

**TROPICAL STORM
WINONA**

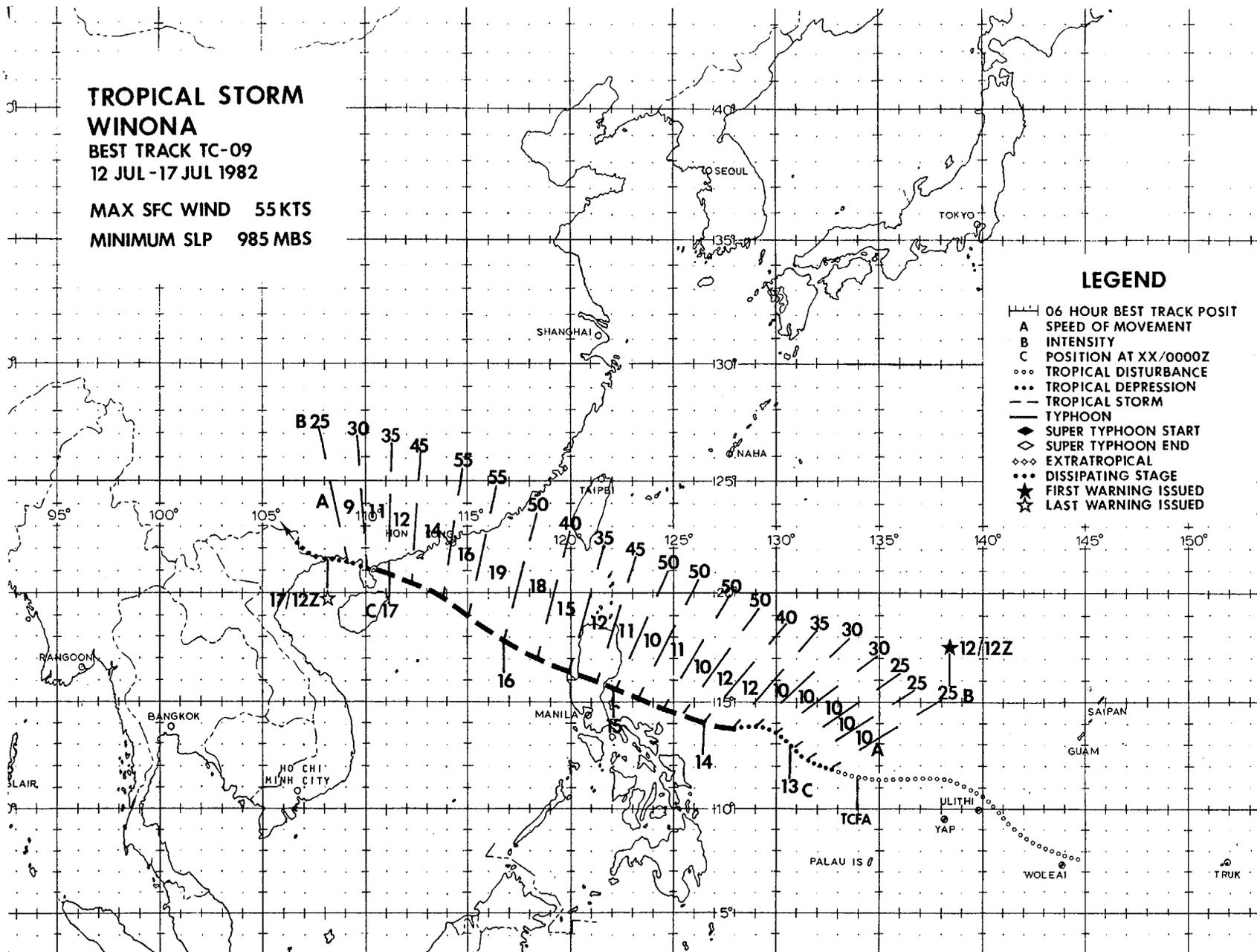
**BEST TRACK TC-09
12 JUL -17 JUL 1982**

**MAX SFC WIND 55KTS
MINIMUM SLP 985 MBS**

LEGEND

- 06 HOUR BEST TRACK POSIT
- A SPEED OF MOVEMENT
- B INTENSITY
- C POSITION AT XX/0000Z
- ⋯ TROPICAL DISTURBANCE
- ⋯ TROPICAL DEPRESSION
- TROPICAL STORM
- TYPHOON
- ◆ SUPER TYPHOON START
- ◇ SUPER TYPHOON END
- ◇ EXTRATROPICAL
- ⋯ DISSIPATING STAGE
- ★ FIRST WARNING ISSUED
- ☆ LAST WARNING ISSUED

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TROPICAL STORM WINONA (09)

Tropical Storm Winona exemplifies tropical cyclone development without corresponding upper-level support. The presence of strong upper-level winds is often an inhibiting factor for significant tropical cyclone development. Based on JTWC's 200 mb synoptic data and streamline analyses, a strong subtropical ridge centered over central China was reinforcing strong upper-level winds over the Philippine Sea and South China Sea (See Figure 3-09-1). This situation persisted throughout Winona's warning period. The presence of 35 to 45 kt (17 to 23 m/sec) northeasterly winds in the upper-troposphere over Winona prevented the development of a strong anticyclonic outflow pattern and was a major factor in restricting further development to typhoon strength.

Winona's entire intensification process was slow. Between 10 and 12 July, three Tropical Cyclone Formation Alerts (TCFA) were issued as satellite imagery, synoptic and reconnaissance aircraft data revealed a persistent, but weak, disturbance moving westward through a primary tropical cyclone genesis region between Guam and the Republic of the Philippines. Reconnaissance aircraft investigative missions on the 10th and 11th found a weakly organized system with minimum sea level pressures of 1008 mb. At 121200Z, synoptic data gave the first indication that the disturbance was intensifying as gradient-level winds reported by Yap (WMO 91413) increased to 25 kt (13 m/sec). Simultaneously, the 200 mb streamline analysis indicated the development of a weak anti-

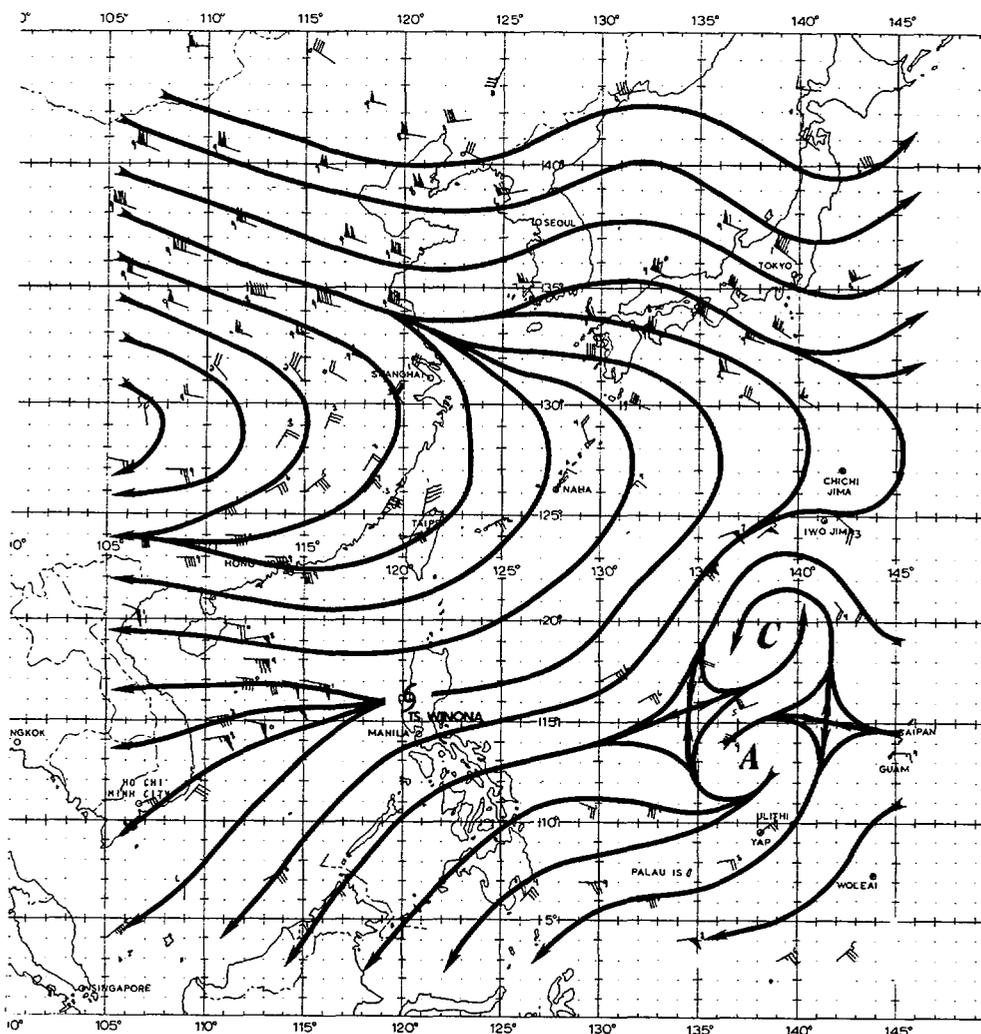


Figure 3-09-1. 200 mb streamline analysis at 151200Z July. Strong upper-level northeasterly winds prevent the development of outflow channels to the north.

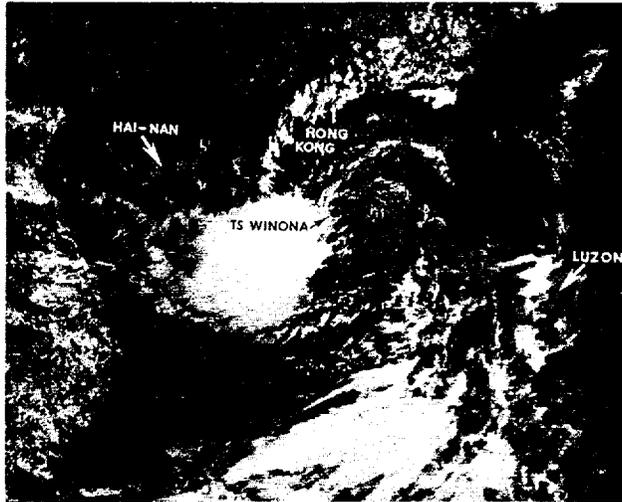


Figure 3-09-2. Tropical Storm Winona at 55 kt (28 m/sec) intensity, 400 nm (741 km) northwest of central Luzon. Even at maximum intensity, Winona's upper- and lower-level centers are not aligned due to the presence of strong upper-tropospheric winds. 160707Z (NOAA 7 visual imagery).

cyclone over the disturbance. This information, combined with increasing convection and organization (apparent on satellite imagery), prompted the issuance of the initial warning for Tropical Depression 09 at 121400Z. Subsequent aircraft reconnaissance at 130036Z confirmed JTWC's suspicions of intensification when it was reported that the minimum sea level pressure had dropped to 1000 mb.

From the initial warning, JTWC forecasts predicted that Winona would move into a region of strong upper-level winds which would inhibit its development. Thus, a maximum intensity of 50 kt (26 m/sec) was forecast prior to Winona's expected landfall upon central Luzon. Winona's intensity and movement were well-forecast during this period as it

proceeded west-northwestward along the southern periphery of the subtropical ridge, centered along 25N.

By 140600Z, Winona reached the forecast 50 kt (26 m/sec) intensity which it maintained until landfall on Luzon at 150500Z. As Winona crossed central Luzon, it passed 35 nm (65 km) north of Clark AB, where maximum sustained winds recorded were 23 kt (12 m/sec) with peak gusts to 30 kt (15 m/sec). Reported damage to the surrounding region was estimated at \$275,000 with 272 families left homeless as a result of severe flooding.

Winona entered the South China Sea as a minimal tropical storm, but upon reaching open waters, its convection increased and Winona reintensified to a peak intensity of 55 kt

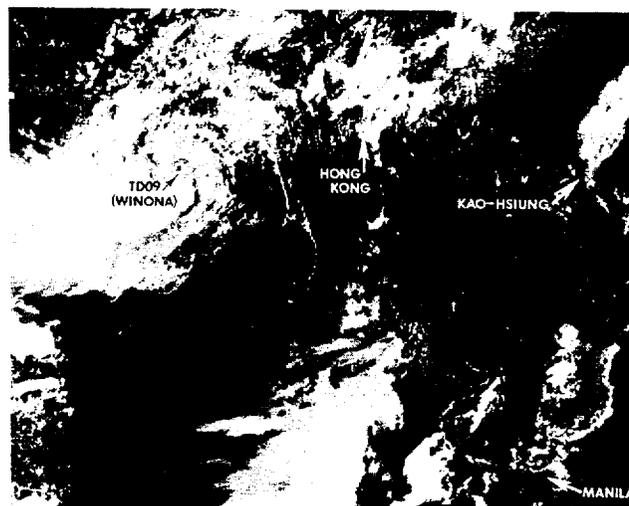


Figure 3-09-3. Winona after being downgraded to a tropical depression 210 nm (389 km) west-southwest of Hong Kong. Notice the persistent strong upper-level shear. 170655Z July (NOAA 7 visual imagery).

(28 m/sec) at 160600Z (Figure 3-09-2). This intensification occurred even though 40 kt (21 m/sec) 200 mb winds persisted over the area. However, based on limited 500 and 700 mb data, it appears that the strong winds did not extend into the mid-tropospheric levels. This situation allowed Winona's convection to develop well into the mid-tropospheric levels while the strong upper-level winds provided a sufficient outflow channel to the southwest.

Winona was forecast to move northward along the western periphery of the subtropical ridge upon entering the South China Sea. However, a 500 mb synoptic track completed by the 54th Weather Reconnaissance Squadron at 151200Z showed that a second ridge had developed east of Taiwan, resulting in a steering flow over the South China Sea

toward the west-northwest. The 151800Z and subsequent forecasts reflected this new information and projected Winona on a west-northwestward track, with landfall expected southwest of Hong Kong.

After reaching maximum intensity on 16 July, Winona weakened as wind shear in the mid- and upper-layers increased. Winona became an exposed low-level system as its convective center was sheared to the southwest early on 17 July. By 170600Z, Winona was downgraded to a tropical depression as it passed 40 nm (74 km) north of Hai-Nan Island (See Figure 3-09-3). Further dissipation as a significant tropical cyclone occurred as it moved toward the China-Vietnam coastline on 18 July.