

## TYPHOON COLLEEN (28W)

Forming just north of the Marshall Islands, Colleen passed through the northern Mariana Islands before recurving south of Japan. The tropical cyclone maintained typhoon intensity until it completed extratropical transition. Also, Colleen threatened PACEX 89 — the largest US Navy exercise conducted in the Pacific since the Korean War. Colleen underscored the difficulty of tracking poorly organized systems with only nighttime infrared satellite imagery, but also showed the value of the microwave imager data as a tool to help locate these systems.

In the last week of September, Super Typhoon Angela (26W) was forming in the Philippine Sea and Typhoon Brian (27W) in the South China Sea. A deep trough penetrated into the tropical northwestern Pacific near the dateline. An area of cloudiness formed at the base of the trough on 23 September and moved slowly southwestward toward the Marshall Islands. In the data sparse area there were no

indications of a surface circulation until 271200Z when pressure falls and wind shifts throughout the northern Marshall Islands reflected the passage of a surface circulation or a tropical wave. JTWC first identified the disturbance as a suspect area on the Significant Tropical Weather Advisory at 280600Z. The disturbance was tracked on the Advisories for the next three days until a Tropical Cyclone Formation Alert was issued at 010030Z October. At that time, based on satellite imagery, the disturbance was analyzed as moving west-northwestward at 15 kt (28 km/hr). Forecasters noted that gradient-level winds at Guam (WMO 91217) had slowly veered from the south-southeast to the west-northwest from 290000Z September until 010000Z October despite the presence of Tropical Storm Angela (26W) to the west of Guam.

The Alert was reissued at 011400Z when satellite analysts determined that the disturbance was moving westward at 9 kt (17

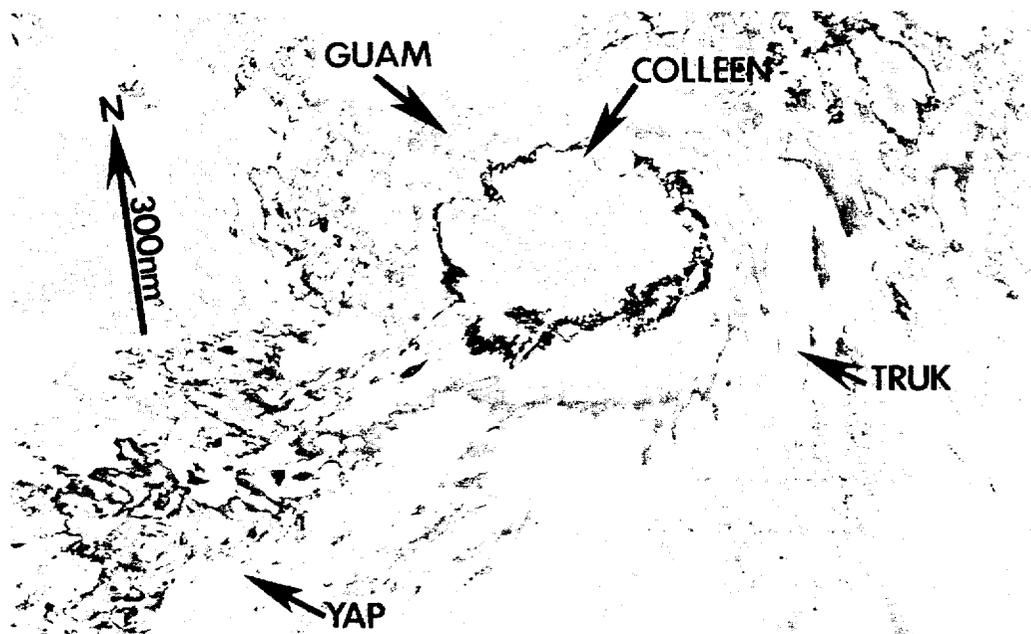


Figure 3-28-1. Tropical Storm Colleen approaching Guam (021159Z October DMSP enhanced infrared imagery).

km/hr). The first warning on Tropical Depression 28W followed at 011800Z after satellite imagery indicated the development of a central dense overcast. The depression was upgraded to Tropical Storm Colleen with the second warning at 020000Z. The forecasts for the initial five warnings called for the system to track south of Guam, however, the accompanying Prognostic Reasoning Messages discussed the possibility of a "stair step" in response to the passage of a short wave trough indicated by the NOGAPS prognostic series.

Tracking Colleen (Figure 3-28-1) became a problem during the night of 2 October. Earlier in the evening, a USAF contractor was installing a computer at Detachment 1, 1WW to process and display DMSP microwave imager information. Between 020800Z and 020900Z, microwave imager data from the 85-gigahertz channel was acquired and processed. These data were able to "see through" the high overcast clouds and the analyst could locate the center of the tropical storm and verify the positions obtained from the infrared channel. Subsequent nighttime infrared positions, without the benefit of the microwave data,

indicated that the system was moving west-northwestward in excess of 12 kt (22 km/hr). The 021200Z satellite fix placed the position of the storm within 100 nm (185 km) of Guam, but neither the weather radar at Andersen AFB nor the Air Traffic Control radar operated by the Federal Aviation Administration on Guam could confidently locate the center. Because of the contradictory information presented by the satellite fixes, the lack of central or banding features on radar, and the absence of falling pressures that should accompany a rapidly approaching system, the 021200Z warning position was based only partly on the satellite-derived position. In the post-analysis, the 021200Z satellite position was 96 nm (178 km) west of the final best track position. The average error of the eight infrared satellite fixes made during the night of 2 October was 68 nm (126 km) compared to the 20-nm (37-km) average error for the visual fixes on the 2 and 3 October. Warning number five, valid at 021800Z, was amended at 022300Z and relocated the position of the system to the north based on the first available visual satellite imagery. Also, at that time, 24-hour surface pressure falls at Saipan (WMO 91232) in-

### 24 HOUR PRESSURE FALLS 020300Z - 030000Z

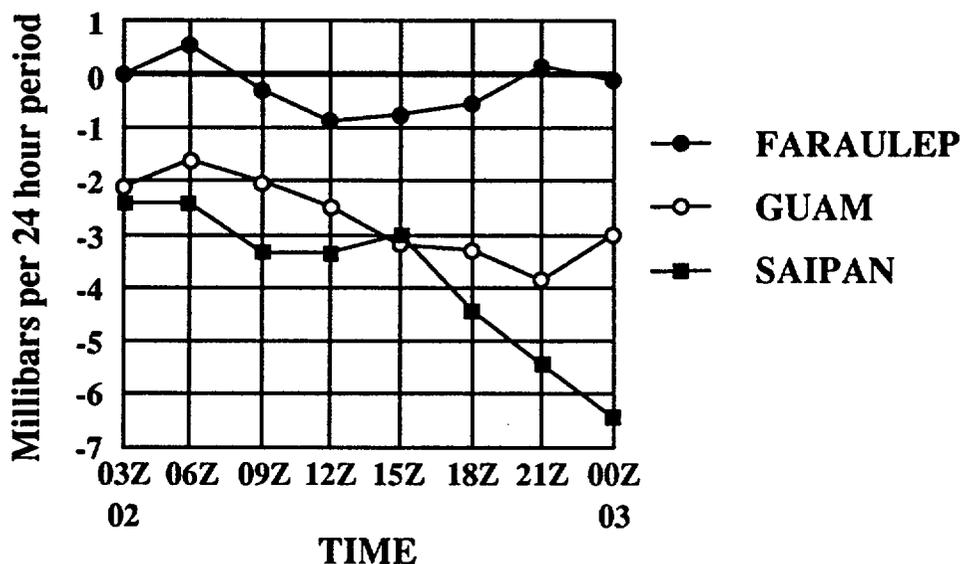


Figure 3-28-2. Twenty-four hour pressure falls at Guam, Saipan, and Faraulep from 020300Z through 030000Z.

creased while Guam (WMO 91212) and the Faraulep AMOS station (WMO 52005) indicated slowing trends (Figure 3-28-2). The relocated position indicated the system had tracked northwestward during the night and was moving towards a weakness in the subtropical ridge. JTWC's amended warning took the system near Saipan in 36 hours. Colleen would eventually pass 120 nm (220 km) to the east of Guam and 30 nm (55 km) to the northeast of Saipan. Colleen tracked northwestward through the northern Marianas (Figure 3-28-3) passing within 60 nm (110 km) of the islands of Pagan and Farallon de Pajaros -- both proposed sites for future Automated Meteorological Observing Stations (AMOS). Heavy rains during Colleen's passage caused widespread flooding on Guam.

Warning number 6, valid at 030000Z, called for the start of recurvature in the vicinity

of Iwo Jima near the 72-hour point. However, Colleen slowed to 5 kt (9 km/hr) on 5 October and recurvature was delayed until 061800Z. Subsequent warnings retained the recurvature scenario well south of Japan with significant acceleration to the northeast.

At 040600Z, satellite imagery indicated a partial eyewall, and Colleen was upgraded to a typhoon. The system reached peak intensity at 051200Z -- 210 nm (390 km) southeast of Iwo Jima -- and weakened only slightly as it headed for its recurvature point. Ships involved in PACEX 89 altered course to avoid any encounter with Colleen. After 061800Z, the tropical cyclone moved northeastward and weakened to 70 kt (36 m/sec). Colleen maintained its intensity but doubled its speed of movement to 21 kt (39 km/hr) during the next 18 hours, and almost doubled it again to 40 kt

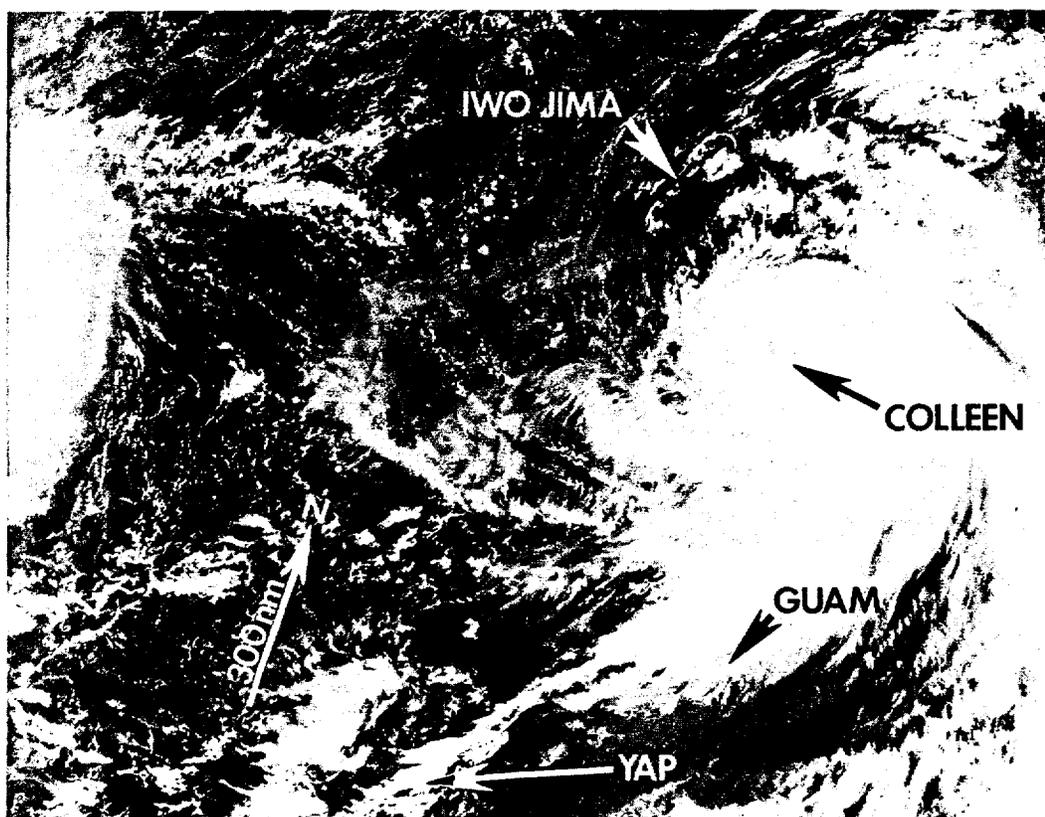


Figure 3-28-3. Typhoon Colleen leaving the northern Marianas. The cloud mass on the left is Typhoon Angela (26W) (042358Z October DMSP visual imagery).

(74 km/hr) during the following 12 hours.

JTWC issued its final warning at 080600Z (Figure 3-28-4) when Colleen was approximately 660 nm (1220 km) east of northern Honshu moving at 54 kt (100 km/hr) to

the northeast and still packing sustained winds of 70 kt (36 m/sec). It became one of the most intense extratropical cyclones of the year. In satellite imagery at 081200Z the extratropical remnants of Colleen were discernible near 46° north latitude.

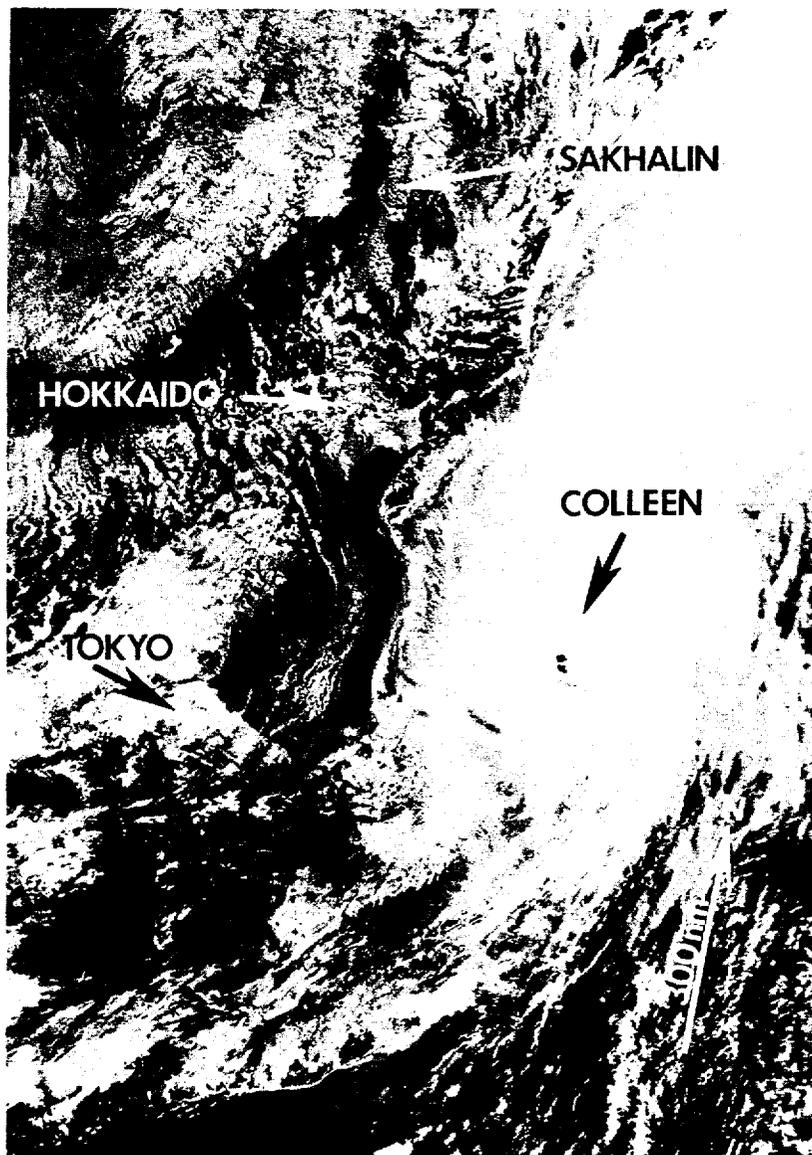


Figure 3-28-4. Typhoon Colleen undergoing extratropical transition (080344Z October NOAA visual imagery).