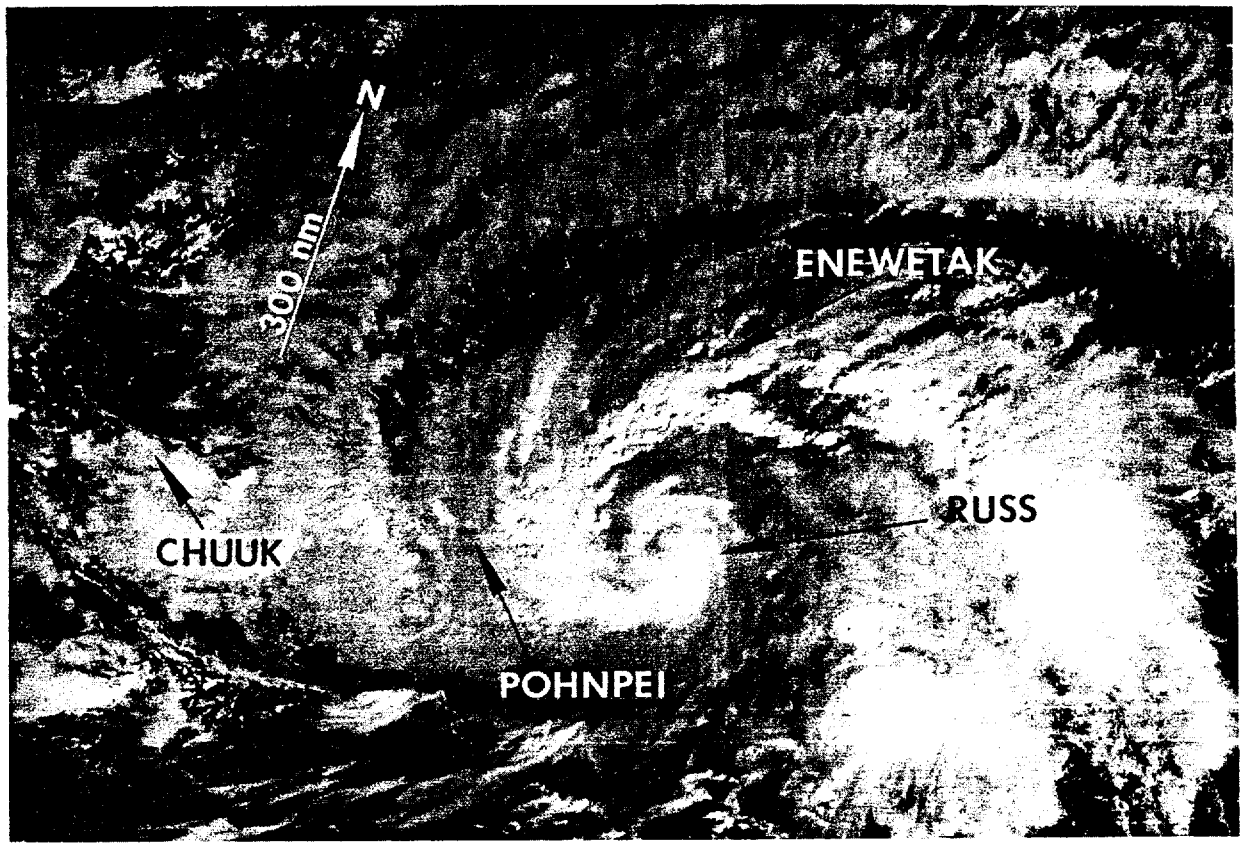

Figure 3-31-2. Spiral cloud band curvature increases as Russ intensifies (152229Z December DMSP visual imagery).

After passing to the west of Guam and into the Philippine Sea, Russ started to slowly weaken as it turned more to the north and interacted with the stronger polar westerly winds aloft (Figure 3-31-10). The typhoon's compact central convection resisted the increased vertical wind shear until 24 December, a day after recurvature. By then, the supporting deep convection was displaced to the north and east of the low-level circulation center and the cyclone (Figure 3-31-11) was extratropical.

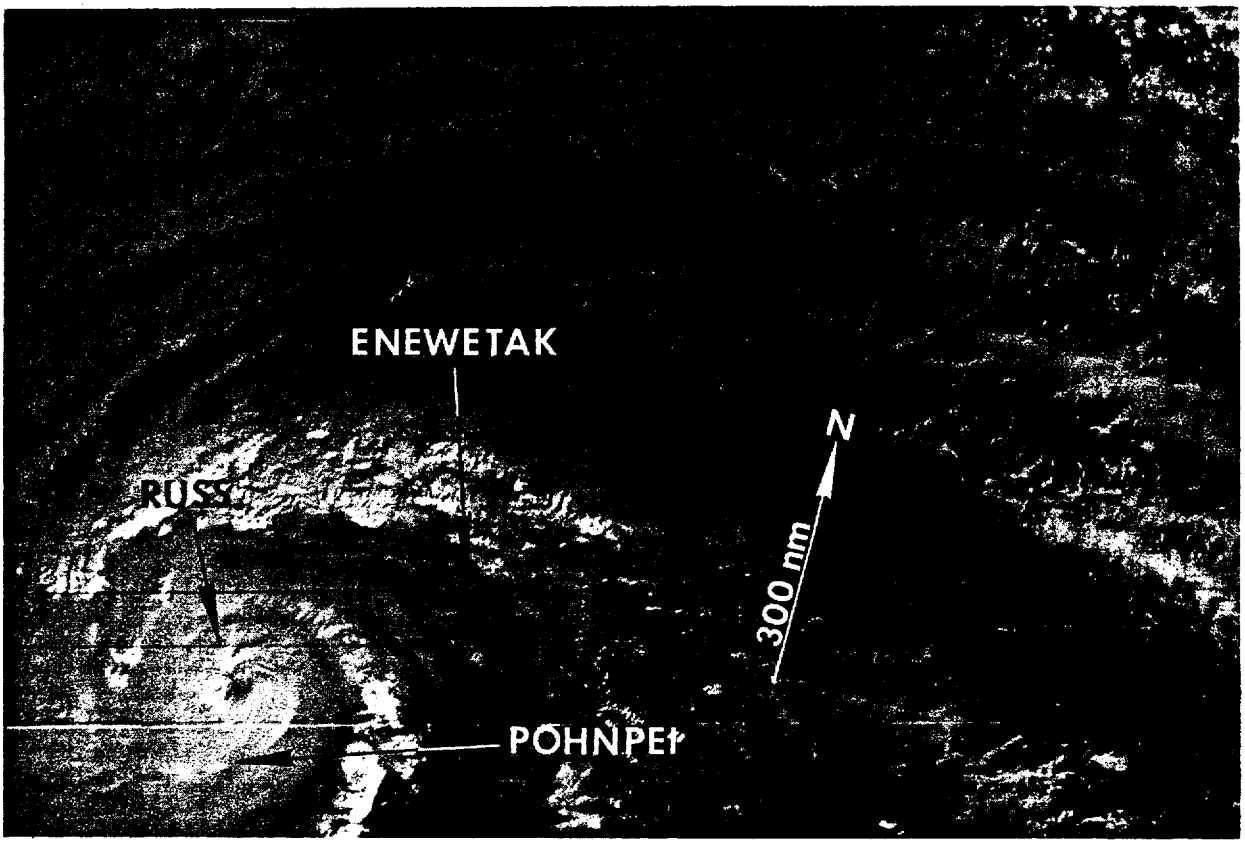

Figure 3-31-3. Russ develops an eye and reaches typhoon intensity (162207Z December DMSP visual imagery).

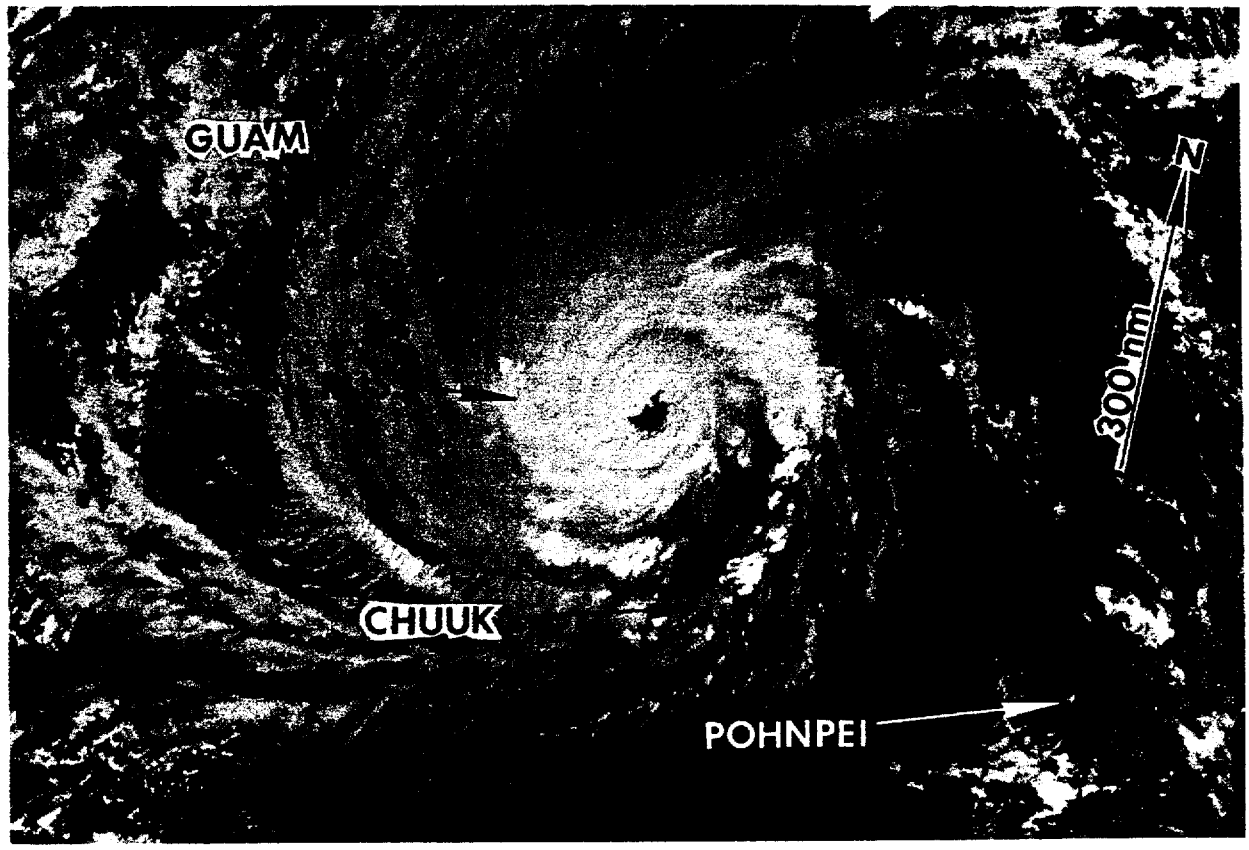

Figure 3-31-4. Russ at near peak intensity after the passage of a mid-latitude short wave to the north enhanced its outflow aloft (182307Z December DMSP visual imagery).

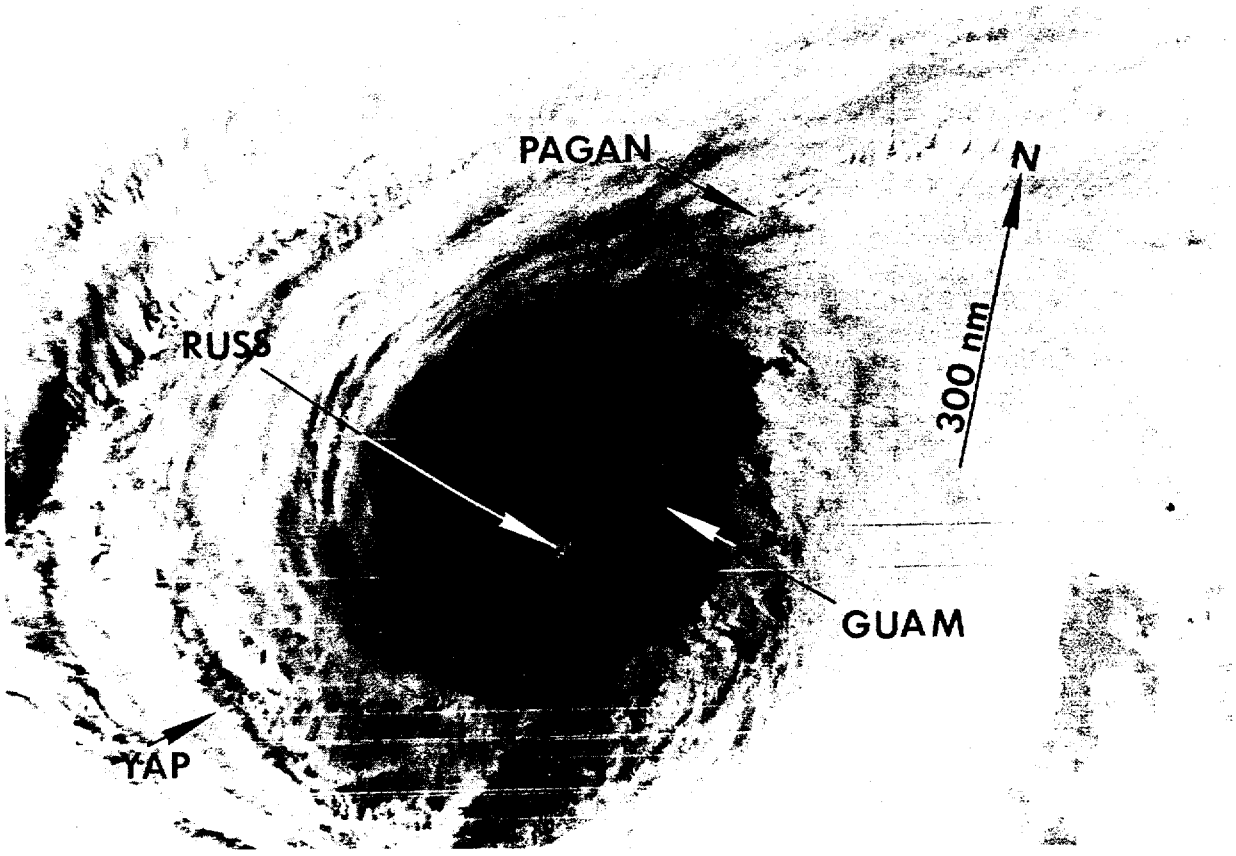

Figure 3-31-5. Russ after its closest point of approach to Guam (202014Z December DMSP infrared imagery).

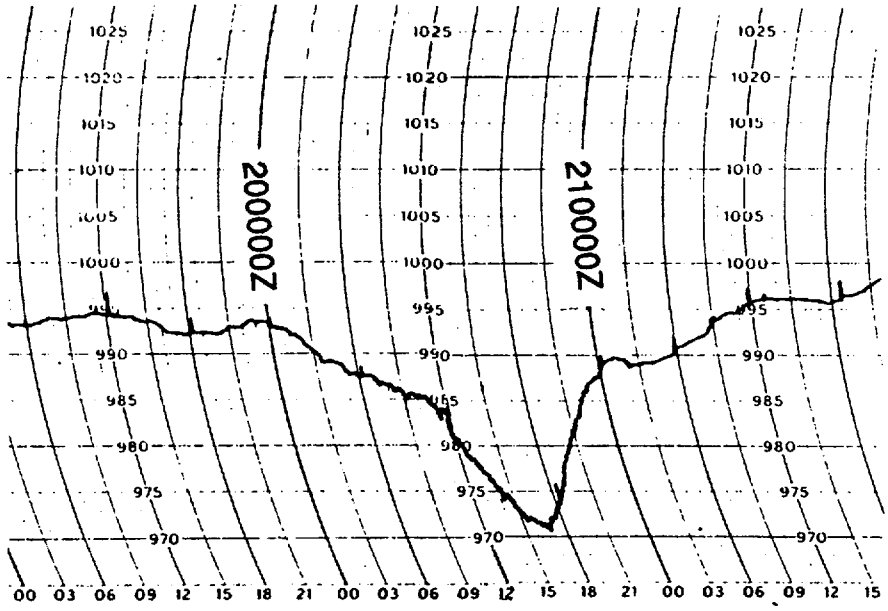

Figure 3-31-6. The microbarograph trace from Naval Air Station (WMO 91212), Agana, Guam shows its lowest pressure of 971 mb, at 201700Z, as Russ is near its closest point of approach to Guam.

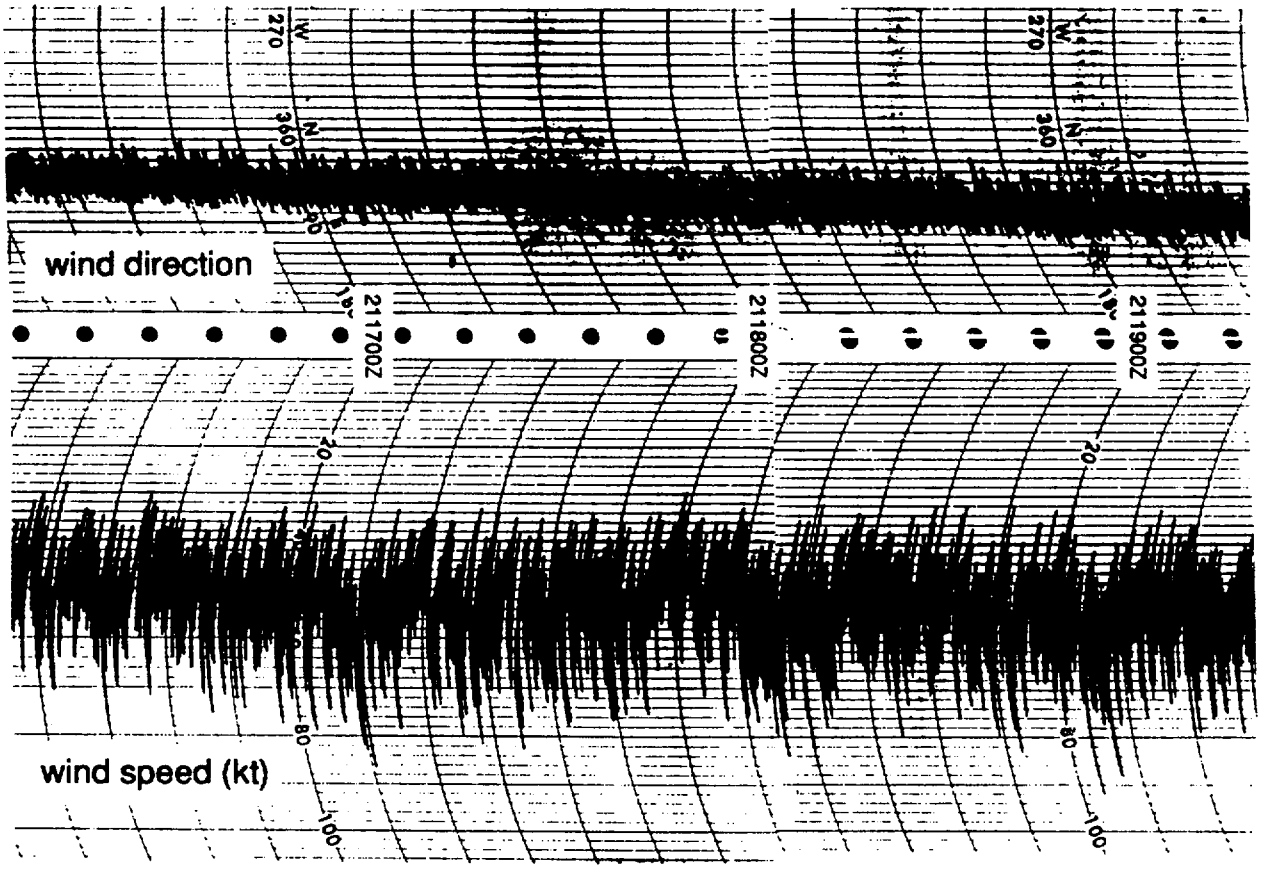

Figure 3-31-7. The wind record from Naval Air Station (WMO 91212), Agana, Guam reflects a steady increase from 211500Z through 211700Z as Russ approaches.

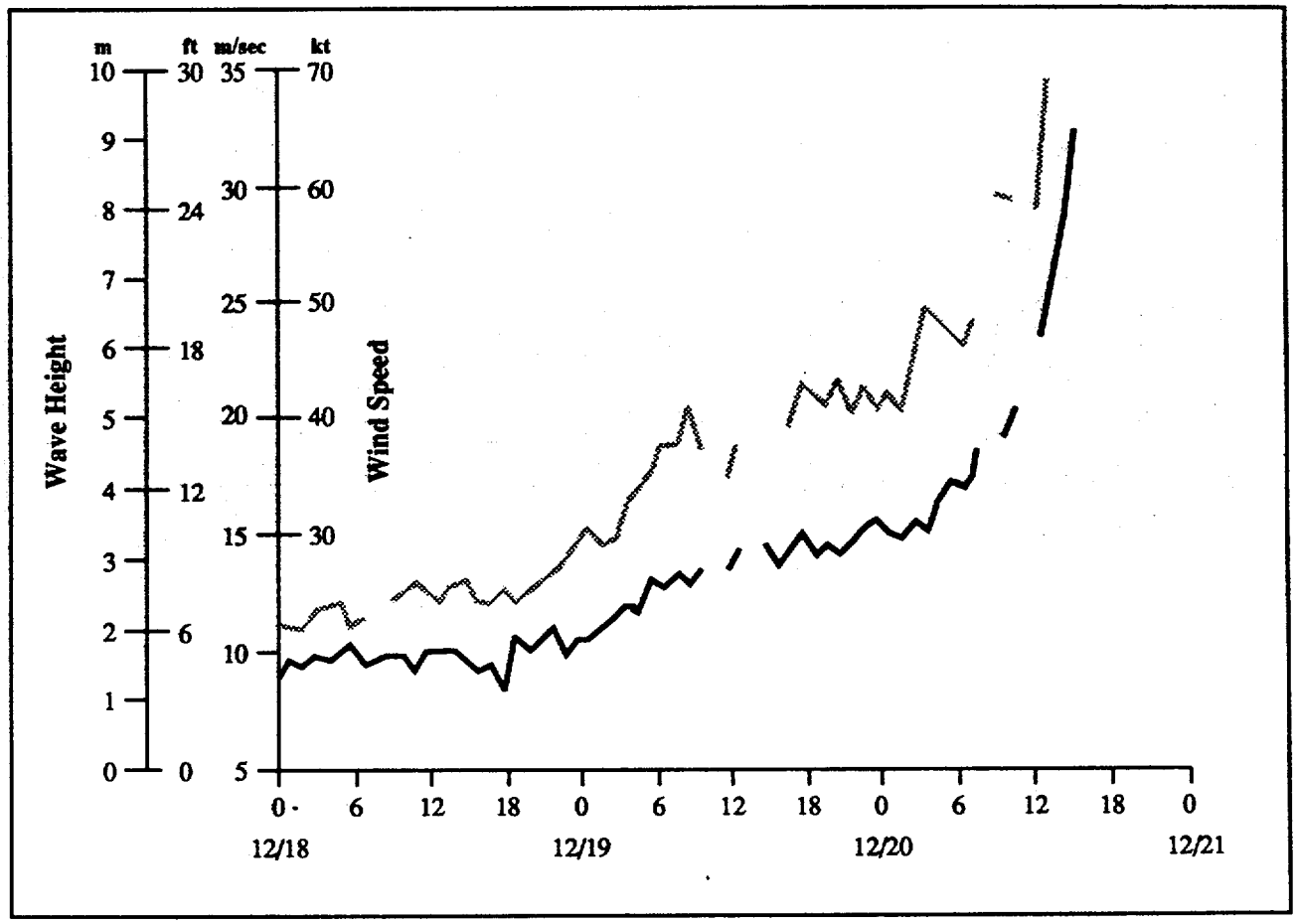

Figure 3-31-8. Time series plot of wave height (gray line) and wind speeds (black line) from a buoy moored 7 nm (13 km) west of the southern tip of Guam shows 30 ft (10 m) seas and 65 kt (33 m/sec) winds. The buoy was in the lee of Guam, but was lost shortly before Russ' CPA. (Data courtesy of the National Data Buoy Center)

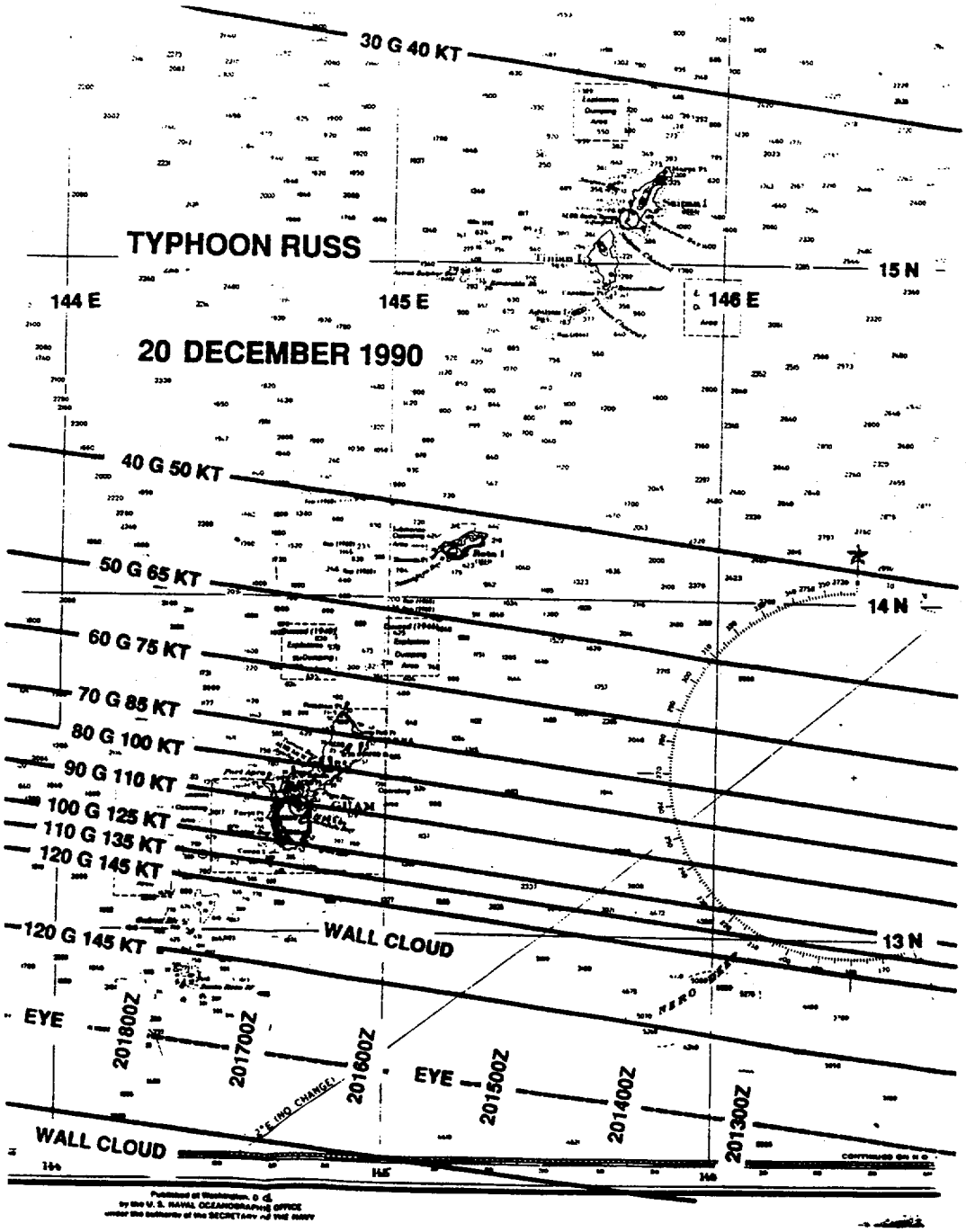

Figure 3-31-9. The post-analysis of the over water winds associated with Russ on 20 and 21 December while its track was nearest Guam. Note the rapid increase of winds near the eye wall.

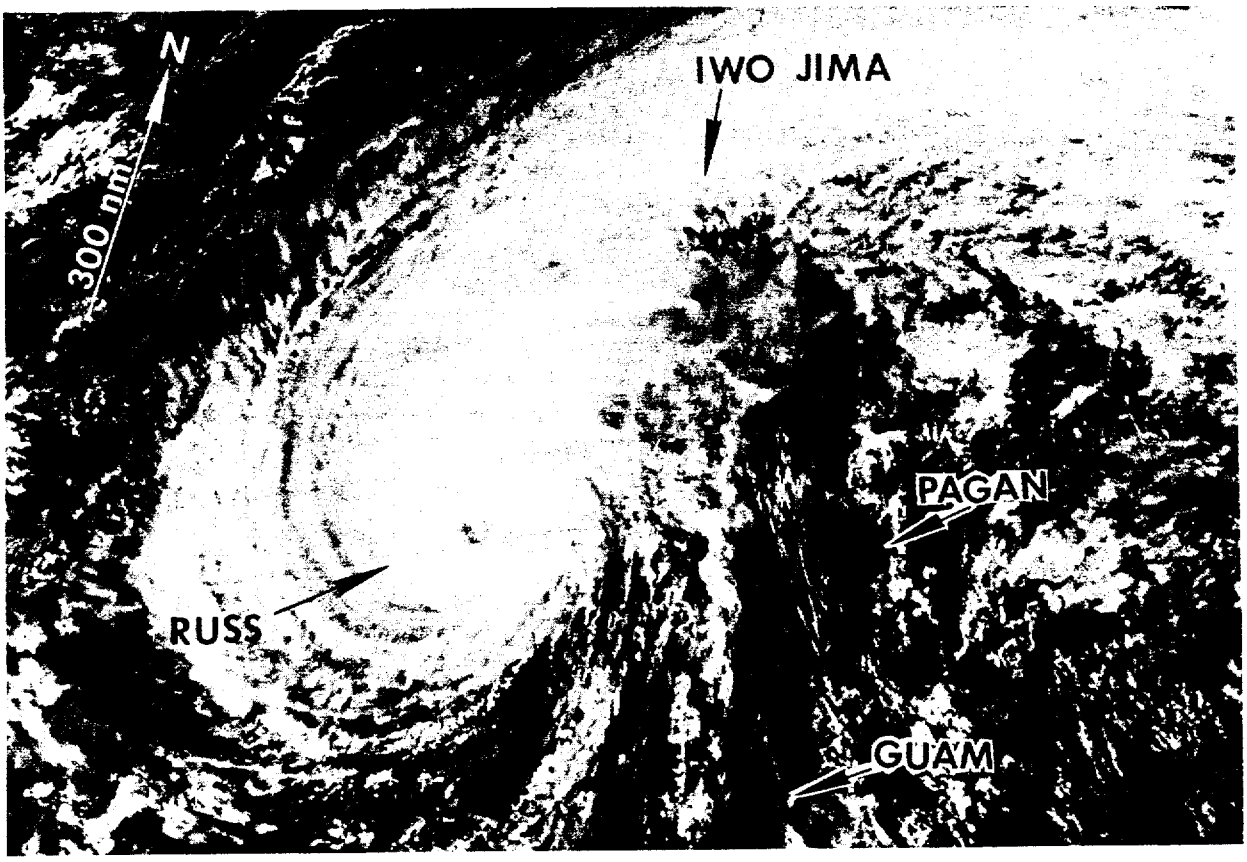

Figure 3-31-10. As Russ starts to move northward, it interacts with the polar westerlies aloft. The eye is still present in a compact central dense overcast, but the typhoon is weakening (220445Z December NOAA visual imagery).

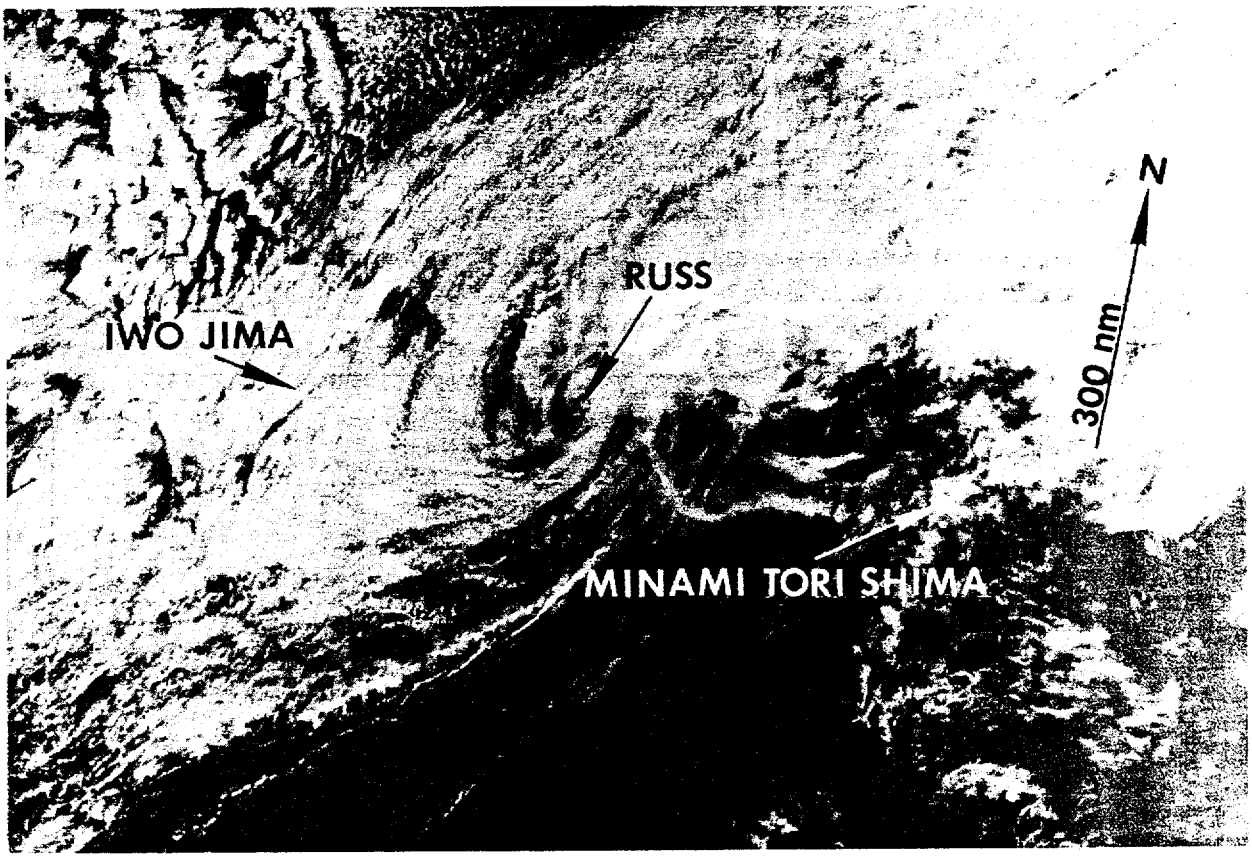

Figure 3-31-11. With the central dense overcast gone, Russ' low-level circulation center is exposed (232302Z December DMSP visual imagery).

V. FORECASTING PERFORMANCE

Overall JTWC forecast performance is shown in Figure 3-31-12. The clustering of the forecasts about the best track indicated that JTWC had a good handle on Russ' direction of motion. The mean cross track (direction) error was roughly one half the magnitude of the along track (speed) errors. This larger mean along track (speed) error was due to problems forecasting slowing and acceleration of Russ east of Guam and its acceleration after recurvature.

Russ influenced JTWC's operations. However, the day before Russ arrived JTWC had anticipated that damage might occur and had transferred all its tropical cyclone data files to the Alternate Joint Typhoon Warning Center (AJTWC) at Pearl Harbor, Hawaii. This transfer paid off because as Russ approached, JTWC began, after 201200Z, to lose most of its data base, including meteorological satellite imagery, analytic and prognostic fields, and objective guidance from Fleet Numerical Oceanography Center at Monterey, California. The increasing winds destroyed the geostationary satellite antenna, the polar orbiting satellite receiver lost power when the back up generator failed and off-island communications were interrupted. In addition, the Andersen AFB weather radar failed at this time, leaving the Federal Aviation Administration's air traffic control radar at Mount Santa Rosa as the only remaining on-island source of fixes. Rather than operate in a degraded mode, JTWC transferred responsibility for warnings to the AJTWC at Pearl Harbor, Hawaii, after the 201800Z warning. A half a day later, JTWC was able to resume normal operations and take the warning responsibility back from AJTWC.

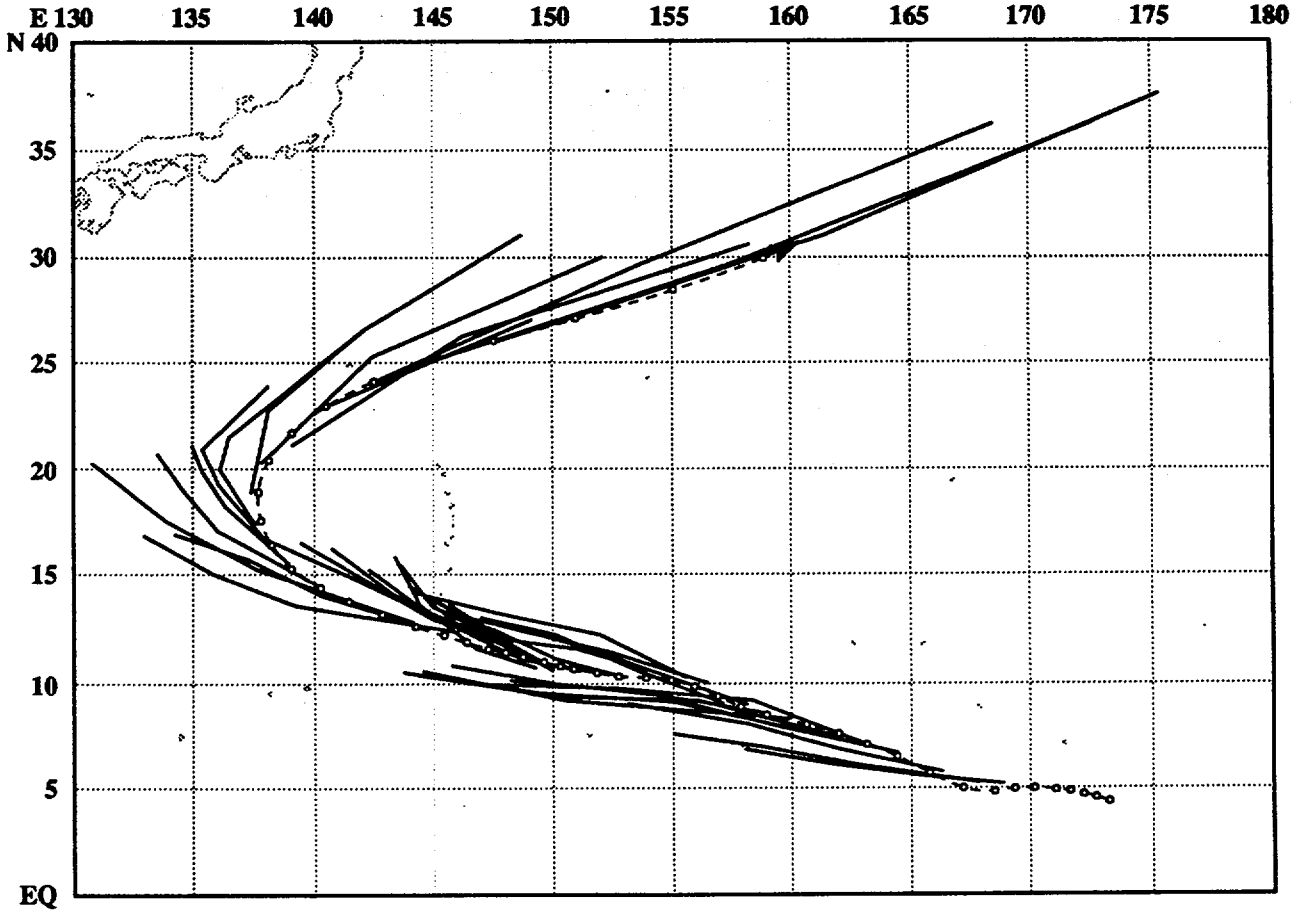

Figure 3-31-12. JTWC forecasts (solid lines) overlaid on the best track (dashed line). The clustering of forecasts shows that the general understanding of the motion toward Guam and of the recurvature track taken by Russ was good.

VI. IMPACT

Russ was the most severe tropical cyclone to hit Guam in 14 years. The island was declared a national disaster area by President Bush on 24 December, and damage estimates were as high as 120 million dollars. Miraculously, no fatalities occurred on Guam and only minor injuries were reported. This was a great credit to the disaster preparedness agencies and communications media which heightened public awareness. At sea, however, one crew member was lost from a Japanese fishing vessel that foundered southeast of Guam, and ten crew members from a South Korean fishing vessel were lost at sea after their 65 ft (20 m) boat apparently broke down south of Guam, directly in the typhoon's path.

The southern end of the Guam experienced the highest sustained winds and the most damage. Russ' winds uprooted many of the island's trees and defoliated much of the island's foliage. Two thousand houses were considered uninhabitable due to unsafe or unhealthy conditions. Of these, 341 houses were destroyed, 460 suffered major damage, and 1210 suffered minor damage. In addition, 10% of the island's total structures sustained some damage. Russ also left most of the island without power and water for several days. On the southern end of Guam, many residences were without power (Figure 3-31-13) and water for more than one week; some experienced outages for several weeks. Most telephones remained in service throughout the typhoon; however, the cable TV network sustained extensive damage. In some place on the southern and southeastern end of the island the combination of storm surge and wave run-up reached levels of 8 to 9 ft (2 to 3 m) above normal and extended inland 240-300 ft (75-90 m). For Guam, Russ was a relatively dry typhoon because the eye wall with its torrential rains passed just to the south, and rain bands were oriented north-south allowing the heavy rain to pass rapidly across the island. Thus, the inhabited part of the island was spared extensive flooding and additional damage.

An estimated 20 million dollars damage was done to civilian housing and 5 million dollars to the infrastructure. Government buildings incurred another estimated 20 million dollars in damage, including an estimated 300,000 dollars at the Oceanview High School to replace the roofing on three classrooms and other school property. The Port Authority of Guam recorded 107,000 dollars in property damage to port service equipment, primarily generators and gantry cranes. Private businesses estimated damage at 31 million dollars. This included 28 million dollars damage to the Cocos Island Resort, located on a small island on the fringing reef at the south end of Guam. The resort will have to be completely rebuilt. In addition, two ships broke their moorings and went aground on the breakwater in Apra Harbor. One of vessels was a three masted dinner cruise ship (Figure 3-31-14); the other was a 220 ft (65 m) commercial fishing vessel. Military losses (Figure 3-31-15) were estimated at over 6.5 million dollars, including 2 million dollars to military housing. It would be months before Guam fully recovered from the fury of Typhoon Russ (Figure 3-31-16).

Figure 3-31-13. Splintered utility pole bares mute testimony to Russ' high winds and termites that never sleep. (Photo courtesy of COMNAVMAR Public Affairs/PH1 Jon Hockersmith)

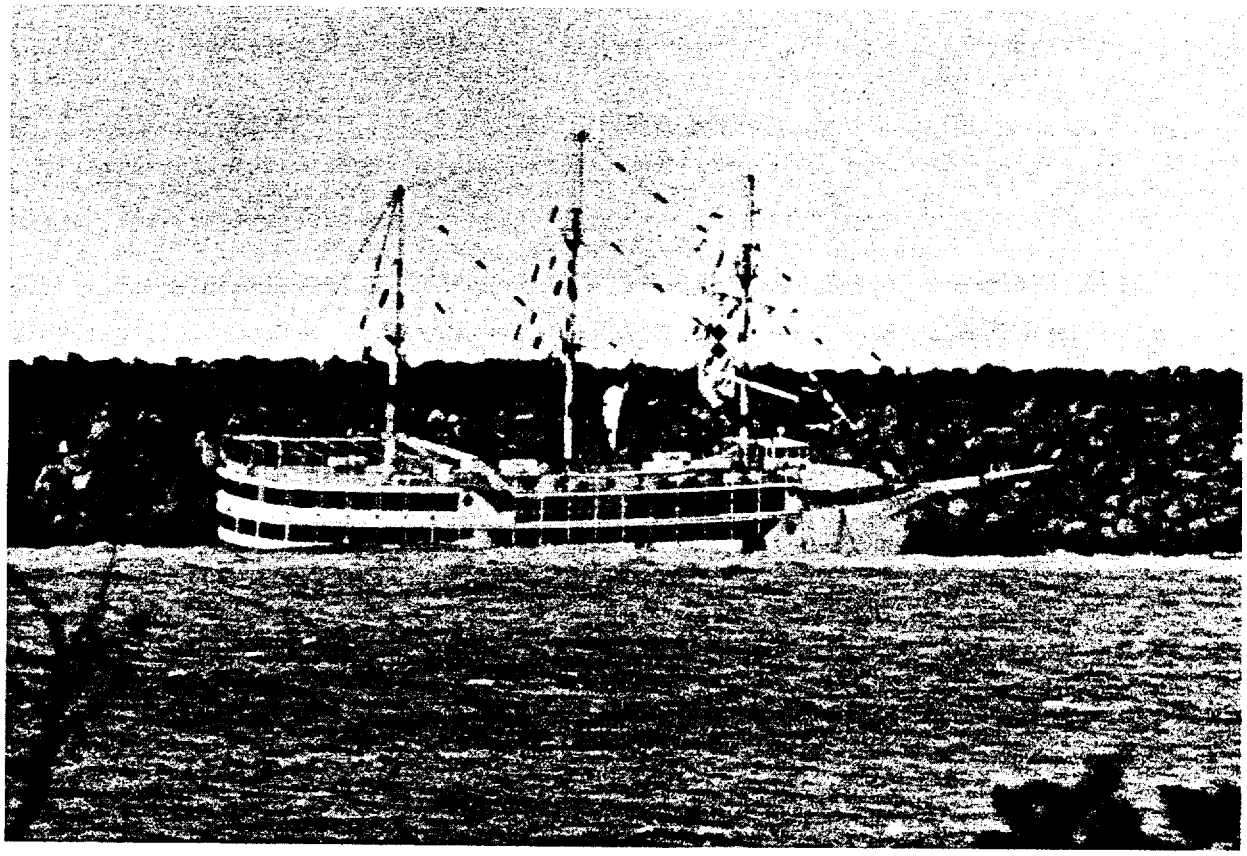

Figure 3-31-14. Dinner cruise ship Courageous aground on the Glass breakwater in Apra Harbor, Guam. (Photo courtesy of COMNAVMAR Public Affairs/PH1 Jon Hockersmith)

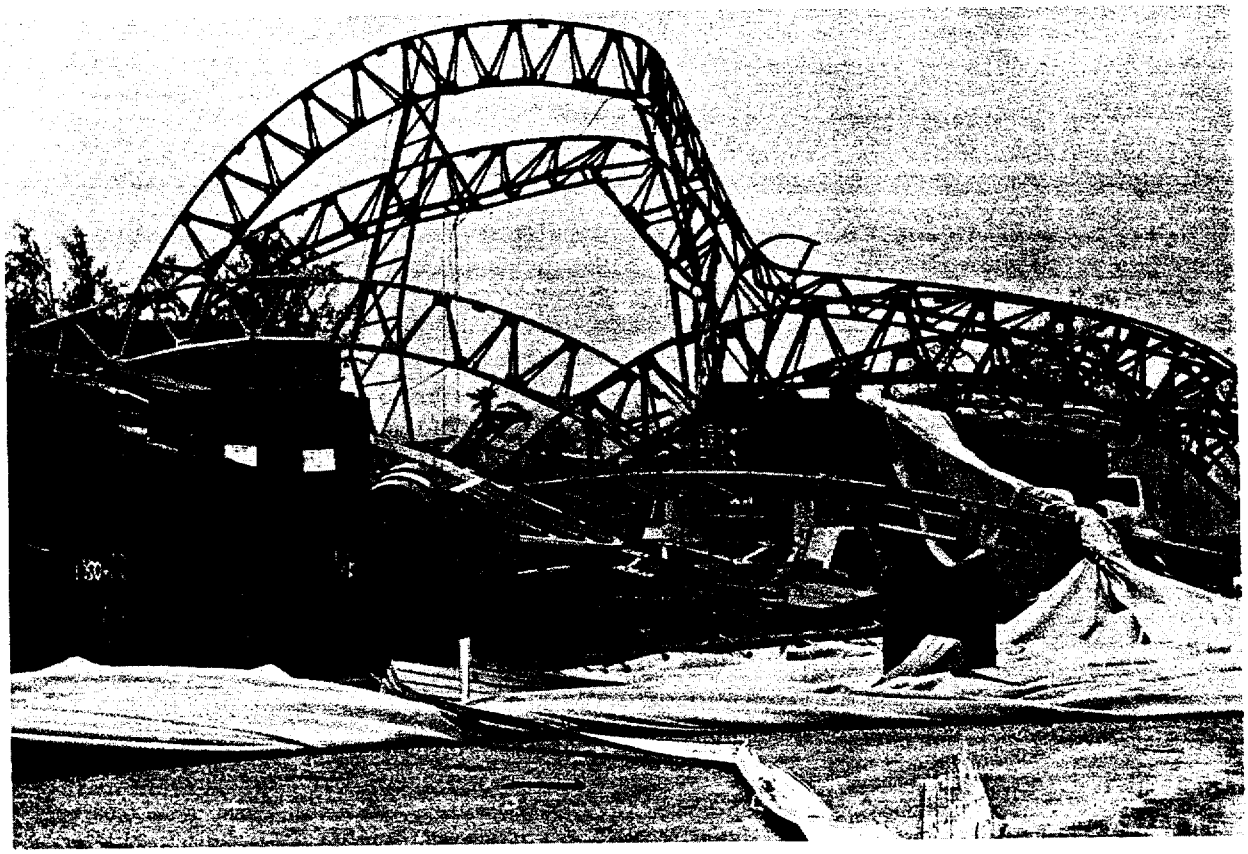

Figure 3-31-15. The steel girders of this temporary warehouse on Naval Station, Guam were twisted by the high winds and collapsed during Russ' passage.

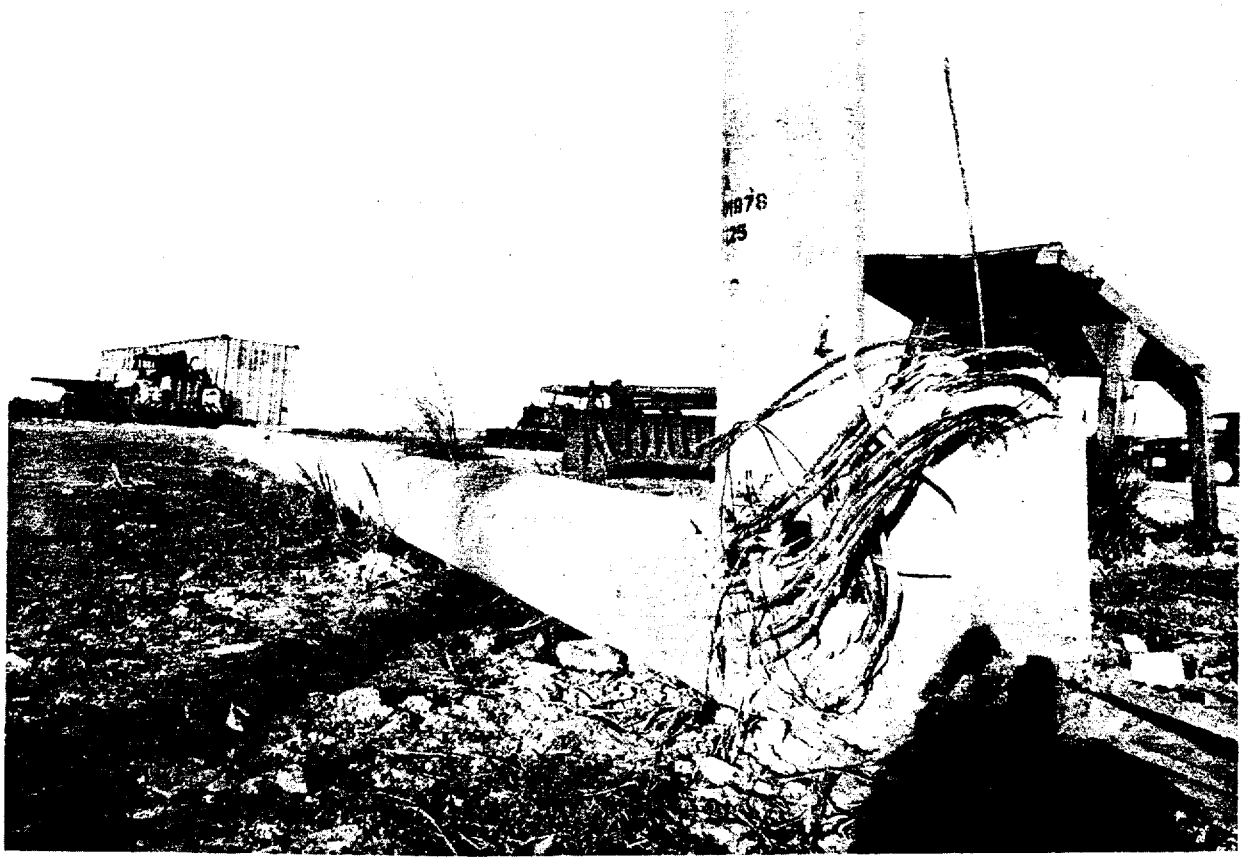

Figure 3-31-16. Concrete power pole on the highway north of Talofofo, Guam. The pole snapped about 5 feet above the ground and fell across the road. It was later pushed out of the road to enable traffic to pass. (Photo courtesy of Det 1, 1 Weather Wing/1Lt Joe Hanser)