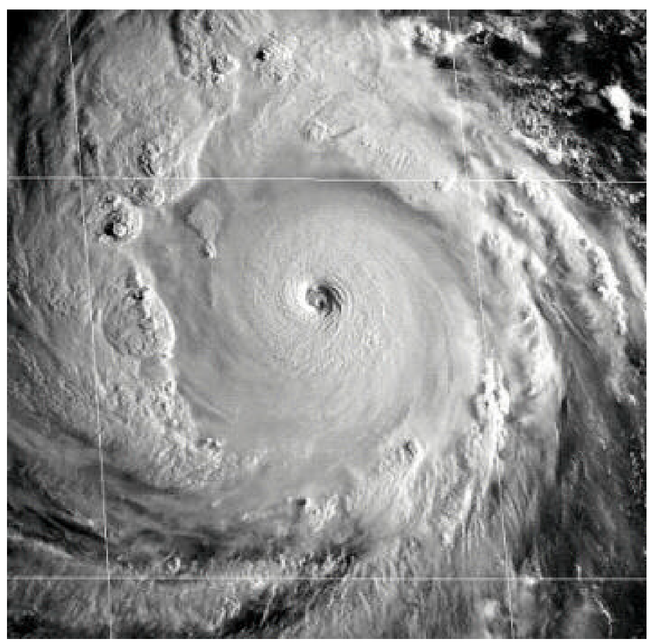
SUPER TYPHOON OLIWA (02C)

I. HIGHLIGHTS

The sixth of eleven tropical cyclones (TCs) to attain super typhoon intensity in the western North Pacific (WPN) during 1997, Oliwa formed east of the international dateline (IDL) and to the southwest of the Hawaiian Islands. After becoming a tropical storm in the Central Pacific Hurricane Center (CPHC) area of responsibility (AOR), this TC was named Oliwa. Oliwa moved on a long straight running track which brought it across the IDL into the WPN, and eventually to landfall in southwestern Japan. As it moved westward from its region of formation in an eastward displaced monsoon trough and into the WNP basin (which was unusually cloud free for the time of year), the intensity forecasts for Oliwa were nearly all too low. Early in its life, Oliwa was accompanied by a weak, unnamed Southern Hemisphere twin. While near its peak intensity, a possible eye-wall meso vortex was revealed by visible satellite imagery. After its peak, well-defined concentric eye wall clouds were observed, which were especially distinct in microwave imagery.

II. TRACK AND INTENSITY

During late August, low-level monsoon westerlies extended across the IDL and stretched eastward at low latitudes to the southwest of Hawaii. At the end of August, a tropical disturbance formed southwest of Hawaii at the eastern end of the monsoon trough associated with these eastward-displaced low-latitude westerlies. This disturbance moved slowly westward and intensified. On 02 September, while it was still east of the IDL, the CPHC (located in Honolulu, Hawaii) upgraded it to Tropical Depression (TD) 02C. After becoming a tropical storm in CPHC's AOR at 030000Z September, TD 02C was named Oliwa (Hawaiian for "Oliver", the letter "w" in Oliwa is pronounced as a "v" in this case). On 04 September, Oliwa crossed the IDL and entered the JTWC AOR. The first warning issued by JTWC was valid at 040600Z September.



3-02C-1 The low-angle morning sun nicely highlights the features of the cloud tops of Oliwa's eye wall cloud and peripheral rainbands as the typhoon reached its peak of 140 kt (72 m/sec) (092034Z September visible GMS imagery).

After crossing the IDL into the WNP basin, Oliwa moved on a steady west-northwestward track and intensified. At first, the rate of intensification was slow; during the 72-hr period from 0600Z on 04 September to 0600Z on 07 September, Oliwa's intensity increased from 35 kt (18 m/sec) to only 50 kt (26 m/sec). After another 30 hours (by 1200Z on the 8th), its intensity had slowly climbed to that of a minimum typhoon (65 kt or 33 m/sec). Between 1800Z on the 08th and 1800Z on the 09th, Oliwa explosively deepened as its intensity climbed from 75 kt (39 m/sec) to its peak of 140 kt (72 m/sec), as shown in Figure 3-02C-1. The 24- hour pressure drop associated with this wind-speed increase was 69 mb (see the discussion below for more details on Oliwa's explosive deepening).

For five days after reaching peak intensity, Oliwa continued its steady motion toward the west-northwest and slowly weakened. On 14 September, the typhoon passed to the northeast of Okinawa where it slowed, and on 15 September, it reached its point of recurvature and turned northeastward toward Kyushu. Early on the morning of 16 September, Oliwa made landfall on the coast of southern Kyushu, where despite having weakened considerably (down to 70 kt - 36 m/sec), it was responsible for loss of life and considerable damage (see the Impacts Section). After landfall, the typhoon moved across Japan and weakened. By the morning of 17 September, it had moved to the Sea of Japan where it dissipated. The final JTWC warning was issued at 170600Z.

III. DISCUSSION

a. Oliwa's Digital Dvorak (DD) time series: a case of explosive deepening

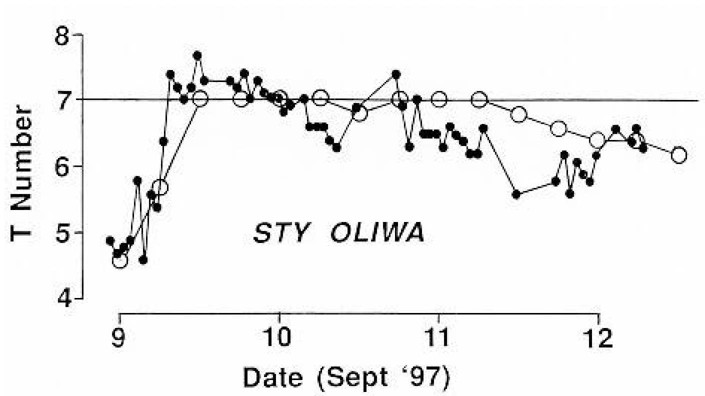


Figure 3-02C-2 A time series of Oliwa's hourly DD numbers (small black dots) compared with the warning intensity (open circles). On 09 September, the TC underwent a period of explosive deepening as indicated by both the DD numbers and the best-track intensities. After reaching its peak intensity, the typhoon's intensity changed very little for nearly two days.

Oliwa was one of several typhoons during 1997 for which a time series of its hourly DD numbers (Figure 3-02C-2) was calculated. Oliwa's DD numbers are in overall agreement with the best-track intensity. The rate of intensification (a drop in the sea level pressure of 69 mb in 24 hours for an average of 2.9 mb/hr), as indicated by both the DD time series and the best-track intensities during the 24-hour period from 1800Z on 08 September to 1800Z on 09 September, qualifies as a case of explosive deepening (a drop of minimum sea level pressure of 2.5 mb/hr for at least 12 hours (Dunnavan 1981)). Many typhoons which reach high peak intensities (i.e., more than 100 kt (51 m/sec)) undergo a period of rapid or explosive deepening which tends to commence when the TC reaches minimal typhoon intensity.

Oliwa's explosive deepening was unforeseen. Neither the official forecasts, nor numerical guidance indicated that this event would take place. The official forecasts prior to Oliwa's peak intensity were up to 40, 60, 65 and 90 kt too low for the 12-, 24-, 48- and 72-hour forecast periods respectively. While much progress has been made toward reducing the errors of track forecasts, and real skill as measured against such benchmarks as CLIPER has been achieved, errors of intensity forecasts remain large, and there is much room for improvements.

b. A possible eye wall mesovortex

Eyewall mesocyclonic vortices (EMs) were first detected and documented in airborne Doppler radar data by Marks and Houze (1984) and also with aircraft inertial navigation equipment as noted by Black and Marks (1991). Stewart and Lyons (1996) identified EMs with the Guam NEXRAD in association with the passage of Ed (1993) over Guam. Until the implementation of the NEXRAD radar network in the United States during the early 1990s, only chance encounters with EMs have occurred during reconnaissance aircraft penetrations. However, now that Doppler velocity data are available, strong mesocyclones associated with TC outer convective bands and eyewall convection are frequently detected. Stewart et al. (1997) used NEXRAD data to show that mesocyclonic vortices in the wall clouds of TC eyes may be a mechanism for TC intensification and for extreme wind bursts in TCs, as noted with Hurricane Andrew damage (Wakimoto and Black 1993). In three cases, a TC underwent a period of rapid intensification during which time several vertically deep EMs formed prior to the occurrence of rapid intensification and persisted for several hours while rapid deepening was occurring.

In the case of Oliwa, a possible EM was observed in its eye on visible satellite imagery (Figure 3-02C-3) in the early daylight hours of 10 September. Possible EMs were evident on only two image frames: at 092030Z and 092130Z September. Unlike the cases investigated by Stewart et al. (1997), the EMs observed in Oliwa's eye wall cloud occurred after the TC had reached its peak intensity.

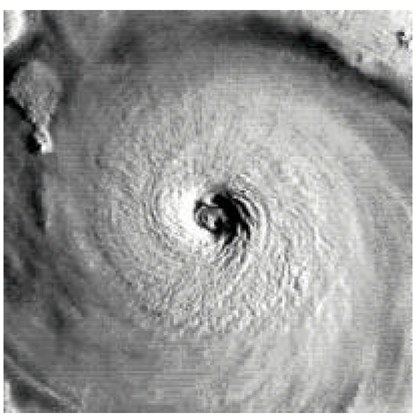


Figure 3-02C-3 A small comma shaped cloud along the inner edge of Oliwa's eye wall cloud is a possible manifestation of an eyewall mesovortex. This image is a zoom of the eye and eye wall cloud which appears in Figure 3-02C-1 (092034Z September visible GMS imagery).

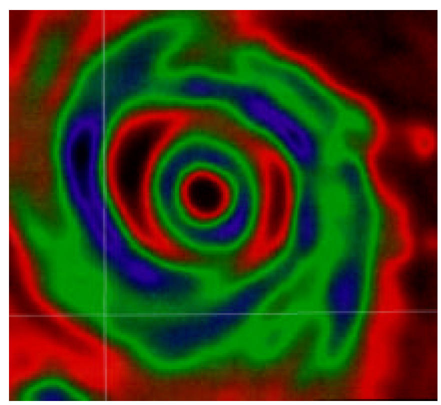


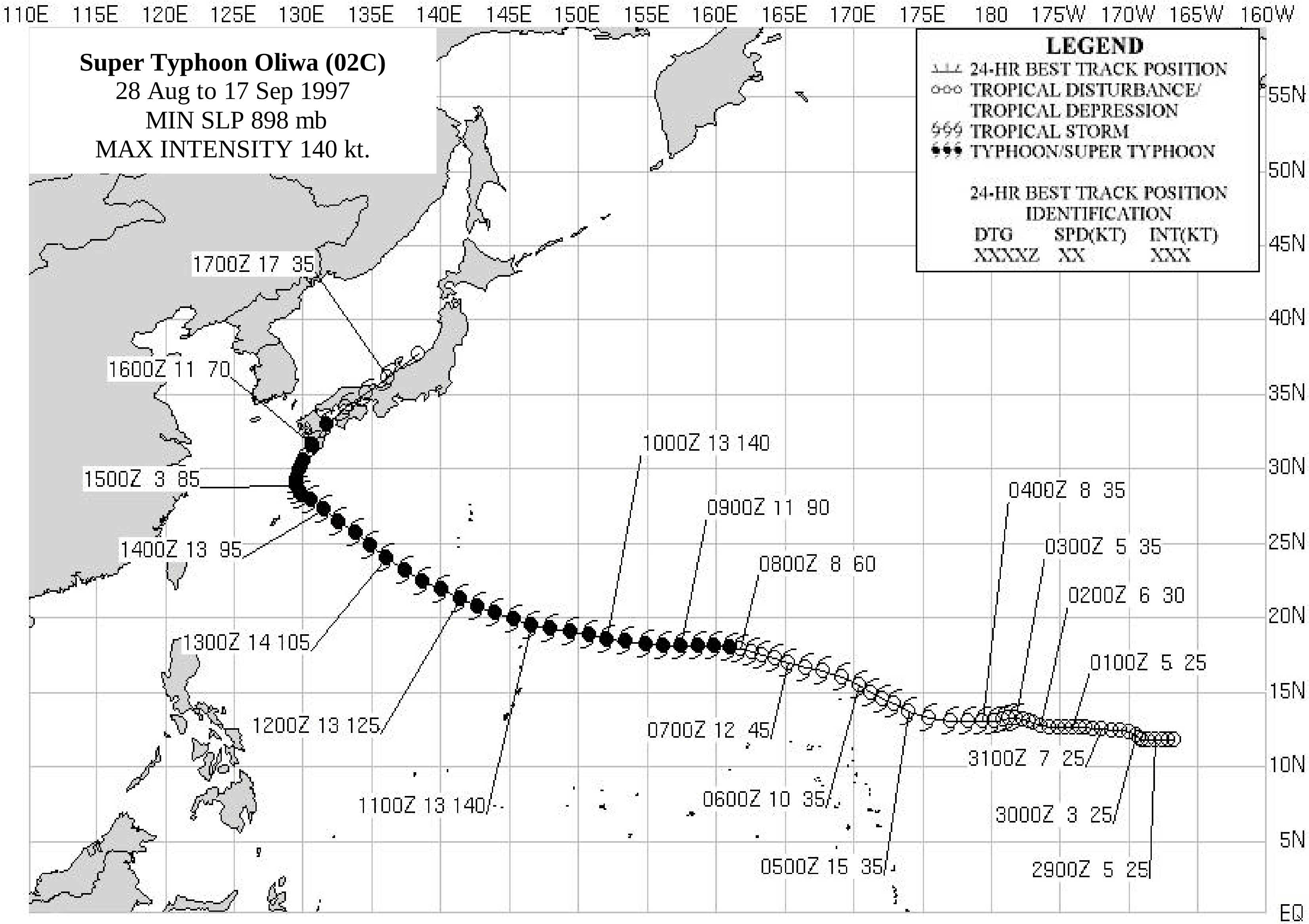
Figure 3-02C-4 Microwave imagery is especially suited to view concentric wall clouds in a TC. Oliwa developed well-defined concentric wall clouds as it began to weaken (120104Z September 85 GHz horizontally polarized microwave DMSP imagery).

c. Concentric wall clouds

Oliwa was yet another example of an intense WNP typhoon acquiring concentric eye wall clouds which were easily seen on conventional visible and infrared imagery, and especially well-defined on microwave imagery (Figure 3-02C-4). Microwave imagery is particularly well-suited to observe and document the evolution of concentric eye wall clouds (e.g., Paka's (05C) eye-wall replacement cycle was exceptionally well documented on microwave imagery) There is a tendency for high-end typhoons (i.e., those with peak intensity greater than 100 kt (51 m/sec)) to develop concentric eye wall clouds.

IV. IMPACT

Oliwa made landfall in southwestern Japan where it was responsible for widespread damage and for loss of life. On Japan's southern island of Kyushu, seven people were reported killed. One thousand homes were flooded and dozens of homes were destroyed. Along Korea's southern coast, twenty-eight ships sank or were wrecked in strong winds and high waves. A crabbing ship with 10 crewmen aboard was reported missing. Earlier in its life, Oliwa passed close to the island of Agrihan in the Marianas, which reported winds of about 85 mph (74 kt). No reports of damage or injuries were received at JTWC.



Super Typhoon Oliwa (02C)
28 Aug to 17 Sep 1997
MIN SLP 898 mb
MAX INTENSITY 140 kt.
LEGEND
24-HR BEST TRACK POSITION
TROPICAL DISTURBANCE/ TROPICAL DEPRESSION
TROPICAL STORM
TYPHOON/SUPER TYPHOON
24-HR BEST TRACK POSITION IDENTIFICATION
DTG SPD(KT) INT(KT)
XXXXZ XX XXX
110E 115E 120E 125E 130E 135E 140E 145E 150E 155E 160E 165E 170E 175E 180 175W 170W 165W 160W
55N 50N 45N 40N 35N 30N 25N 20N 15N 10N 5N EQ
1700Z 17 35
1600Z 11 70
1500Z 3 85
1400Z 13 95
1300Z 14 105
1200Z 13 125
1100Z 13 140
1000Z 13 140
0900Z 11 90
0800Z 8 60
0700Z 12 45
0600Z 10 35
0500Z 15 35
0400Z 8 35
0300Z 5 35
0200Z 6 30
0100Z 5 25
3100Z 7 25
3000Z 3 25
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