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METEOROLOGICAL ASSESSMENT FOR SUPER TYPHOON PONGSONA AT LANDFALL ON GUAM – DECEMBER 8, 2002.

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1. INTRODUCTION

On the early morning of December 8, 2002 Typhoon Pongsona came into the range of the Andersen Air Force Base (Guam) Weather Surveillance Radar—1988 Doppler (WSR-88D), which indicated that the typhoon was continuing to move on a track toward Rota and Guam. Later on that day (a Sunday), the center of the eye passed to within 10 n mi of Guam's northeast coastline, with the southwestern semicircle of the eye wall cloud traversing most of the island (Figs. 1 and 2).

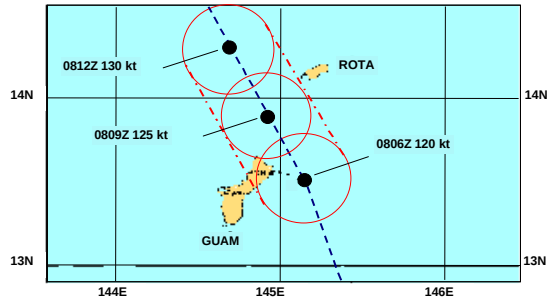

Figure 1. The 8 Dec 0600 UTC, 0900 UTC, and 1200 UTC positions (black dots) of Typhoon Pongsona as the eye passed over Guam and between Guam and Rota. The red circles indicate the inner edge of the eye wall cloud.

While over Guam, the eye of Pongsona extended from central Guam to near the island of Rota. The western half of the eye entered the northeast side of Guam at about 0600 UTC on December 8 and exited the northwest side of the island about 0830 UTC the same day. The relative calm of the eye lasted about 2 hours and 30 minutes at Andersen Air Force Base to only a few minutes in parts of central Guam. Most of the southern half of the island remained in the eye wall cloud, being pounded continuously by strong winds and heavy rains. Pongsona was one of the worst typhoons to strike Guam in recent history. It was Guam's third most intense typhoon in a 102-year span, exceeded only by Super Typhoon Karen in 1962 and the Typhoon of 1900. Typhoon Paka in 1997 equaled Pongsona in intensity while over Guam. Preliminary damage estimates for Guam totaled more than $700 million which placed Pongsona in the top five typhoons for damage.

Estimating Pongsona's intensity while it was over Guam was a difficult task since nearly all instrumentation failed. Barometric readings of a minimum central SLP of 935 mb converted to wind speeds (using operational typhoon wind-pressure relationships) yielded values of wind speed that were certainly too low for the level of damage on Guam, and also as compared with intensity estimates made from satellite imagery. The National Weather Service commissioned both a meteorological assessment and a service assessment for Pongsona. This presentation gives some of the findings of the meteorological assessment of Pongsona.

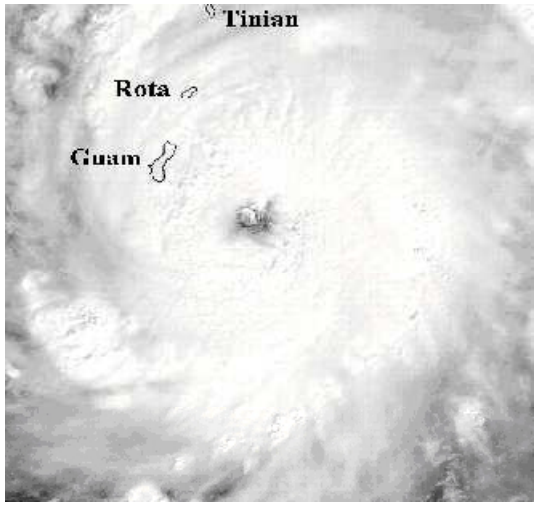

Figure 2. MODIS visual imagery 072222 UTC December 2002 of Typhoon Pongsona as it approaches Guam. The center of the eye is about 75 n mi (86 miles) southeast of Guam. (Courtesy of Chris Velden, CIMSS.)

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2. LANDFALL ASSESSMENT

a) Intensity

As part of the NWS Meteorological Assessment, the intensity of Pongsona when over Guam was determined. Hampering this effort was the fact that virtually all of the wind sensors on the island failed during the period of maximum winds. Several lines of evidence were used to estimate the intensity: (1) Dvorak Analysis (Dvorak 1975, 1984) of METSAT data (Fig.3); (2) considerations of TC wind-pressure relationships (Fig. 4); (3) a peak gust from an anemometer operated by Air Traffic Control; and, (4) considerations of damage. Based on all of the available data, the over-water intensity of Pongsona as it passed across Guam was 125 knots (144 mph) with gusts to 150 knots (173 mph). Typhoon Pongsona exposed the most populated and developed part of the island to the strongest winds, with winds over 100 knots (115 mph) lasting more than 6 hours in some west coast locations. Often during these wind assessments, one or more of the components of the analysis falls outside the expected range of values, clouding the picture and increasing the uncertainty. However, in the case of Pongsona, all of the components fit nicely in to a very narrow 12-knot (14-mph) window of maximum wind speed, with a sharp peak at 125 knots (144 mph).

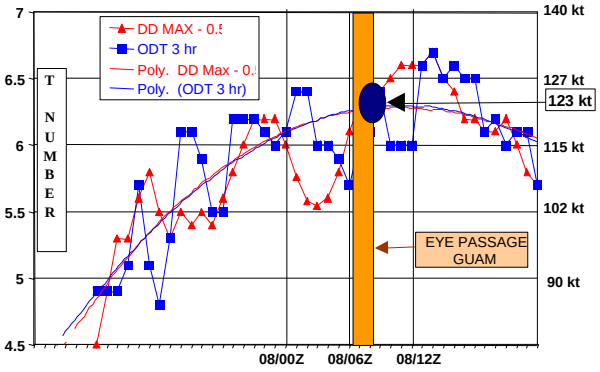

Figure 3. Intensity analysis of meteorological satellite imagery using Zehr's Digital Dvorak (DD) technique: maximum possible T number minus 0.5 T-number (triangles); and, the Velden-Olander Objective Dvorak Technique (ODT) (Velden, et al., 1998): 3-hour moving average (squares). The respective polynomial best-fit curves are also shown. Black oval indicates the intensity range with a peak near 123 knots (142 mph) as the eye of the typhoon exited the island.

b) Rainfall

Rainfall from Typhoon Pongsona was heavy across central parts of the island, with some locations receiving over 20 inches. The 24-hour rainfall for WFO Guam was 19.67 inches ending at 1350 UTC. A NASA TRMM tipping-bucket recording rain gauge at the Andersen AFB measured a 24-hour rainfall total of 20.68 inches and a maximum 1-hour rain rate of 7.56 inches (Fig. 5). Storm-total rainfall and short-term rain rates were similar at other sites. Analysis confirmed a simple pattern to the rainfall that was a function of the geometry of the typhoon and the line-of-passage that each site made through the typhoon with respect to the eye and eye wall.

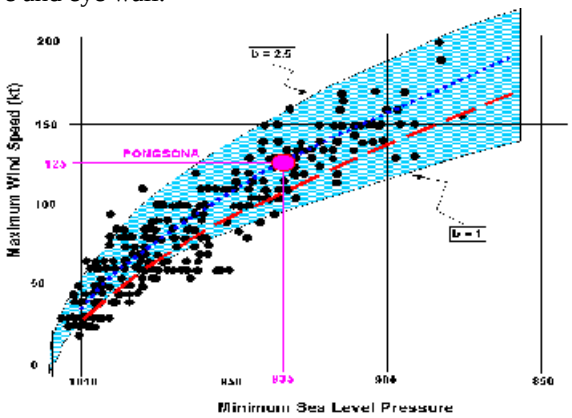

Figure 4. Relationship between maximum sustained wind and minimum sea-level pressure, where "b" values indicate theoretical limits of the relationship. Dots are actual aircraft reports for 1960's and 1970's prior to JTWC's use of the Atkinson-Holliday (1974) wind-pressure relationship (dashed line). Dotted line is the best-fit solution that provides the value used for Pongsona in this assessment.

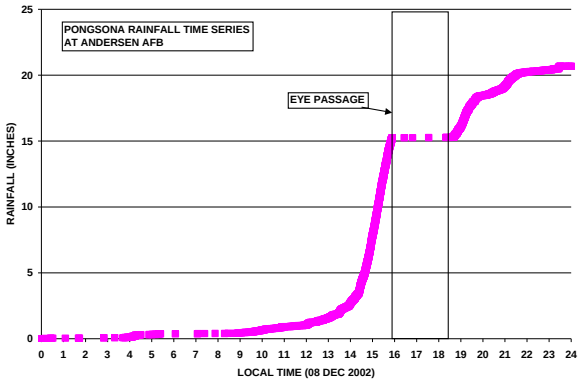

Figure 5. Rainfall time series from a NASA TRMM tipping bucket rain gage located at Andersen AFB. Rain rates in excess of 7 inches in one hour were experienced during the first half of the typhoon. The rain-free eye is clearly evident.

3. CONCLUSIONS

All methods of estimating the intensity of Pongsona while over Guam were in good agreement. The wind-pressure relationship used by the JTWC for typhoons needs to be reevaluated. Rainfall rates were enormous with a pattern governed by the typhoon geometry.

References

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Atkinson, G. D., and C. R. Holliday, 1977. *MWR.*, **105.**
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