

SUPER TYPHOON VIOLET (26W)

I. HIGHLIGHTS

As the long-lived Orson (19W) recurved at the beginning of September, the unusual monsoon flow pattern of August (See Figure 3-13-4 in Kirk's summary) gave way to a pattern more in line with climatology: the maximum cloud zone and the axis of the monsoon trough extended from the Philippines east-southeastward into Micronesia. Violet was the fourth of five significant TCs to form in this trough. At one point, Tom (25W), Violet, Willie (27W) and a subtropical (ST) low existed simultaneously along the trough axis (see Figure 3-25-1a, b in Tom's (25W) summary). Due to the relative motions of these TCs (and the ST low), the trough axis became reverse oriented. Violet was one of three TCs during 1996 which acquired a very large eye — the other two were Kirk (13W) and Orson (19W). Passing just off the southeastern tip of the Japanese main island of Honshu, Violet was responsible for extensive damage and loss of life.

II. TRACK AND INTENSITY

On 10 September, an area of deep convection began to consolidate into a discrete tropical disturbance located between the Philippines and Guam. The early stages of this tropical disturbance were somewhat complicated as noted in the remarks on the 100600Z Significant Tropical Weather Advisory: "An area of convection is located near 13N 140E. Satellite imagery and synoptic data indicate this is a convective region formerly associated with Tropical Depression 24W that has separated from TD 24W and remained quasi-stationary as TD 24W moves west. . . ." On 11 September, the disturbance became better organized, and remarks on the 110600Z Significant Tropical Weather Advisory included:

"The area of convection previously located near 13N 140E [has moved west]. . . . Synoptic data indicate this convective region lies near a broad cyclonic circulation along the monsoon trough. . . ."

Further consolidation of the deep convection and rapid improvements in the organization of the convection and of its outflow cirrus prompted JTWC to issue a Tropical Cyclone Formation Alert at 111100Z September, followed by the first warning on Tropical Depression (TD) 26W, valid at 111800Z. This is the same valid time for the first warning on the tropical depression that became Tom (25W) — a TC located approximately 1000 nm (1900 km) to the east-southeast of TD 26W. At the time of the first warning on TD 26W, NOGAPS was indicating TD 25W (Tom) would become the dominant system and engulf the smaller circulation of TD 26W. The official forecast reflected the dynamic guidance and dissipated TD 26W as a significant tropical cyclone in 36 hours. The dynamic guidance was in error, and TD 26W intensified and eventually became a large intense TC with a size comparable to that of Tom (25W) (see Figure 3-25-1b in Tom's summary). TD 26W was upgraded to Tropical Storm Violet on the warning valid at 121800Z. The system became a typhoon at 130600Z and reached its peak intensity of 130 kt (67 m/sec) at 160000Z (Figure 3-26-1).

After becoming a typhoon, Violet turned and began to move very slowly toward the northwest. When the typhoon reached its peak intensity at 160000Z, it began to track slowly toward the northeast in tandem with Tom (25W) (located approximately 1100 nm (2050 km) to Violet's east-northeast). The turn to the northeast of Violet and of Tom (25W) was associated with the monsoon trough acquiring a reverse orientation. Whereas Tom continued to intensify while moving northeastward, Violet began to weaken. As it weakened, its eye became very large (Figure 3-26-2) (see the discussion). Slowly gaining forward speed, Violet continued to weaken as it moved toward the

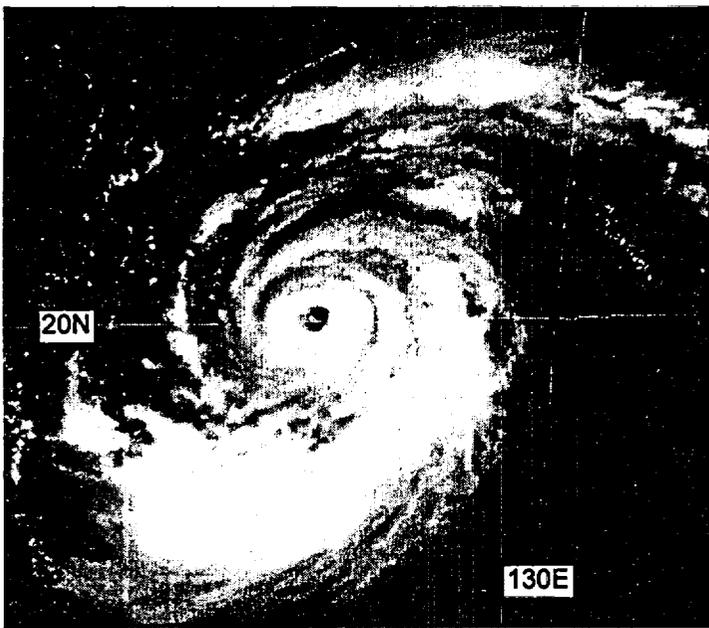


Figure 3-26-1 Violet at its peak intensity of 130 kt (67 m/sec) (160131Z September visible GMS imagery).

northeast. Its large eye passed just offshore to the east of the Tokyo area. High winds and heavy rains caused damage and loss of life in southeastern Japan (see the Impact section). The final warning was issued valid at 230000Z as the typhoon continued on a northeastward track toward the eastern end of the Kuril Island chain where it became an extratropical low.

III. DISCUSSION

a. Violet's behavior in a reverse-oriented monsoon trough

The monsoon trough within which Violet was embedded, became reverse oriented by virtue of the relative motion of Tom (25W) and Violet (see Figure 3-25-3 in Tom's summary). Both of these TCs moved on similarly shaped tracks, however,

there was a gradual cyclonic rotation of the two about their centroid so that Tom, once east-south-east of Violet, moved so as to be located to the east-northeast of Violet. For more details on the characteristics of TC motion in a reverse-oriented monsoon trough see Tom's (25W) summary.

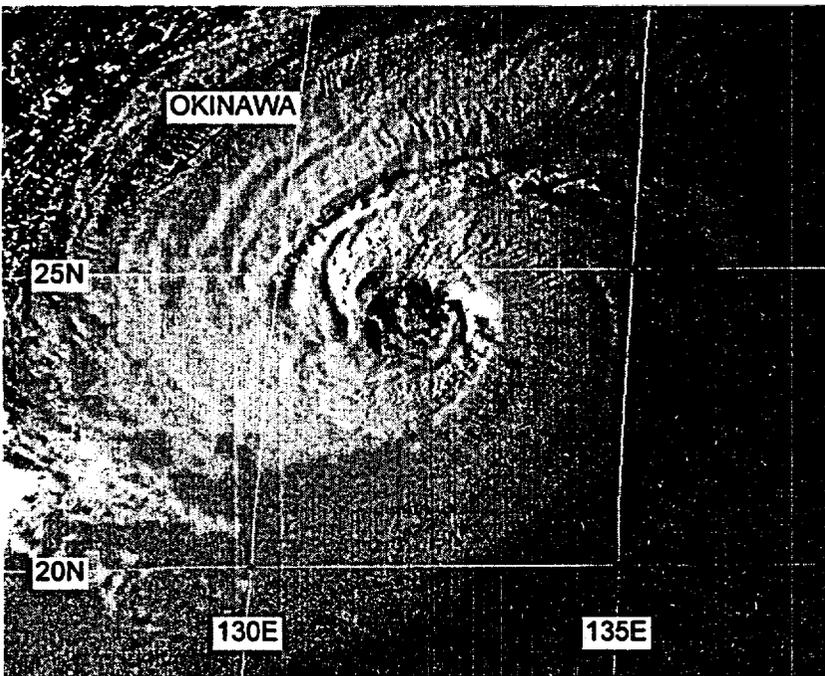


Figure 3-26-2 Violet was one of three WNP TCs during 1996 which acquired a very large eye with a maximum satellite-observed diameter greater than 75 nm (140 km) (190831Z September visible GMS imagery).

b. Very large eye

Violet was one of three TCs during 1996 — the other two were Kirk (13W) and Orson (19W) — that acquired very large eyes. Violet's eye evolved greatly during its life: it was at times a banding eye, a large ragged eye, an eye with concentric wall clouds, a small well-defined eye, and a very large eye. The changes in the character of Violet's eye were reflected in fluctuations of Violet's digital Dvorak (DD) numbers (Figure 3-26-3). From 172330Z to 201130Z Violet's satellite-observed eye diameter exceeded 45 nm (85 km) (Figure 3-26-4). From 190450Z to 192030Z the eye diameter ranged from 62 to 79 nm (115 to 145 km) (Table 3-26-1).

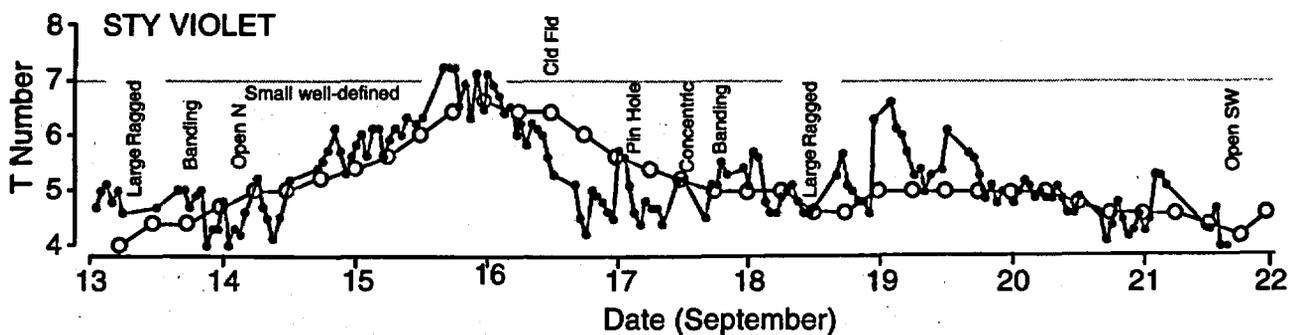


Figure 3-26-3 Violet's DD time series for the period 130130Z September through 211830Z September. Small black dots are the hourly DD values, open circles are the best track intensity (converted to a T number). Comments on the structure of the eye are included.

Table 3-26-1 Eye diameter of Violet from satellite during its period of very large eye size.

DTG (Z)	T Number	Satellite-derived eye diameter (nm)
172330	4.0	52
180230	---	45
180330	---	65
180430	---	42
180501*	4.0	58
180511*	4.0	64
182030	---	46
182111	4.5	55
182330	5.0	63
190230	---	59
190450	4.5	76
190530	5.0	62
190828	4.5	72
190830	---	78
191130	5.0	75
191630	---	79
191730	5.0	78
192030	---	71
192330	4.5	59
200230	---	49
200430	4.5	51
200830	---	64
201130	4.0	72

* These fixes are from different agencies using the same NOAA-14 pass.

c. Gravity waves

When Violet passed through the eastern part of the Kuril Island chain on 24 September, the rugged high islands produced a spectacular display of gravity waves in the low and middle cloud field (Figure 3-26-5). Such displays of terrain-induced gravity waves are commonly observed in the flow of typhoons which are becoming extratropical. Stabilization of the lower atmosphere by ocean chilling sets up conditions favorable for these gravity waves. In the deep tropics (e.g., over the islands of the Philippines), terrain-induced gravity waves in the circulation of a TC are far less common.

IV. IMPACT

Violet was responsible for killing seven people and injuring 44 others in southeastern Japan. Based on radar and satellite data, the center of Violet's large ragged eye passed approximately 80 nm (150 km) to the east-southeast of the Tokyo metropolitan area, and about 30 nm (55 km) east of the coastal cities of Tateyama and Choshi in Chiba prefecture. The western wall cloud passed over Tokyo and nearby areas, dumping 10.4 inches (265 mm) of rain in 24 hours on Tokyo's main business district (the third-largest 24-hour rainfall recorded there since 1876), and producing wind gusts to near 100 kt (51 m/sec) in exposed coastal areas. Tateyama (on the

southern tip of Chiba prefecture) recorded a peak gust to 106 kt (55 m/sec) and a minimum SLP of 969 mb. No significant damage occurred at Fleet Activities Yokosuka, although numerous trees were uprooted or blown down and fencing along a sea wall was torn down due to wave action.

Figure 3-26-4 A close-up view of Violet's very large eye. The relatively clear region in the eye has a diameter of approximately 60 nm in this image (190038Z September visible DMSP imagery).

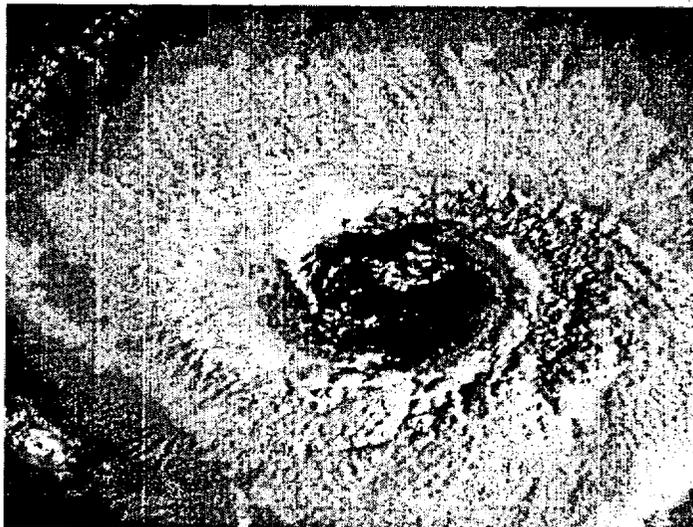


Figure 3-26-5 A multitude of gravity waves is apparent in the low and middle clouds of Violet as the system moves northeastward over the Kuril Islands (240332Z September visible GMS imagery).