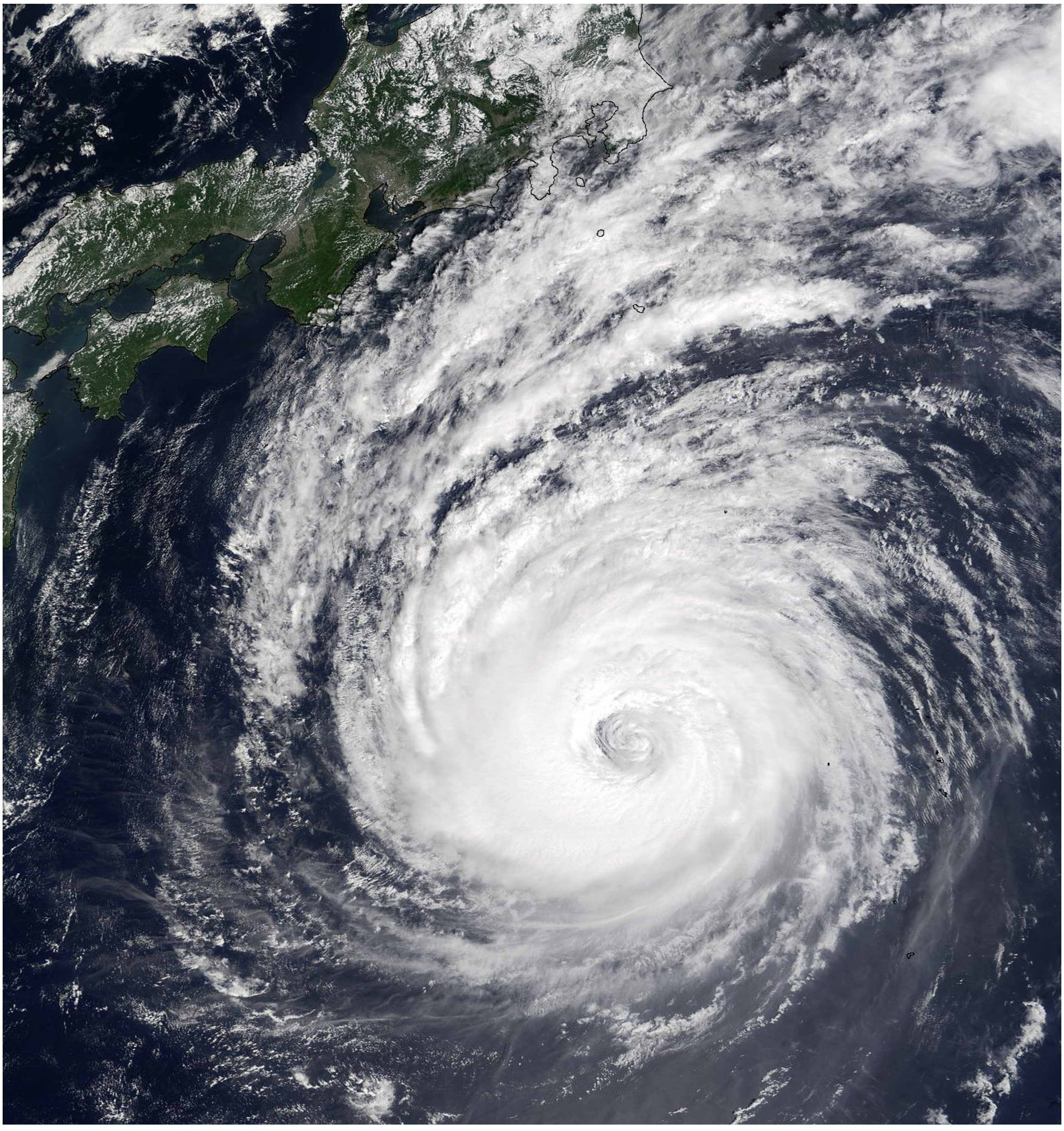
# 2002
# Annual Tropical Cyclone Report

U.S. Naval Pacific Meteorology and Oceanography Center/ Joint Typhoon Warning Center
Pearl Harbor, Hawaii



This true-color Moderate Resolution Imaging Spectroradiometer (MODIS) image captured on 17 August depicts Supertyphoon 19W (Phanphone) south of Honshu before it made a sharp turn northeast. The maximum sustained surface winds were estimated to be 130 knots.

# Pete Furze

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Commanding Officer

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# 6. APPLIED TROPICAL CYCLONE RESEARCH SUMMARY

## 6.1 CONSENSUS APPROACH TO TC FORECASTING (Jeffries, R.A., Fukada, E.M., NPMOC/JTWC)

This paper gives an overview of consensus forecast research and discusses the Joint Typhoon Warning Center (JTWC) use and development of consensus forecast techniques for tropical cyclone track forecasting. The use of simple consensus forecast guidance at the JTWC has resulted in three straight record forecast seasons in the western North Pacific even with a 100% turnover in the forecast staff. The use of consensus model blends for tropical cyclone track forecast guidance is discussed in detail. Early consensus forecast results and the evolution of consensus forecasting at the JTWC are described, along with results of the first two years of a three-year test of the Systematic Approach to Tropical Cyclone Forecasting Aid (SAFA) at the JTWC.

SAFA provided JTWC with a systematic process to refocus the TC track forecast process on use of consensus forecast guidance as the first-guess forecast track. The Non-selective CONsensus (NCON) (a simple blended consensus of five available dynamic models) was a major contributor to JTWC forecast improvement during the 2000 TC season. SAFA also enabled the development of a thorough mental picture of the evolution of the TC environment, which increases forecaster understanding, standardizes the forecast process, and facilitates forecaster training. But, another basic element of SAFA, the development of Selective Consensus (SCON) forecasts, proved to be of little value to the JTWC warning process when compared to a consensus of all available dynamic models.

Consensus forecasts do not apply to all forecast scenarios and much work is needed to help forecasters rapidly identify the cases where consensus forecasts lack skill. JTWC continues to refine the consensus forecast process, develop new consensus forecast tools and expects to experiment with consensus forecasting to improve TC intensity and structure predictions. Data are also presented that show the value of extending these two new consensus forecasts to 120 h.

6.1.1 Introduction to the Consensus Forecasting Approach.

At the Fourth WMO/ICSU International Workshop on Tropical Cyclones (IWTC-IV), it was suggested that the systematic use of ensembles could aid the forecaster in information management and result in improved tropical cyclone (TC) track forecasts. A demonstration project to document the use of ensembles was suggested as a way to identify where improvements can be made.

The Joint Typhoon Warning Center (JTWC) has experimented with and inconsistently used ensemble type forecast methods for approximately 10 years. Since 2000 the JTWC has been systematically applying simple ensembles of dynamic model forecasts to the TC track forecast problem.

State University, Mark DeMaria NOAA/NESDIS, and C. R. (Buck) Sampson, Naval Research Laboratory)

6.5 NRL MODIFICATIONS TO JTWC CONSENSUS TOOLS (C. R. (Buck) Sampson, Naval Research Laboratory)

6.6 ON-SCENE ANALYSIS OF TROPICAL CYCLONES USING NUMERICAL WEATHER PREDICTION DATA (CDR Mike Fiorino, USNR, fiorino@tenkimap.com, METOC Department Head NR NRL Science & Technology 220, Naval Air Reserve Center supporting NRL and JTWC)

6.7 SATELLITE APPLICATIONS AT THE JOINT TYPHOON WARNING CENTER (Lt Col Greg Engel, NPMOC/JTWC)

The idea of using a consensus of various objective or dynamical model tracks as a tool in developing a tropical cyclone (TC) track forecast is not new. Aberson (2001) noted that "...ensemble forecasting has been used operationally since the middle 1960s at the National Hurricane Center…."

It has been and continues to be common practice for a forecast center to plot all available dynamic and objective model TC track forecasts and subjectively evaluate this guidance considering the recent-past motion, the synoptic situation, known error characteristics of the various track forecasts and other factors. This subjective evaluation at the JTWC has resulted in very accurate official forecasts when the numerous numerical track forecasts were in basic agreement.

In the mid-1990's, Goerss proposed that TC track forecasts by regional and global numerical models be used to produce a simple ensemble average or consensus forecast. Goerss (1998) presented data that indicated that "the overall forecast performance of simple ensemble, determined by averaging the forecast positions for the three global models in the western North Pacific, was superior to that of the best model, JGSM." In February 1998, Goerss presented similar findings at the Department of Defense (DoD) Tropical Cyclone Conference (TCC) at the U.S. Forces Center, Tokyo Japan. Goerss (1999) also evaluated the extension of consensus forecast to 96 h and 120 h in the North Atlantic and further evaluated the consensus forecast technique using three global models and two regional models (Goerss 2000a,b). He found that the average consensus track errors were smaller than the average errors for each of the individual models. Goerss, op. cit., also found that the consensus forecasts provided either the most accurate or second-most accurate TC track forecast in more than 70% of the cases. At the 2001 DoD TCC, Goerss and Sampson described the potential improvements from using COAMPS and MM5 in the 72 h consensus forecasts. At this same conference, Goerss also described findings that indicated that the quality of the 120 h consensus forecasts in the western North Pacific would be greatly improved with the inclusion of the AVN/MRF and ECMWF global models.

Elsberry and Carr (2000) used the same five models evaluated by Goerss (2000a) to evaluate consensus forecasts and the consensus error versus the linear spread of the numerical forecasts (distance from 72-h consensus position to the farthest track position of the five models). Based on these findings, Elsberry and Carr proposed that the forecaster could improve on the large spread consensus forecasts by eliminating erroneous track(s) to form a "selective consensus" forecast. Subsequently, Carr and Elsberry (2000a, b) developed conceptual models for detecting large consensus forecast error situations.

Aberson (2001) investigated the "ensemble mean" of most of the model track guidance available at the U. S. National Hurricane Center (NHC), Miami, FL from 1976 to 2000 and determined that numerical guidance available at the NHC had improved since 1976. Aberson also concluded that the ensemble forecast process needed more development to further develop forecast reliability and forecast distribution potential.

Weber (2002a, 2002b) developed a statistical ensemble prediction system (STEPS) that uses the model performance during the previous year as a weighting factor for use in consensus forecasts. Results with STEPS showed a mean positive skill for Atlantic TC track predictions of more than 15% relative to all major dynamical models and the official National Hurricane Center forecasts for the 1997-2000 TC dataset.

In a different approach to Goerss (2000a), Krishnamurti et al. (2000) created a consensus of two global models and one spectral model of the Florida State University (FSU), the GFDL model, the UKMO model and NOGAPS to predict storm tracks and intensities during the 1998 Atlantic hurricane season. In the 'training period' of Krishnamurti's method, statistical weights were determined for each individual model. The individual model forecasts of all storms except the one to be predicted and all available model forecasts of the ensemble members were subjected to a linear multiple regression relative to best track information to derive the statistical weights of the expected performance of each ensemble member. In the 'forecast period' the weighted individual forecasts of all ensemble members were used to produce track and intensity predictions. Krishnamurti et al. justified this cross-validation approach based on the major modifications made to some of the models after 1997. With mean position errors of about 125, 190 and 260 km at 24, 48, and 72 h, respectively, the average guidance was found to be significantly better than that of each individual model and the official NHC forecast.

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5.1 WARNING VERIFICATION STATISTICS

5.2 WESTERN NORTH PACIFIC AND NORTH INDIAN OCEAN VERIFICATION TABLES

TS 01W Tapah

STY02W Mitag

TD 03W

TD 04W

STY05W Hagibis

TD 06W

TY 07W Noguri

STY08W Chataan

TY 09W Rammasun

STY10W Halong

TS 11W Nakri

STY12W Fengshen

TS 13W

TY 14W Fung-Wong

TD 15W Kalmaegi

TS 16W Kammuri

TD 17W

# 5. TROPICAL CYCLONE WARNING VERIFICATION STATISTICS

## 5.1 WARNING VERIFICATION STATISTICS

The verification data in this chapter includes best tracks (6-hourly positions and intensities), and JTWC forecasts (12-, 24-, 36-, 48-, and 72-hour position, and intensity). These data are archived and available for download from the JTWC web page.

## 5.2 WESTERN NORTH PACIFIC AND NORTH INDIAN OCEAN VERIFICATION TABLES

This section includes this year's verification statistics for each western North Pacific and North Indian Ocean tropical cyclone warned on by JTWC.

**Statistics for JTWC on TS 01W Tapah**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02010806 | | 6.7N | 141.1E | 20 | | | | | | | | | | | | | | | | |
| 02010812 | | 7.1N | 140.3E | 20 | | | | | | | | | | | | | | | | |
| 02010818 | | 7.6N | 139.5E | 20 | | | | | | | | | | | | | | | | |
| 02010900 | | 8.3N | 138.7E | 25 | | | | | | | | | | | | | | | | |
| 02010906 | | 8.9N | 137.8E | 25 | | | | | | | | | | | | | | | | |
| 02010912 | | 9.3N | 136.7E | 25 | | | | | | | | | | | | | | | | |
| 02010918 | | 9.4N | 135.8E | 25 | | | | | | | | | | | | | | | | |
| 02011000 | | 9.3N | 135.0E | 25 | | | | | | | | | | | | | | | | |
| 02011006 | | 9.4N | 134.1E | 25 | | | | | | | | | | | | | | | | |
| 02011012 | 1 | 9.6N | 133.3E | 30 | 11 | 0 | 30 | 54 | 126 | 290 | | | 0 | 5 | 10 | 5 | -10 | -5 | | |
| 02011018 | 2 | 9.9N | 132.5E | 30 | 5 | 12 | 32 | 78 | 150 | 377 | | | 0 | 0 | 5 | 0 | -5 | 5 | | |
| 02011100 | 3 | 10.2N | 131.7E | 30 | 0 | 38 | 60 | 118 | 179 | 436 | | | 0 | -5 | -10 | -25 | -20 | 5 | | |
| 02011106 | 4 | 10.7N | 130.9E | 30 | 8 | 18 | 72 | 126 | 182 | | | | 0 | 0 | -10 | -15 | -10 | | | |
| 02011112 | 5 | 11.2N | 130.0E | 35 | 0 | 30 | 96 | 141 | 235 | | | | 0 | 0 | -10 | -15 | -15 | | | |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02011118 | 6 | 11.6N | 129.1E | 35 | 6 | 64 | 131 | 173 | 326 | | | | 0 | -5 | -10 | -10 | -5 | | | |
| 02011200 | 7 | 12.1N | 128.0E | 40 | 0 | 55 | 103 | 206 | 334 | | | | 0 | -10 | -10 | -10 | 10 | | | |
| 02011206 | 8 | 12.9N | 126.8E | 45 | 24 | 73 | 143 | 249 | | | | | 0 | 0 | -5 | 0 | | | | |
| 02011212 | 9 | 13.7N | 125.6E | 50 | 13 | 53 | 133 | 199 | | | | | 0 | 0 | -10 | 5 | | | | |
| 02011218 | 10 | 14.3N | 124.6E | 45 | 0 | 13 | 55 | | | | | | 0 | 0 | 0 | | | | | |
| 02011300 | 11 | 14.9N | 123.8E | 45 | 0 | 36 | 84 | | | | | | 0 | 0 | 10 | | | | | |
| 02011306 | 12 | 15.6N | 123.0E | 40 | 8 | 25 | | | | | | | 0 | 0 | | | | | | |
| 02011312 | 13 | 16.8N | 122.5E | 40 | 0 | 49 | | | | | | | 0 | 10 | | | | | | |
| 02011318 | 14 | 18.0N | 122.2E | 30 | 0 | | | | | | | | 0 | | | | | | | |
| 02011400 | 15 | 19.1N | 122.1E | 20 | 0 | | | | | | | | 0 | | | | | | | |
| | | | AVERAGE | | 5 | 36 | 86 | 149 | 219 | 368 | | | 0 | 3 | 8 | 9 | 11 | 5 | | |
| | | | BIAS | | | | | | | | | | 0 | 0 | -4 | -7 | -8 | 2 | | |
| | | | # CASES | | 15 | 13 | 11 | 9 | 7 | 3 | | | 15 | 13 | 11 | 9 | 7 | 3 | | |

**Statistics for JTWC on STY02W Mitag**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02022606 | | 6.1N | 156.3E | 25 | | | | | | | | | | | | | | | | |
| 02022612 | | 6.1N | 156.0E | 25 | | | | | | | | | | | | | | | | |
| 02022618 | 1 | 6.1N | 155.7E | 25 | 5 | 43 | 78 | 99 | 47 | 30 | | | 0 | -10 | -10 | -5 | -15 | -30 | | |
| 02022700 | 2 | 6.2N | 155.3E | 30 | 5 | 27 | 49 | 43 | 25 | 68 | | | -5 | -10 | -5 | -5 | -25 | -25 | | |
| 02022706 | 3 | 6.3N | 154.9E | 35 | 21 | 43 | 72 | 132 | 147 | 140 | | | 0 | 5 | 10 | 5 | -15 | -15 | | |
| 02022712 | 4 | 6.5N | 154.3E | 35 | 18 | 27 | 38 | 89 | 86 | 83 | 93 | 66 | 0 | 5 | 5 | -15 | -15 | -30 | -45 | -60 |
| 02022718 | 5 | 6.6N | 153.8E | 35 | 13 | 36 | 42 | 76 | 78 | 6 | 59 | 50 | 0 | 5 | 0 | -20 | -10 | -30 | -25 | -35 |
| 02022800 | 6 | 6.7N | 153.3E | 35 | 0 | 25 | 44 | 72 | 47 | 41 | 72 | 53 | 0 | 5 | -15 | -10 | -5 | -25 | -50 | -55 |
| 02022806 | 7 | 6.9N | 152.7E | 35 | 24 | 56 | 76 | 85 | 97 | 166 | 82 | 129 | 0 | 0 | -20 | -10 | -10 | -25 | -40 | -65 |
| 02022812 | 8 | 7.1N | 151.6E | 40 | 24 | 70 | 68 | 55 | 88 | 130 | 106 | 58 | 0 | -20 | -20 | -10 | -25 | -25 | -45 | -75 |
| 02022818 | 9 | 6.8N | 150.3E | 45 | 58 | 85 | 97 | 104 | 128 | 131 | 71 | 21 | 0 | -20 | -10 | -5 | -20 | -15 | -45 | -50 |
| 02030100 | 10 | 6.5N | 149.0E | 65 | 43 | 60 | 42 | 38 | 72 | 106 | 58 | 6 | -20 | -20 | -10 | -20 | -20 | -25 | -50 | -40 |
| 02030106 | 11 | 6.5N | 148.0E | 70 | 13 | 8 | 34 | 83 | 104 | 77 | 109 | 180 | 0 | 5 | 5 | -15 | -10 | -15 | -40 | -35 |
| 02030112 | 12 | 6.5N | 146.9E | 70 | 5 | 62 | 131 | 184 | 220 | 178 | 119 | 141 | 0 | 5 | -10 | -15 | -10 | -30 | -50 | -30 |
| 02030118 | 13 | 6.7N | 145.5E | 70 | 0 | 32 | 70 | 83 | 124 | 112 | 69 | 179 | 0 | 5 | -10 | 0 | 5 | -10 | -30 | -10 |
| 02030200 | 14 | 7.1N | 144.1E | 70 | 13 | 43 | 60 | 86 | 118 | 77 | 96 | 262 | 0 | -10 | -10 | -5 | -15 | -25 | -25 | 10 |

**TC 10S Dina**
**TC 11S Eddy**
**TC 12S Francesca**
**TC 13S Chris**
**TC 14P Claudia**
**TC 15S Guillaume**
**TC 16P**
**TC 17P Des**
**TC 18S Hary**
**TC 19P**
**TC 20S Ikala**
**TC 21S Dianne-Jery**
**TC 22S Bonnie**
**TC 23S Kesiny**
**TC 24S Errol**
**TC 25P Upia**

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02030206 | 15 | 7.6N | 142.6E | 75 | 17 | 84 | 112 | 142 | 118 | 46 | 109 | 391 | 0 | -20 | -10 | -10 | -15 | -30 | -15 | 25 |
| 02030212 | 16 | 8.0N | 140.9E | 90 | 17 | 34 | 26 | 51 | 27 | 47 | 102 | 337 | -10 | -10 | -5 | -20 | -20 | -30 | -20 | 45 |
| 02030218 | 17 | 8.4N | 139.3E | 100 | 6 | 27 | 48 | 73 | 82 | 101 | 230 | 447 | 0 | 5 | 10 | 5 | 0 | -10 | 20 | 75 |
| 02030300 | 18 | 8.8N | 137.8E | 100 | 8 | 42 | 58 | 71 | 84 | 120 | 289 | 478 | 0 | 5 | 0 | 0 | -5 | 0 | 30 | 95 |
| 02030306 | 19 | 9.5N | 136.7E | 100 | 0 | 51 | 58 | 80 | 99 | 179 | 392 | 522 | -5 | -10 | -15 | -20 | -25 | -5 | 45 | 90 |
| 02030312 | 20 | 10.2N | 135.3E | 100 | 0 | 31 | 43 | 35 | 71 | 251 | 505 | 577 | 0 | -15 | -15 | -25 | -25 | -5 | 50 | 95 |
| 02030318 | 21 | 10.5N | 134.2E | 105 | 6 | 19 | 24 | 40 | 84 | 157 | 287 | | 10 | -5 | -10 | -20 | -20 | 15 | 20 | |
| 02030400 | 22 | 10.9N | 133.0E | 115 | 8 | 32 | 38 | 55 | 91 | 184 | 252 | | 0 | -5 | -5 | -10 | -5 | 25 | 40 | |
| 02030406 | 23 | 11.3N | 132.5E | 115 | 11 | 54 | 86 | 124 | 188 | 354 | 430 | | 0 | -10 | -20 | -10 | 0 | 45 | 95 | |
| 02030412 | 24 | 12.0N | 131.8E | 120 | 16 | 43 | 61 | 109 | 192 | 440 | 452 | | -5 | -15 | -20 | -5 | 5 | 55 | 100 | |
| 02030418 | 25 | 12.5N | 131.2E | 125 | 8 | 21 | 48 | 121 | 207 | 390 | | | -10 | -20 | -15 | -5 | 0 | 55 | | |
| 02030500 | 26 | 13.1N | 130.6E | 130 | 13 | 17 | 67 | 131 | 225 | 377 | | | -15 | -25 | -20 | -15 | 0 | 45 | | |
| 02030506 | 27 | 13.7N | 130.0E | 140 | 0 | 13 | 35 | 58 | 120 | 165 | | | 0 | -5 | -10 | -20 | 10 | 40 | | |
| 02030512 | 28 | 14.2N | 129.9E | 140 | 0 | 24 | 34 | 60 | 87 | 389 | | | 0 | 0 | -5 | -5 | 5 | 30 | | |
| 02030518 | 29 | 14.8N | 129.9E | 140 | 8 | 19 | 6 | 43 | 95 | | | | 0 | 5 | 0 | 15 | 10 | | | |
| 02030600 | 30 | 15.5N | 130.1E | 130 | 6 | 17 | 8 | 21 | 103 | | | | 0 | 5 | 15 | 15 | 30 | | | |
| 02030606 | 31 | 16.0N | 130.4E | 125 | 0 | 17 | 24 | 62 | 172 | | | | 0 | 0 | 15 | 10 | 20 | | | |
| 02030612 | 32 | 16.6N | 130.9E | 120 | 0 | 13 | 45 | 90 | 223 | | | | 5 | 20 | 25 | 25 | 20 | | | |
| 02030618 | 33 | 17.1N | 131.5E | 115 | 6 | 57 | 88 | 104 | | | | | 0 | 30 | 35 | 35 | | | | |
| 02030700 | 34 | 17.6N | 132.4E | 95 | 6 | 67 | 113 | 119 | | | | | 0 | 15 | 30 | 30 | | | | |
| 02030706 | 35 | 17.9N | 133.5E | 75 | 0 | 27 | 78 | | | | | | 0 | 5 | 25 | | | | | |
| 02030712 | 36 | 18.0N | 134.3E | 65 | 18 | 55 | 13 | | | | | | 0 | 10 | 10 | | | | | |
| 02030718 | 37 | 17.9N | 134.9E | 55 | 6 | 38 | | | | | | | 0 | 20 | | | | | | |
| 02030800 | 38 | 17.6N | 135.4E | 35 | 5 | 70 | | | | | | | 10 | 15 | | | | | | |
| 02030806 | 39 | 17.1N | 135.3E | 25 | 0 | | | | | | | | 0 | | | | | | | |
| 02030812 | | 16.8N | 134.7E | 20 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 11 | 39 | 56 | 83 | 114 | 162 | 190 | 229 | 2 | 11 | 13 | 13 | 13 | 26 | 42 | 52 |
| | | | BIAS | | | | | | | | | | -1 | -2 | -2 | -5 | -6 | -3 | -4 | -1 |
| | | | # CASES | | 39 | 38 | 36 | 34 | 32 | 28 | 21 | 17 | 39 | 38 | 36 | 34 | 32 | 28 | 21 | 17 |

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4.1 ANNUAL FORECAST VERIFICATION

4.2 TESTING AND RESULTS

# 4. SUMMARY OF FORECAST VERIFICATION

## 4.1 ANNUAL FORECAST VERIFICATION

Verification of warning positions and intensities at initial, 12-, 24-, 48-, and 72-hour forecast periods are made against the final best track. The (scalar) track forecast, along-track and cross-track errors (illustrated in Figure 4-1) were calculated for each verifying JTWC forecast. These data, in addition to a detailed summary for each tropical cyclone, are included in Chapter 4. This section summarizes verification data this year and contrasts it with annual verification statistics from previous years.

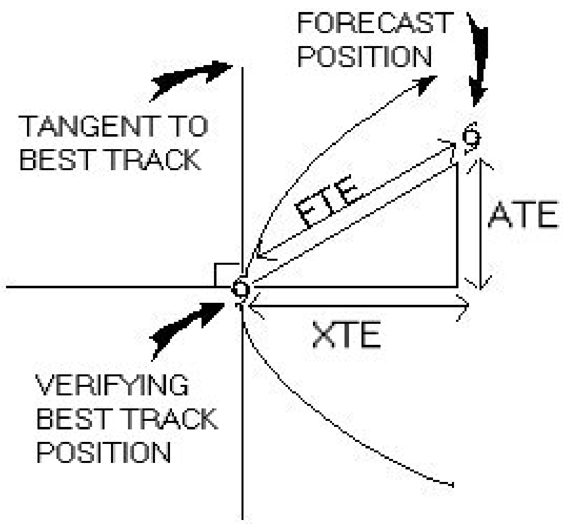


Figure 4-1. Definition of cross-track error (XTE), along-track error (ATE), and forecast track error (FTE). In this example, the forecast position is ahead of and to the right of the verifying best track position. Therefore, the XTE is positive (to the right of the best track) and the ATE is positive (ahead or faster than the best track). Adapted from Tsui and Miller, 1988.

### 4.1.1 WESTERN NORTH PACIFIC OCEAN

Table 4-1 includes mean track, along-track and cross-track errors from 1959, when JTWC was founded, until the present. Figure 4-2 shows mean track errors and a 5-year running mean of track errors at 24-, 48- and 72-hours since 1974. Figure 4-3 shows mean forecast intensity errors and a 5-year running mean of intensity errors at 24-, 48- and 72-hours since 1974.

**Table 4-1**

**MEAN FORECAST TRACK ERRORS (NM) FOR WESTERN NORTH PACIFIC**

**TROPICAL CYCLONES FOR 1959-2002**

| | 24-HOUR | | | | 48-HOUR | | | | 72-HOUR | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **YEAR** (Notes) | **TY (1)** | **TC (3)** | **CROSS TRACK (2)** | **ALONG TRACK (2)** | **TY (1)** | **TC (3)** | **CROSS TRACK (2)** | **ALONG TRACK (2)** | **TY (1)** | **TC (3)** | **CROSS TRACK (2)** | **ALONG TRACK (2)** |
| 1959 | 117* | | | | 267* | | | | | | | |
| 1960 | 177* | | | | 354* | | | | | | | |
| 1961 | 136 | | | | 274 | | | | | | | |
| 1962 | 144 | | | | 287 | | | | 476 | | | |
| 1963 | 127 | | | | 246 | | | | 374 | | | |
| 1964 | 133 | | | | 284 | | | | 429 | | | |
| 1965 | 151 | | | | 303 | | | | 418 | | | |
| 1966 | 136 | | | | 280 | | | | 432 | | | |
| 1967 | 125 | | | | 276 | | | | 414 | | | |
| 1968 | 105 | | | | 229 | | | | 337 | | | |
| 1969 | 111 | | | | 237 | | | | 349 | | | |
| 1970 | 98 | 104 | | | 181 | 190 | | | 272 | 279 | | |
| 1971 | 99 | 111 | 64 | | 203 | 212 | 118 | | 308 | 317 | 177 | |
| 1972 | 116 | 117 | 72 | | 245 | 245 | 146 | | 382 | 381 | 210 | |
| 1973 | 102 | 108 | 74 | | 193 | 197 | 134 | | 245 | 253 | 162 | |
| 1974 | 114 | 120 | 78 | | 218 | 226 | 157 | | 357 | 348 | 245 | |
| 1975 | 129 | 138 | 84 | | 279 | 288 | 181 | | 442 | 450 | 290 | |
| 1976 | 117 | 117 | 71 | | 232 | 230 | 132 | | 336 | 338 | 202 | |
| 1977 | 140 | 148 | 83 | | 266 | 283 | 157 | | 390 | 407 | 228 | |
| 1978 | 120 | 127 | 71 | 87 | 241 | 271 | 151 | 194 | 459 | 410 | 218 | 296 |
| 1979 | 113 | 124 | 76 | 81 | 219 | 226 | 138 | 146 | 319 | 316 | 182 | 214 |
| 1980 | 116 | 126 | 76 | 86 | 221 | 243 | 147 | 165 | 362 | 389 | 230 | 266 |
| 1981 | 117 | 124 | 77 | 80 | 215 | 221 | 131 | 146 | 342 | 334 | 219 | 206 |
| 1982 | 114 | 113 | 70 | 74 | 229 | 238 | 142 | 162 | 337 | 342 | 211 | 223 |
| 1983 | 110 | 117 | 73 | 76 | 247 | 260 | 164 | 169 | 384 | 407 | 263 | 259 |
| 1984 | 110 | 117 | 64 | 84 | 228 | 232 | 131 | 163 | 361 | 363 | 216 | 238 |
| 1985 | 112 | 117 | 68 | 80 | 228 | 231 | 138 | 153 | 355 | 367 | 227 | 230 |
| 1986 | 117 | 126 | 70 | 85 | 261 | 261 | 151 | 183 | 403 | 394 | 227 | 276 |
| 1987 | 101 | 107 | 64 | 71 | 211 | 204 | 127 | 134 | 318 | 303 | 186 | 198 |
| 1988 | 107 | 114 | 58 | 85 | 222 | 216 | 103 | 170 | 327 | 315 | 159 | 244 |
| 1989 | 107 | 120 | 69 | 83 | 214 | 231 | 127 | 162 | 325 | 350 | 177 | 265 |
| 1990 | 98 | 103 | 60 | 72 | 191 | 203 | 110 | 148 | 299 | 310 | 168 | 225 |
| 1991 | 93 | 96 | 53 | 69 | 187 | 185 | 97 | 137 | 298 | 287 | 146 | 229 |
| 1992 | 97 | 107 | 59 | 77 | 194 | 205 | 116 | 143 | 295 | 305 | 172 | 210 |
| 1993 | 102 | 112 | 63 | 79 | 205 | 212 | 117 | 151 | 320 | 321 | 173 | 226 |
| 1994** | 96 | 105 | 56 | 76 | 172 | 186 | 105 | 131 | 244 | 258 | 152 | 176 |
| 1995 | 105 | 123 | 67 | 89 | 200 | 215 | 117 | 159 | 311 | 325 | 167 | 240 |
| 1996 | 85 | 105 | 56 | 76 | 157 | 178 | 89 | 134 | 252 | 272 | 137 | 203 |
| 1997 | 86 | 93 | 55 | 76 | 159 | 164 | 87 | 134 | 251 | 245 | 120 | 202 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1998 | 127 | 124 | 58 | 98 | 263 | 239 | 127 | 178 | 392 | 370 | 201 | 274 |
| 1999 | 88 | 106 | 59 | 74 | 150 | 176 | 102 | 119 | 225 | 234 | 139 | 155 |
| 2000 | 75 | 81 | 45 | 57 | 136 | 142 | 80 | 98 | 205 | 209 | 118 | 144 |
| 2001 | 67 | 73 | 42 | 50 | 115 | 122 | 75 | 79 | 176 | 180 | 111 | 121 |
| 2002 | 47 | 66 | 45 | 39 | 87 | 115 | 78 | 70 | 131 | 163 | 109 | 100 |
| | | | | | | | | | | | | |
| Averages (1978 - 2002) | 100 | 109 | 62 | 76 | 198 | 207 | 118 | 145 | 308 | 311 | 177 | 217 |

1. Track errors were calculated for typhoons when intensities were at least 65kts at warning times

2. Cross-track and along-track errors were adopted by the JTWC in 1986. Right angle errors (used prior to 1986) were recomputed as cross-track errors after-the fact to extend the data base. See Figure 3-1 for the definitions of cross-track and along-track.

3. Mean forecast errors for all warned systems in Northwest Pacific.

*Forecast positions north of 35 degrees North latitude were not verified.

**1994 statistics were recalculated to resolve earlier Along and Cross-Track discrepancies.

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# 3. TROPICAL CYCLONE FIX DATA



## 3.1 2002 SEASON

Tables 3-1 to 3-4 list the number of tropical cyclone center "fixes", or locations, made using satellite (visible, infrared, and microwave), scatterometer, radar, and synoptic data. Fixes made by the DOD tropical cyclone reconnaissance network sites are included in the tables as well as those fixes received from other sources (e.g., Japanese Meteorological Agency, Australian Bureau of Meteorology, and U.S. National Weather Service National Environmental Satellite Data and Information Service). For further details with respect to Satellite Operations, please refer to the artcile in Chapter 6 Section 6.7.

**TABLE 3-1**

**SOUTH PACIFIC & SOUTH INDIAN OCEAN FIX SUMMARY FOR 2002**

| Tropical Cyclone | | Satellite | Scatt | Radar | Synoptic | Total |
|---|---|---|---|---|---|---|
| 01S | - | 59 | 0 | 0 | 0 | 59 |
| 02S | Alex | 155 | 4 | 0 | 0 | 159 |
| 03S | - | 74 | 0 | 0 | 0 | 74 |
| 04S | - | 96 | 2 | 0 | 0 | 98 |
| 05S | Bessi | 210 | 11 | 0 | 0 | 221 |
| 06P | Trina | 33 | 3 | 0 | 0 | 36 |
| 07P | Waka | 109 | 0 | 0 | 0 | 109 |
| 08S | Cyprien | 67 | 2 | 0 | 0 | 69 |
| 09S | Bernie | 60 | 1 | 1 | 0 | 62 |
| 10S | Dina | 189 | 1 | 0 | 0 | 190 |
| 11S | Eddy | 126 | 4 | 0 | 0 | 130 |
| 12S | Francesca | 263 | 8 | 0 | 0 | 271 |
| 13S | Chris | 84 | 1 | 0 | 0 | 85 |
| 14P | Claudia | 59 | 3 | 0 | 0 | 62 |
| 15S | Guillaume | 176 | 2 | 0 | 0 | 178 |
| 16P | - | 48 | 0 | 0 | 0 | 48 |
| 17P | Des | 55 | 1 | 0 | 0 | 56 |
| 18S | Hary | 193 | 2 | 0 | 0 | 195 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 19P | - | 74 | 0 | 0 | 0 | 74 |
| 20S | Ikala | 136 | 2 | 0 | 0 | 138 |
| 21S | Dianne | 148 | 4 | 0 | 0 | 152 |
| 22S | Bonnie | 131 | 3 | 0 | 0 | 134 |
| 23S | Kesiny | 204 | 6 | 0 | 1 | 211 |
| 24S | Errol | 120 | 1 | 0 | 0 | 121 |
| 25P | Upia | 102 | 5 | 0 | 0 | 107 |
| | Totals | 2971 | 66 | 1 | 1 | 3039 |
| Percentage of Total | | 97.6 | 2.2 | 0.1 | 0.1 | 100 |

**TABLE 3-2**

**WESTERN NORTH PACIFIC OCEAN FIX SUMMARY FOR 2002**

| Tropical Cyclone | | Satellite | Scatt | Radar | Synoptic | Total |
|---|---|---|---|---|---|---|
| 01W | Tapah | 117 | 3 | 0 | 0 | 120 |
| 02W | Mitag | 249 | 3 | 0 | 2 | 254 |
| 03W | - | 126 | 0 | 0 | 4 | 130 |
| 04W | - | 32 | 1 | 0 | 0 | 33 |
| 05W | Hagibis | 189 | 5 | 0 | 0 | 194 |
| 06W | - | 51 | 2 | 0 | 1 | 54 |
| 07W | Noguri | 167 | 0 | 19 | 2 | 188 |
| 08W | Chataan | 325 | 3 | 13 | 2 | 343 |
| 09W | Rammasun | 201 | 1 | 13 | 0 | 215 |
| 10W | Halong | 249 | 0 | 19 | 2 | 270 |
| 11W | Nakri | 125 | 0 | 30 | 7 | 162 |
| 12W | Fengshen | 332 | 1 | 15 | 5 | 353 |
| 13W | - | 78 | 0 | 0 | 3 | 81 |
| 14W | Fung-wong | 188 | 0 | 0 | 1 | 189 |
| 15W | Kalmaegi | 59 | 0 | 0 | 0 | 59 |
| 16W | Kammuri | 87 | 1 | 0 | 5 | 93 |
| 17W | - | 33 | 0 | 0 | 0 | 33 |
| 18W | - | 77 | 3 | 0 | 2 | 82 |
| 19W | Phanfone | 264 | 2 | 2 | 2 | 270 |
| 20W | Vongfong | 100 | 3 | 0 | 4 | 107 |
| 21W | Rusa | 252 | 3 | 41 | 3 | 299 |
| 22W | Sinlaku | 265 | 4 | 52 | 1 | 322 |
| 23W | Hagupit | 73 | 1 | 0 | 1 | 75 |
| 24W | Mekkhala | 140 | 0 | 0 | 4 | 144 |
| 25W | Higos | 164 | 2 | 2 | 4 | 172 |
| 26W | Bavi | 160 | 5 | 0 | 0 | 165 |
| 27W | - | 86 | 1 | 0 | 0 | 87 |
| 28W | - | 38 | 0 | 0 | 0 | 38 |
| 29W | Maysak | 104 | 3 | 0 | 0 | 107 |
| 30W | Haishen | 149 | 2 | 0 | 0 | 151 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 31W | Pongsona | 274 | 10 | 21 | 0 | 305 |
| | Totals | 4754 | 59 | 227 | 55 | 5095 |
| Percentage of Total | | 93.3 | 1.2 | 4.5 | 1.1 | 100 |

**TABLE 3-3**

**NORTHERN INDIAN OCEAN FIX SUMMARY FOR 2002**

| Tropical Cyclone | | Satellite | Scatt | Radar | Synoptic | Total |
|---|---|---|---|---|---|---|
| 01A | - | 114 | 4 | 0 | 0 | 118 |
| 02B | - | 62 | 0 | 0 | 1 | 63 |
| 03B | - | 69 | 1 | 0 | 1 | 71 |
| 04B | - | 116 | 5 | 0 | 0 | 121 |
| 05B | - | 99 | 2 | 0 | 0 | 101 |
| | Totals | 460 | 12 | 0 | 2 | 474 |
| Percentage of Total | | 97.0 | 2.5 | 0 | 0.4 | 100 |

**TABLE 3-4**

**FIXES BY OCEANIC BASIN FOR 2002**

| **Oceanic Basin** | **Total Fixes** |
|---|---|
| Northwest Pacific | 5095 |
| Southern Hemisphere | 3039 |
| Northern Indian Ocean | 474 |
| Total | 8608 |

# 2. SOUTH PACIFIC AND SOUTH INDIAN OCEAN TROPICAL CYCLONES

## 2.1 GENERAL

In accordance with CINCPACINST 3140.1 (series), Southern Hemisphere tropical cyclones are numbered sequentially from 01 July through 30 June to reflect the Southern Hemisphere tropical season.

For warning message delineation, the Southern Hemisphere Area of Responsibility (AOR) is divided into two basins: the South Indian (west of 135° East longitude) and the South Pacific Ocean (east of 135° East longitude). The suffixes "S" (South Indian Ocean) and "P" (South Pacific Ocean) are appended to the tropical cyclone number to differentiate warnings for these basins. For this report, the Southern Hemisphere AOR is broken down into three sub-basins, reflecting primary cyclogenesis areas: South Indian (west of 105° East longitude), Australia (105° East longitude to 165° East longitude), and South Pacific (east of 165° East longitude).

## 2.2 SUMMARY

Table 2-1 lists the significant tropical cyclones during the 2002 season and can be compared to the climatological mean presented in Table 2-2. Table 2-3 compares this year's tropical cyclone activity in the Southern Hemisphere sub-basins to previous years and climatology. Composites of the tropical cyclone best tracks for the Southern Hemisphere appear following Table 2-3.

**Table 2-1**

**SOUTHERN HEMISPHERE TROPICAL CYCLONES FOR 2002**

**(01 JULY 2001 - 30 JUNE 2002)**

| TC | NAME | PERIOD | NUMBER ISSUED | EST MAX SFC WINDS KTS (M/SEC) | MSLP (MB)** |
|---|---|---|---|---|---|
| 01S | - | 06 Oct – 08 Oct | 5 | 35 (18) | 997 |
| 02S | Alex-Andre | 26 Oct – 31 Oct | 15 | 55 (28) | 984 |

TC 18S Hary

TC 19P

TC 20S Ikala

TC 21S Dianne-Jery

TC 22S Bonnie

TC 23S Kesiny

TC 24S Errol

TC 25P Upia

| | | | | | |
|---|---|---|---|---|---|
| 03S | - | 21 Nov | 2 | 35 (18) | 997 |
| 04S | - | 21 Nov – 23 Nov | 5 | 35 (18) | 997 |
| 05S | Bessi-Bako | 27 Nov – 5 Dec | 17 | 75 (39) | 967 |
| 06P | Trina | 30 Nov – 01 Dec | 2 | 35 (18) | 997 |
| 07P | Waka | 29 Dec – 02 Jan | 9 | 100 (51) | 944 |
| 08S | Cyprien | 01 Jan – 02 Jan | 4 | 50 (26) | 987 |
| 09P | Bernie | 03 Jan – 04 Jan | 3 | 45 (23) | 991 |
| 10S | Dina | 17 Jan – 24 Jan | 15 | 130 (67) | 910 |
| 11S | Eddy | 24 Jan – 28 Jan | 9 | 75 (39) | 967 |
| 12S | Francesca | 01 Feb – 11 Feb | 21 | 115 (59) | 927 |
| 13S | Chris | 03 Feb – 06 Feb | 8 | 125 (64) | 916 |
| 14P | Claudia | 11 Feb - 13 Feb | 9 | 75 (39) | 967 |
| 15S | Guillaume | 15 Feb – 22 Feb | 17 | 120 (62) | 922 |
| 16P | - | 24 Feb – 26 Feb | 4 | 35 (18) | 997 |
| 17P | Des | 05 Mar – 07 Mar | 5 | 50 (26) | 991 |
| 18S | Hary | 06 Mar - 13 Mar | 17 | 140 (72) | 898 |
| 19P | - | 14 Mar – 16 Mar | 4 | 35 (18) | 997 |
| 20S | Ikala | 24 Mar – 28 Mar | 10 | 110 (57) | 933 |
| 21S | Dianne-Jery | 07 Apr – 11 Apr | 10 | 105 (54) | 938 |
| 22S | Bonnie | 10 Apr – 15 Apr | 12 | 50 (26) | 987 |
| 23S | Kesiny | 03 May – 11 May | 18 | 65 (33) | 976 |
| 24S | Errol | 09 May – 14 May | 10 | 45 (23) | 991 |
| 25P | Upia | 25 May – 28 May | 12 | 35 (18) | 997 |
| | | | | | |
| | | | | | |
| | | **TOTAL** | 248 | | |

**MSLP Converted from estimated maximum surface winds using Atkinson/Holiday wind-pressure relationship

**Table 2-2**

**DISTRIBUTION OF SOUTH PACIFIC AND SOUTH INDIAN OCEAN TROPICAL CYCLONES**

**FOR 1958 - 2001**

| YEAR | JUL | AUG | SEP | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | TOTALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | |
| **1958-1977 AVE*** | - | - | - | 0.4 | 1.5 | 3.6 | 6.1 | 5.8 | 4.7 | 2.1 | 0.5 | - | **24.7** |
| | | | | | | | | | | | | | |
| **1981** | 0 | 0 | 0 | 1 | 3 | 2 | 6 | 5 | 3 | 3 | 1 | 0 | **24** |
| **1982** | 1 | 0 | 0 | 1 | 1 | 3 | 9 | 4 | 2 | 3 | 1 | 0 | **25** |
| **1983** | 1 | 0 | 0 | 1 | 1 | 3 | 5 | 6 | 3 | 5 | 0 | 0 | **25** |
| **1984** | 1 | 0 | 0 | 1 | 2 | 5 | 5 | 10 | 4 | 2 | 0 | 0 | **30** |
| **1985** | 0 | 0 | 0 | 0 | 1 | 7 | 9 | 9 | 6 | 3 | 0 | 0 | **35** |
| **1986** | 0 | 0 | 1 | 0 | 1 | 1 | 9 | 9 | 6 | 4 | 2 | 0 | **33** |
| **1987** | 0 | 1 | 0 | 0 | 1 | 3 | 6 | 8 | 3 | 4 | 1 | 1 | **28** |
| **1988** | 0 | 0 | 0 | 0 | 2 | 3 | 5 | 5 | 3 | 1 | 2 | 0 | **21** |
| **1989** | 0 | 0 | 0 | 0 | 2 | 1 | 5 | 8 | 6 | 4 | 2 | 0 | **28** |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1990** | 2 | 0 | 1 | 1 | 2 | 2 | 4 | 4 | 10 | 2 | 1 | 0 | **29** |
| **1991** | 0 | 0 | 1 | 1 | 1 | 3 | 2 | 5 | 5 | 2 | 1 | 1 | **22** |
| **1992** | 0 | 0 | 1 | 1 | 2 | 5 | 4 | 11 | 3 | 2 | 1 | 0 | **30** |
| **1993** | 0 | 0 | 1 | 1 | 0 | 5 | 7 | 7 | 2 | 2 | 2 | 0 | **27** |
| **1994** | 0 | 0 | 0 | 0 | 2 | 4 | 8 | 4 | 9 | 3 | 0 | 0 | **30** |
| **1995** | 0 | 0 | 0 | 0 | 2 | 2 | 5 | 4 | 5 | 4 | 0 | 0 | **22** |
| **1996** | 0 | 0 | 0 | 0 | 1 | 3 | 7 | 6 | 6 | 4 | 1 | 0 | **28** |
| **1997** | 1 | 1 | 1 | 2 | 2 | 6 | 9 | 8 | 3 | 1 | 3 | 1 | **38** |
| **1998** | 1 | 0 | 0 | 3 | 2 | 3 | 7 | 9 | 6 | 6 | 0 | 0 | **37** |
| **1999** | 1 | 0 | 1 | 1 | 1 | 6 | 6 | 8 | 7 | 2 | 0 | 0 | **33** |
| **2000** | 0 | 0 | 0 | 0 | 0 | 3 | 6 | 5 | 7 | 6 | 0 | 0 | **27** |
| **2001** | 0 | 1 | 0 | 0 | 1 | 1 | 4 | 6 | 2 | 5 | 0 | 1 | **21** |
| **2002** | 0 | 0 | 0 | 2 | 4 | 1 | 4 | 5 | 4 | 2 | 3 | 0 | **25** |
| (1981-2002) | | | | | | | | | | | | | |
| **MEAN** | 0.4 | 0.1 | 0.3 | 0.7 | 1.5 | 3.3 | 6.0 | 6.6 | 4.8 | 3.2 | 1.0 | 0.2 | 28.1 |
| **CASES** | 8 | 3 | 7 | 16 | 34 | 72 | 132 | 146 | 105 | 70 | 21 | 4 | 618 |
| * (GRAY, 1978) | | | | | | | | | | | | | |

**The criteria used in TABLE 2-2 are as follows:**

1) If a tropical cyclone was first warned on during the last two days of a particular month and continued into the next month for longer than two days, then that system was attributed to the second month.

2) If a tropical cyclone was warned on prior to the last two days of a month, it was attributed to the first month, regardless of how long the system lasted.

3) If a tropical cyclone began on the last day of the month and ended on the first day of the next month, that system was attributed to the first month. However, if a tropical cyclone began on the last day of the month and continued into the next month for only two days, then it was attributed to the second month.

# 1. SUMMARY OF WESTERN NORTH PACIFIC AND NORTH INDIAN OCEAN TROPICAL CYCLONES

## 1.1 WESTERN NORTH PACIFIC OCEAN TROPICAL CYCLONES

Tropical cyclone genesis regions compared to the 15-year average are shown in Figure 1-1. This year's tropical cyclones are listed in Table 1-1. Table 1-2 shows the monthly distribution of tropical cyclones for each year since 1959 and Table 1-3 shows the monthly average occurrence of tropical storms separated into: (1) typhoons only; and (2) tropical storms and typhoons. A summary of this year's Tropical Cyclone Formation Alerts is shown in Table 1-4. The annual number of tropical cyclones of tropical storm strength and higher appear in Figure 1-2, while the number of super typhoons are shown in Figure 1-3. Composites of the tropical cyclone best tracks for the western North Pacific appear following Figure 1-3.

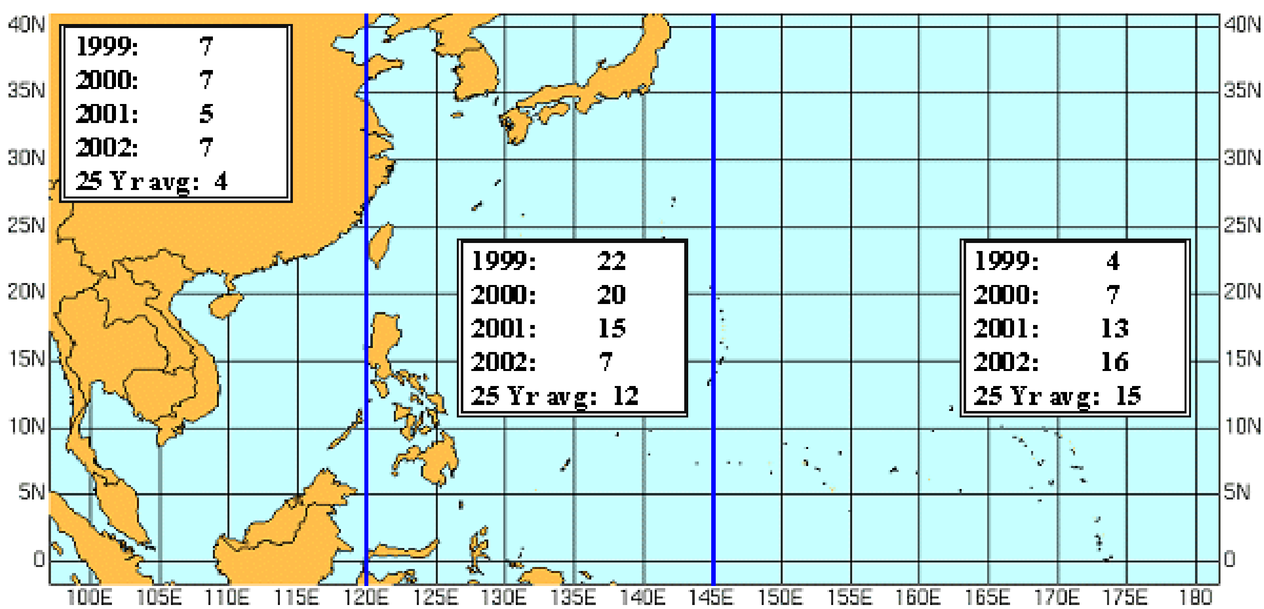


Figure 1-1. Comparison of the number of tropical cyclones that developed within 3 designated areas for 1999, 2000, 2001, 2002 and the 25-year average.

TD 15W Kalmaegi
TS 16W Kammuri
TD 17W
TS 18W
STY19W Phanfone
TS 20W Vongfong
TY 21W Rusa
TY 22W Sinlaku
TS 23W Hagupit
TS 24W Mekkhala
STY25W Higos
TY 26W Bavi
TD 27W
TD 28W
TS 29W Maysak
TY 30W Haishen
STY31W Pongsona
HUR02C Ele
HUR03C Huko
TC 01A
TC 02B
TC 03B
TC 04B
TC 05B

**Table 1-1**

**WESTERN NORTH PACIFIC SIGNIFICANT TROPICAL CYCLONES FOR 2002**

**(01 JAN 2002 - 31 DEC 2002)**

| TC | NAME * | PERIOD | WARNINGS ISSUED | EST MAX SFC WINDS KTS (M/SEC) | MSLP (MB)** |
|---|---|---|---|---|---|
| TS 01W | (TAPAH) | 10 Jan – 14 Jan | 15 | 50 (25) | 987 |
| STY 02W | (MITAG) | 26 Feb – 08 Mar | 39 | 140 (72) | 898 |
| TD 03W | - | 19 Mar – 25 Mar | 25 | 30 (15) | 1000 |
| TD 04W | - | 05 Apr – 07 Apr | 6 | 30 (15) | 1000 |
| STY 05W | (HAGIBIS) | 15 May – 21 May | 26 | 140 (72) | 898 |
| TD 06W | - | 28 May – 29 May | 7 | 25 (13) | 1002 |
| TY 07W | (NOGURI) | 06 Jun – 11 Jun | 21 | 85 (44) | 958 |
| STY 08W | (CHATAAN) | 28 Jun – 11 Jul | 53 | 130 (67) | 910 |
| TY 09W | (RAMMASUN) | 28 Jun – 11 Jul | 33 | 110 (57) | 933 |
| STY 10W | (HALONG) | 07 Jul – 15 Jul | 36 | 135 (70) | 904 |
| TS 11W | (NAKRI) | 08 Jul – 13 Jul | 20 | 40 (21) | 994 |
| STY 12W | (FENGSHEN) | 14 Jul – 27 Jul | 53 | 145 (75) | 892 |
| TS 13W | - | 18 Jul – 22 Jul | 15 | 35 (18) | 997 |
| TY 14W | (FUNG-WONG) | 20 Jul – 27 Jul | 28 | 65 (34) | 976 |
| TD 15W | (KALMAEGI) | 20 Jul – 21 Jul | 3 | 30 (15) | 1000 |
| TS 16W | (KAMMURI) | 02 Aug – 05 Aug | 14 | 50 (25) | 987 |
| TD 17W | - | 05 Aug – 05 Aug | 2 | 25 (13) | 1002 |
| TS 18W | - | 10 Aug – 13 Aug | 12 | 35 (18) | 997 |
| STY 19W | (PHANFONE) | 11 Aug – 20 Aug | 38 | 135 (70) | 904 |
| TS 20W | (VONGFONG) | 15 Aug – 20 Aug | 19 | 55 (28) | 984 |
| TY 21W | (RUSA) | 22 Aug – 01 Sep | 40 | 115 (59) | 927 |
| HUR 02C | (ELE) | 26 Aug – 10 Sep | 45 (62)*** | 115 (59) | 927 |
| TY 22W | (SINLAKU) | 28 Aug – 08 Sep | 42 | 110 (57) | 933 |
| TS 23W | (HAGUPIT) | 10 Sep – 12 Sep | 10 | 45 (23) | 991 |
| TS 24W | (MEKKHALA) | 23 Sep – 27 Sep | 16 | 55 (28) | 984 |
| STY 25W | (HIGOS) | 26 Sep – 02 Oct | 25 | 135 (70) | 904 |
| TY 26W | (BAVI) | 09 Oct – 14 Oct | 21 | 70 (36) | 972 |
| TD 27W | - | 17 Oct – 19 Oct | 10 | 30 (15) | 1000 |
| TD 28W | - | 18 Oct – 19 Oct | 6 | 30 (15) | 1000 |
| HUR 03C | (HUKO) | 24 Oct – 07 Nov | 16 (55)*** | 75 (39) | 967 |
| TS 29W | (MAYSAK) | 26 Oct – 29 Oct | 12 | 60 (31) | 980 |
| TY 30W | (HAISHEN) | 20 Nov – 24 Nov | 19 | 95 (49) | 949 |
| STY 31W | (PONGSoNA) | 02 Dec – 11 Dec | 34 | 130 (67) | 910 |
| | | | | | |
| | | **WEST PAC TOTAL** | 761 | | |
| | | | | | |

* As Designated by RSMC Tokyo or CPHC

** MSLP Converted from estimated maximum surface winds using Atkinson/Holiday wind-pressure relationship

*** TOTAL (CENTRAL AND WESTERN NORTH PACIFIC BASINS)

# EXECUTIVE SUMMARY

The 2002 tropical cyclone season brought the first large turnover in Typhoon Duty Officers since JTWC moved to Pearl Harbor. Given the significant turnover in personnel, the Northwest Pacific Ocean (WESTPAC) tropical cyclone season was entered with some trepidation. The effective use of the consensus forecast approach helped to mitigate the break in forecaster experience. Problems early in the season were overcome after installing quality control procedures and changes to operations which enabled checks and balances in the forecast process. These efforts resulted in the fourth straight year of improved operational support to the U. S. Department of Defense, the U. S. State Department, and the Department of Commerce, National Weather Service. (Details concerning forecast performance are contained in Chapters 4 and 5 of this report.)

In 2002, the Alternate JTWC (AJTWC) moved from NAVPACMETOCCEN Yokosuka to the FLENUMETOCCEN Monterey. The facilities and personnel in Monterey, CA now provide the JTWC with an alternate site to issue Pacific and Indian Ocean TC forecasts should an outage at Pearl Harbor, Hawaii occur. Efforts were initiated to develop a “walk-away” AJTWC locally to provided an interim capability while personnel fly to Monterey to stand-up the primary AJTWC operation.

2002 also saw initial efforts to begin production of a 5-day TC forecast. The ability to produce a skillful 5-day forecast track is the result of improved consensus forecasts as more models were incorporated into the consensus. Efforts were also initiated, as a result of Typhoon Pongsona, to better communicate forecast track uncertainty to the military and National Weather Service users of JTWC forecasts.

JTWC also recognizes the diverse team that has helped to refine and improve TC warning operations. The personnel of JTWC in conjunction with Fleet Numerical Meteorology and Oceanography Center, Air Force Weather Agency, Naval Research Laboratory, Naval Post Graduate School, NOAA Hurricane Research Division, NOAA National Environmental Satellite Data and Information Service, Cooperative Institute for Research in the Atmosphere, Cooperative Institute for Meteorological Satellite Studies, Massachusetts Institute of Technology, and others are key elements of a team that continues to improve the science of TC analysis and forecasting. Some of the support and guidance provided by some of these organizations are summarized in Chapter 6 of this report. JTWC will continue to work with the TC community to exploit science, technology, and training in order to support the sailors, soldiers, and airmen who volunteer to defend our liberty.

# FOREWORD

The Annual Tropical Cyclone Report is prepared by the staff of the Joint Typhoon Warning Center (JTWC), a joint Navy/Air Force organization under the command of the Commanding Officer, Naval Pacific Meteorology and Oceanography Center/Joint Typhoon Warning Center (NPMOC/JTWC) located in Pearl Harbor, Hawaii.

The mission of JTWC as directed by USCINCPAC Instruction 3140.1W (series) is multifaceted and includes:

1. Continuous monitoring of all tropical weather activity in the Northern and Southern Hemispheres, from the west coast of the Americas to the east coast of Africa, and the prompt issuance of appropriate advisories and alerts when tropical cyclone development is anticipated.

2. Issuance of warnings on all significant tropical cyclones in the area of responsibility.

3. Determination of requirements for tropical cyclone reconnaissance and assignment of appropriate priorities.

4. Post-storm analysis of significant tropical cyclones occurring within the Western North Pacific and North Indian Oceans.

Colocated with the JTWC is the 17th Operational Weather Squadron Satellite Operations branch (SATOPS), which executes the PACAF Executive Agency Responsibility for Tropical Cyclone Reconnaissance support. SATOPS primary mission includes the following:

1. Conduct 24-hour meteorological watch on all tropical and subtropical disturbances within the JTWC AOR.

2. Make and disseminate tropical cyclone observations based on all available data. Provide positions every 3 hours and intensities every 6 hours or more frequently as requested by the Typhoon Duty Officer.

3. Report positions, estimated intensities, and warning criteria wind radii of significant tropical cyclones in these regions.

Special thanks are extended to the following organizations for their timely support of the JTWC mission:

Fleet Numerical Meteorology and Oceanography Center

Air Force Weather Agency

NOAA Environmental Satellite Data and Information Service

Naval Research Laboratory, Monterey

Naval Postgraduate School.

Of specific note, we would like to thank the following individuals:

Mr. Charles R. "Buck" Sampson and Ms. Ann Schrader, et al, for their constant support and continued development of the Automated Tropical Cyclone Forecasting System.

Dr. Lester E. Carr III, for continuing work on the Systematic and Integrated Approach to Tropical Cyclone Forecasting.

Mr. Jeff D. Hawkins, et al, for continuing efforts to exploit remote sensing technologies.

The men and women of the USPACOM tropical cyclone warning network, who participate in locating the tropical cyclone and help disseminate the tropical cyclone warning to the operational customer.

2002

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Cover Page

NPMOC/JTWC

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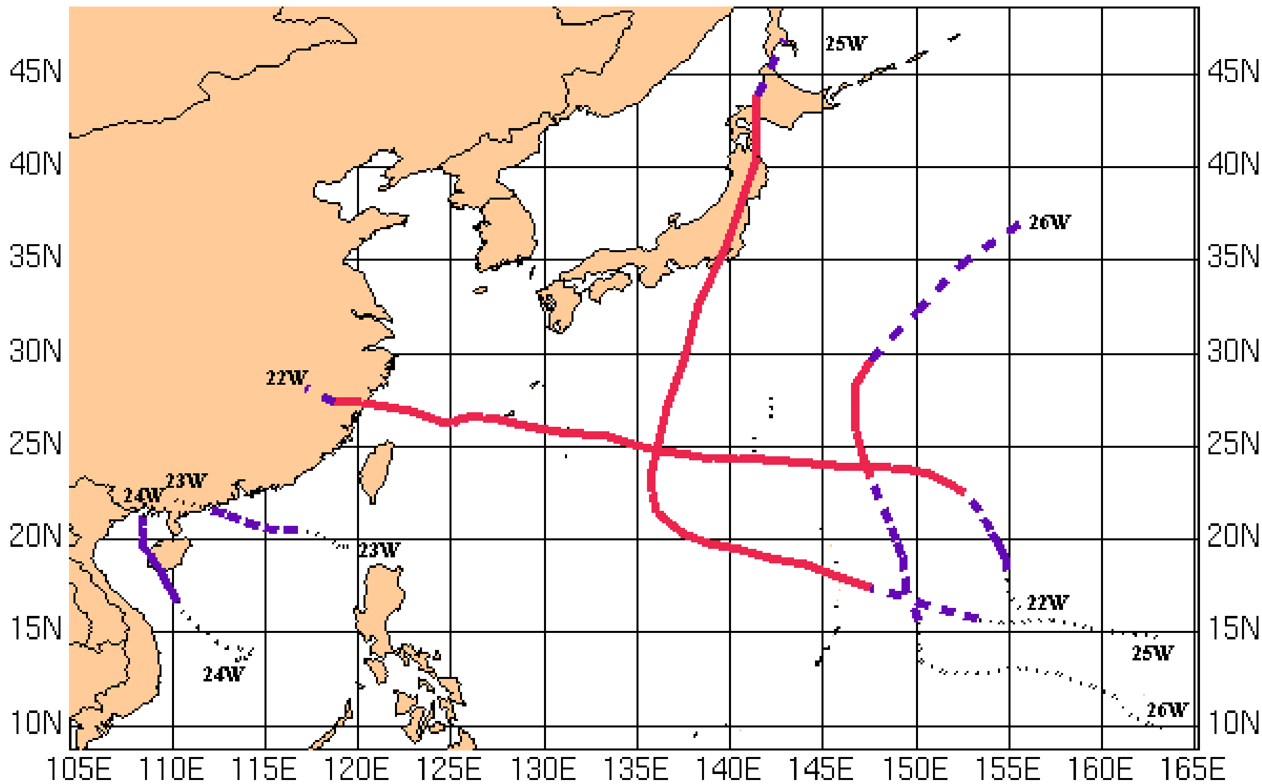


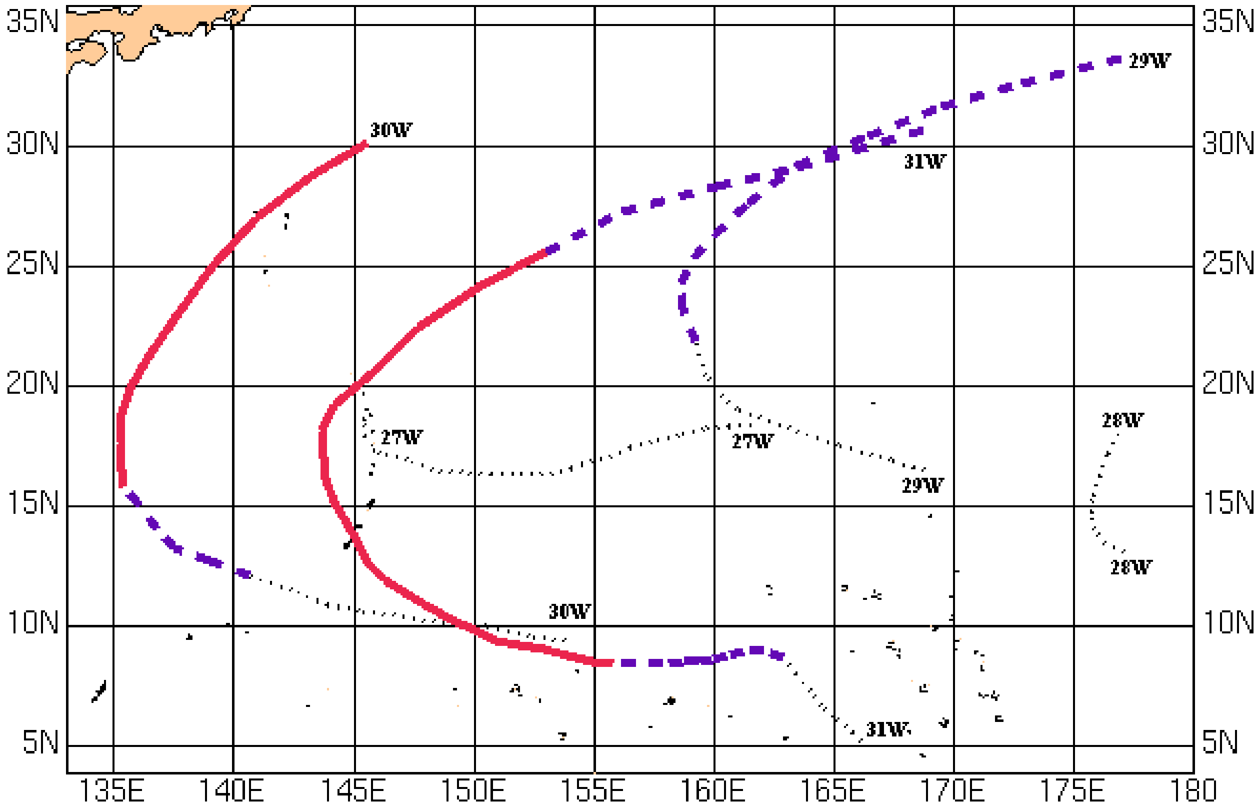

NORTHWEST PACIFIC OCEAN
TROPICAL CYCLONES
28 AUG - 14 OCT

| | |
|---|---|
| 22W TY SINLAKU | 28 AUG - 08 SEP |
| 23W TS HAGUPIT | 10 SEP - 12 SEP |
| 24W TS MEKKHALA | 23 SEP - 27 SEP |
| 25W STY HIGOS | 26 SEP - 02 OCT |
| 26W TY BAVI | 09 OCT - 14 OCT |

**MAXIMUM SUSTAINED SURFACE WIND**

- 64KT (33M/SEC) OR GREATER (solid line)
- 34 TO 63KT (18 TO 32M/SEC) (dashed line)
- 33KT (17M/SEC) OR LESS (dotted line)

TD 15W Kalmaegi
TS 16W Kammuri
TD 17W
TS 18W
STY19W Phanfone
TS 20W Vongfong
TY 21W Rusa
TY 22W Sinlaku
TS 23W Hagupit
TS 24W Mekkhala
STY25W Higos
TY 26W Bavi
TD 27W
TD 28W
TS 29W Maysak
TY 30W Haishen
STY31W Pongsona
HUR02C Ele
HUR03C Huko
TC 01A
TC 02B
TC 03B
TC 04B
TC 05B

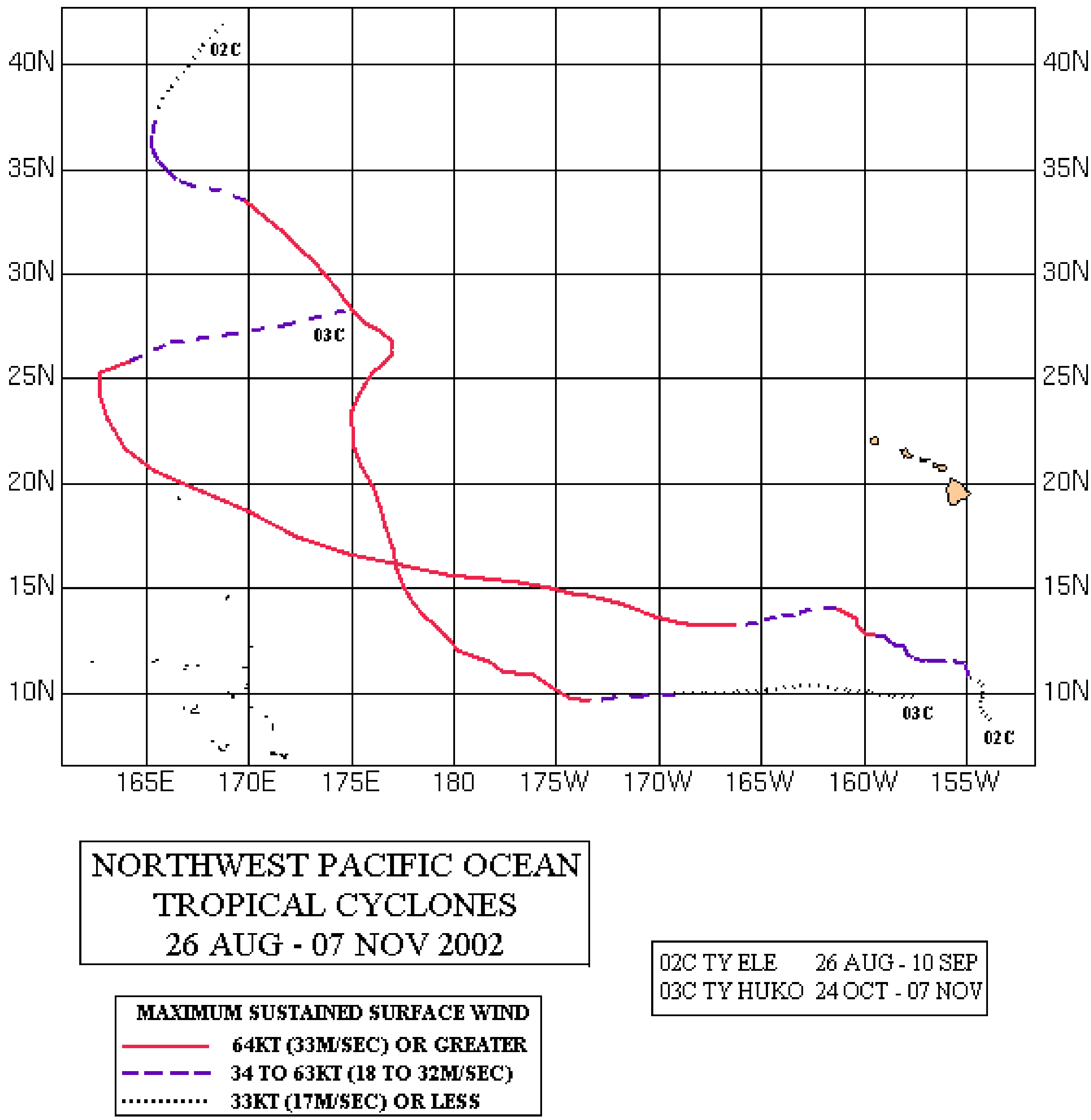



NORTHWEST PACIFIC OCEAN
TROPICAL CYCLONES
17 OCT - 11 DEC

| | |
|---|---|
| 27W TD | 17 OCT - 19 OCT |
| 28W TD | 18 OCT - 19 OCT |
| 29W TS MAYSAK | 26 OCT - 29 OCT |
| 30W TY HAISHEN | 20 NOV - 24 NOV |
| 31W STY PONGSONA | 02 DEC - 11 DEC |

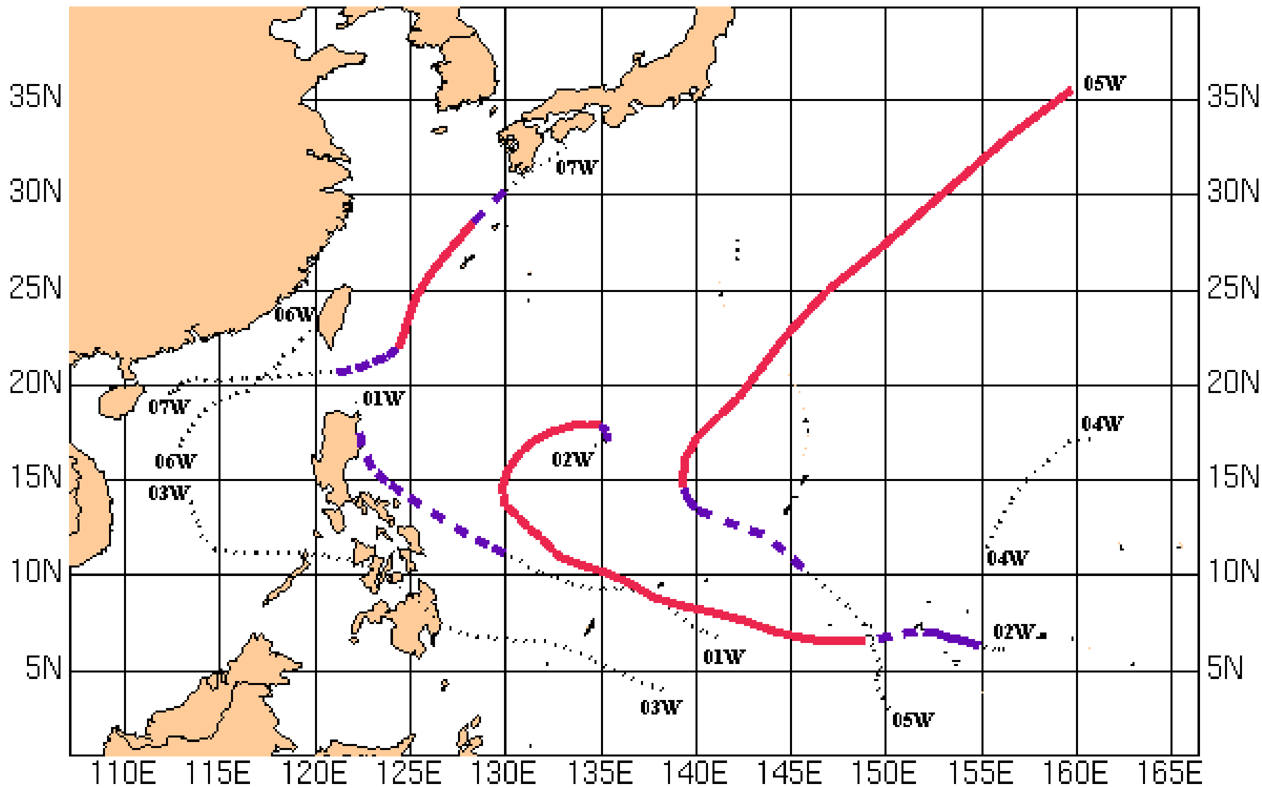
**MAXIMUM SUSTAINED SURFACE WIND**

- **64KT (33M/SEC) OR GREATER**
- **34 TO 63KT (18 TO 32M/SEC)**
- **33KT (17M/SEC) OR LESS**


02C
03C
03C
02C
40N
35N
30N
25N
20N
15N
10N
165E
170E
175E
180
175W
170W
165W
160W
155W
NORTHWEST PACIFIC OCEAN
TROPICAL CYCLONES
26 AUG - 07 NOV 2002
02C TY ELE 26 AUG - 10 SEP
03C TY HUKO 24 OCT - 07 NOV
MAXIMUM SUSTAINED SURFACE WIND
64KT (33M/SEC) OR GREATER
34 TO 63KT (18 TO 32M/SEC)
33KT (17M/SEC) OR LESS

Print Friendly (PDF)



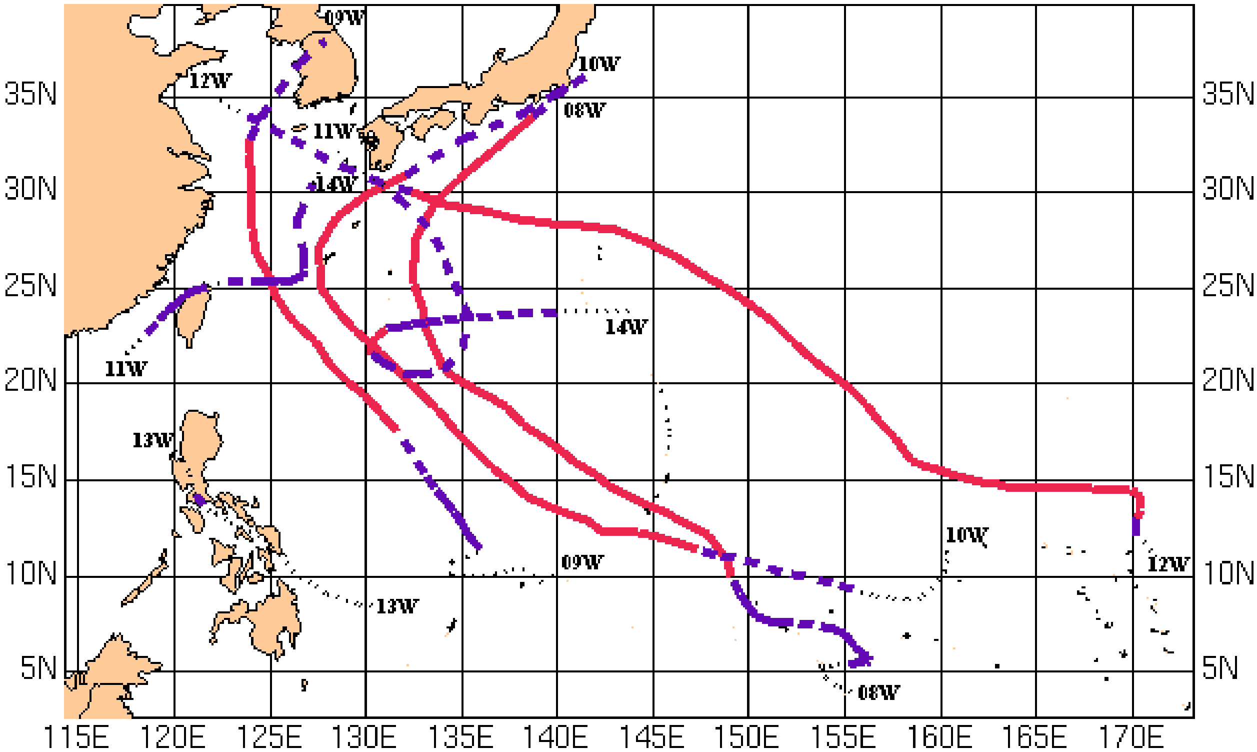



NORTHWEST PACIFIC OCEAN TROPICAL CYCLONES
10 JAN 02 - 11 JUN 02

**MAXIMUM SUSTAINED SURFACE WIND**

- (solid) 64KT (33M/SEC) OR GREATER
- (dashed) 34 TO 63KT (18 TO 32M/SEC)
- (dotted) 33KT (17M/SEC) OR LESS

| | |
|---|---|
| 01W TS TAPAH | 10 JAN - 14 JAN |
| 02W STY MITAG | 26 FEB - 08 MAR |
| 03W TD | 19 MAR - 25 MAR |
| 04W TD | 05 APR - 07 APR |
| 05W STY HAGIBIS | 15 MAY - 21 MAY |
| 06W TD | 28 MAY - 29 MAY |
| 07W TY NOGURI | 06 JUN - 11 JUN |

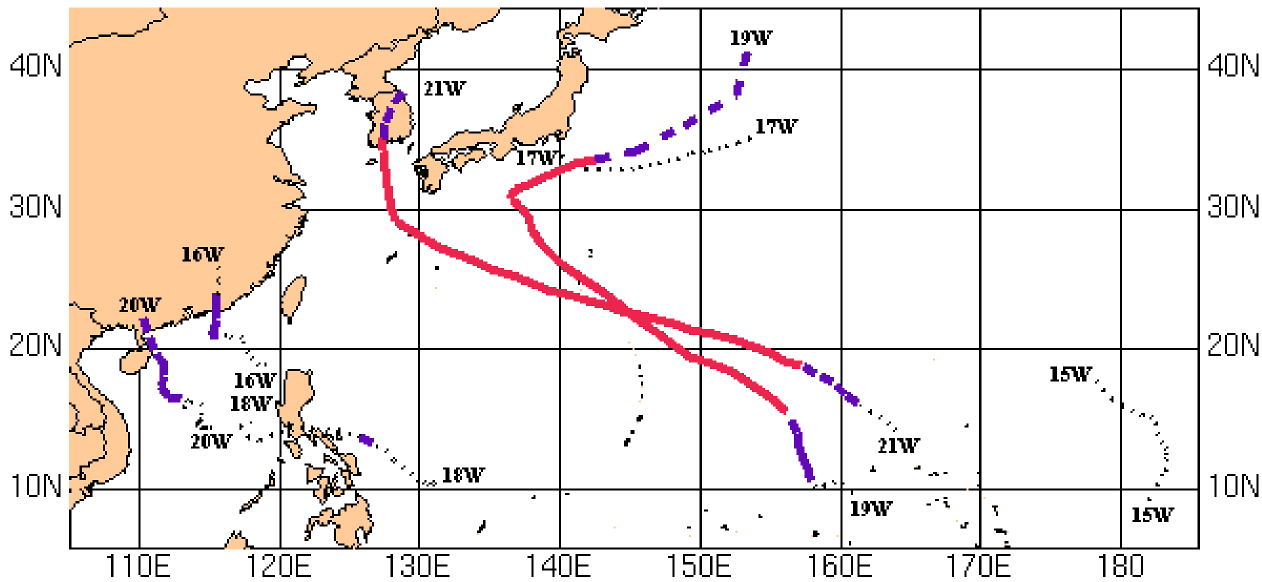



NORTHWEST PACIFIC OCEAN
TROPICAL CYCLONES
28 JUN - 27 JUL

**MAXIMUM SUSTAINED SURFACE WIND**

- 64KT (33M/SEC) OR GREATER
- 34 TO 63KT (18 TO 32M/SEC)
- 33KT (17M/SEC) OR LESS

| | |
|---|---|
| 08W STY CHATAAN | 28 JUN - 11 JUL |
| 09W TY RAMMASUN | 28 JUN - 06 JUL |
| 10W STY HALONG | 07 JUL - 15 JUL |
| 11W TS NAKRI | 08 JUL - 13 JUL |
| 12W STY FENGSHEN | 14 JUL - 27 JUL |
| 13W TS | 18 JUL - 22 JUL |
| 14W TY FUNG-WONG | 20 JUL - 27 JUL |




NORTHWEST PACIFIC OCEAN
TROPICAL CYCLONES
20 JUL - 01 SEP

**MAXIMUM SUSTAINED SURFACE WIND**

- 64KT (33M/SEC) OR GREATER (solid line)
- 34 TO 63KT (18 TO 32M/SEC) (dashed line)
- 33KT (17M/SEC) OR LESS (dotted line)

| | |
|---|---|
| 15W TD KALMAEGI | 20 JUL - 21 JUL |
| 16W TS KAMMURI | 02 AUG - 05 AUG |
| 17W TD | 05 AUG - 05 AUG |
| 18W TS | 10 AUG - 13 AUG |
| 19W STY PHANFONE | 11 AUG - 20 AUG |
| 20W TS VONGFONG | 15 AUG - 20 AUG |
| 21W TY RUSA | 22 AUG - 01 SEP |

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**TABLE 1-3**

**WESTERN NORTH PACIFIC TROPICAL CYCLONES**

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TYPHOONS (1945-1959)** | | | | | | | | | | | | | |
| MEAN | 0.3 | 0.1 | 0.3 | 0.4 | 0.7 | 1 | 2.9 | 3.1 | 3.3 | 2.4 | 2 | 0.9 | 16.4 |
| CASES | 5 | 1 | 4 | 6 | 10 | 15 | 29 | 46 | 49 | 36 | 30 | 14 | 245 |
| **TYPHOONS (1960-2002)** | | | | | | | | | | | | | |
| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTALS |
| MEAN | 0.2 | 0.1 | 0.2 | 0.4 | 0.7 | 1.1 | 2.7 | 3.5 | 3.4 | 3.1 | 1.6 | 0.7 | 17.7 |
| CASES | 10 | 3 | 8 | 18 | 29 | 47 | 117 | 149 | 145 | 135 | 67 | 31 | 759 |
| **TROPICAL STORMS AND TYPHOONS (1945-1959)** | | | | | | | | | | | | | |
| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTALS |
| MEAN | 0.4 | 0.1 | 0.5 | 0.5 | 0.8 | 1.6 | 2.9 | 4 | 4.2 | 3.3 | 2.7 | 1.2 | 22.2 |
| CASES | 6 | 2 | 7 | 8 | 11 | 22 | 44 | 60 | 64 | 49 | 41 | 18 | 332 |
| **TROPICAL STORMS AND TYPHOONS (1960-2002)** | | | | | | | | | | | | | |
| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTALS |
| MEAN | 0.5 | 0.2 | 0.4 | 0.7 | 1.1 | 1.8 | 4.2 | 5.6 | 5.1 | 4.1 | 2.6 | 1.3 | 27.6 |
| CASES | 22 | 10 | 17 | 29 | 48 | 76 | 180 | 241 | 218 | 178 | 113 | 55 | 1187 |

**TABLE 1-4**

**TROPICAL CYCLONE FORMATION ALERTS FOR THE**

**WESTERN NORTH PACIFIC OCEAN FOR 1976-2002**

| YEAR | INITIAL TCFAS | TROPICAL CYCLONES WITH TCFAS | TOTAL TROPICAL CYCLONES | PROBABILITY OF TCFA WITHOUT WARNING* | PROBABILITY OF TCFA BEFORE WARNING |
|---|---|---|---|---|---|
| 1976 | 34 | 25 | 25 | 26% | 100% |
| 1977 | 26 | 20 | 21 | 23% | 95% |
| 1978 | 32 | 27 | 32 | 16% | 84% |

| | | | | | |
|---|---|---|---|---|---|
| 1979 | 27 | 23 | 28 | 15% | 82% |
| 1980 | 37 | 28 | 28 | 24% | 100% |
| 1981 | 29 | 28 | 29 | 3% | 96% |
| 1982 | 36 | 26 | 28 | 28% | 93% |
| 1983 | 31 | 25 | 25 | 19% | 100% |
| 1984 | 37 | 30 | 30 | 19% | 100% |
| 1985 | 39 | 26 | 27 | 33% | 96% |
| 1986 | 38 | 27 | 27 | 29% | 100% |
| 1987 | 31 | 24 | 25 | 23% | 96% |
| 1988 | 33 | 26 | 27 | 21% | 96% |
| 1989 | 51 | 32 | 35 | 37% | 91% |
| 1990 | 33 | 30 | 31 | 9% | 97% |
| 1991 | 37 | 29 | 31 | 22% | 94% |
| 1992 | 36 | 32 | 32 | 11% | 100% |
| 1993 | 50 | 35 | 38 | 30% | 92% |
| 1994 | 50 | 40 | 40 | 20% | 100% |
| 1995 | 54 | 33 | 35 | 39% | 94% |
| 1996 | 41 | 39 | 43 | 5% | 91% |
| 1997 | 36 | 30 | 33 | 17% | 91% |
| 1998 | 38 | 18 | 27 | 53% | 67% |
| 1999 | 39 | 29 | 33 | 26% | 88% |
| 2000 | 40 | 31 | 34 | 23% | 91% |
| 2001 | 34 | 28 | 33 | 18% | 82% |
| 2002 | 39 | 31 | 33 | 21% | 94% |
| | | | | | |
| (1976-2002) | | | | | |
| MEAN: | 37.3 | 28.6 | 30.7 | 23.4% | 92.9% |
| TOTALS: | 1008 | 772 | 830 | | |
| * Percentage of initial TCFAs not followed by warnings. | | | | | |

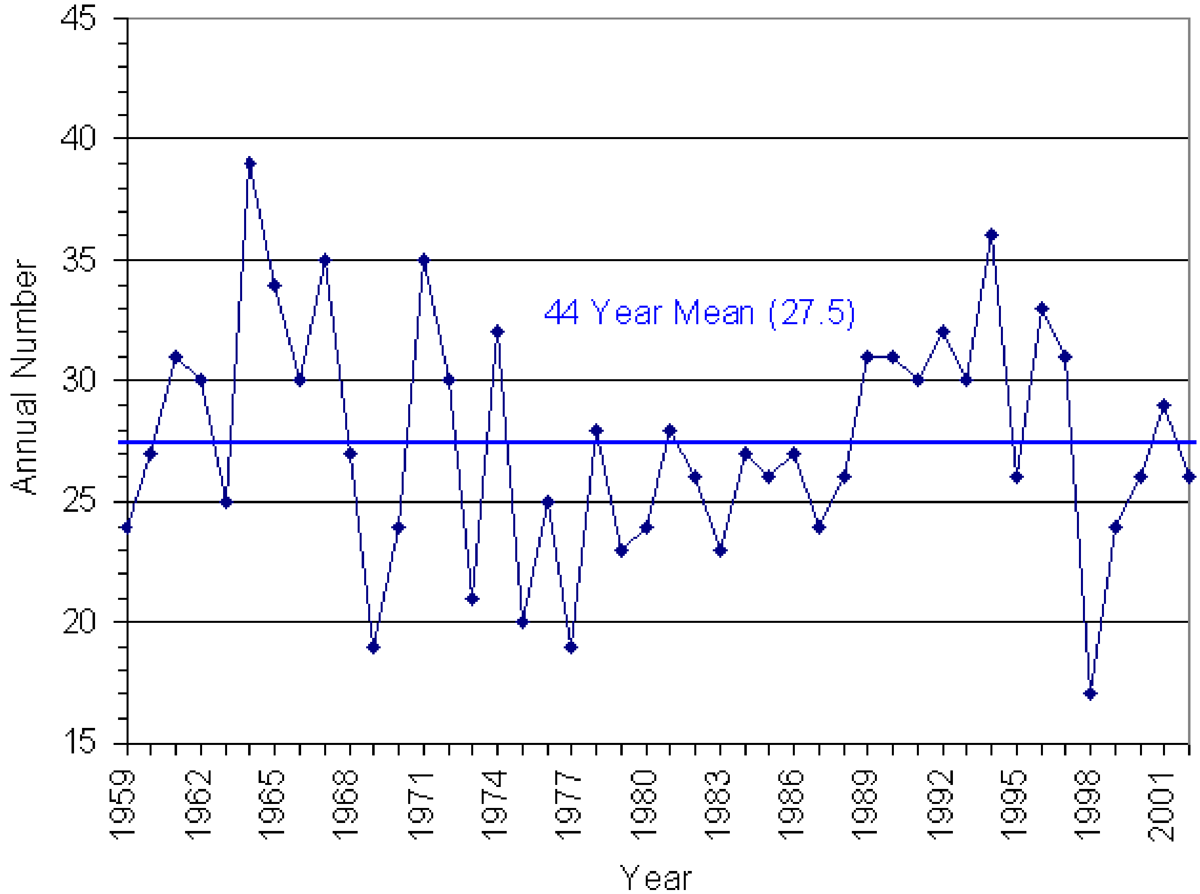


Figure 1-2. Tropical cyclones of tropical storm or greater intensity in the western North Pacific (1959-2002).

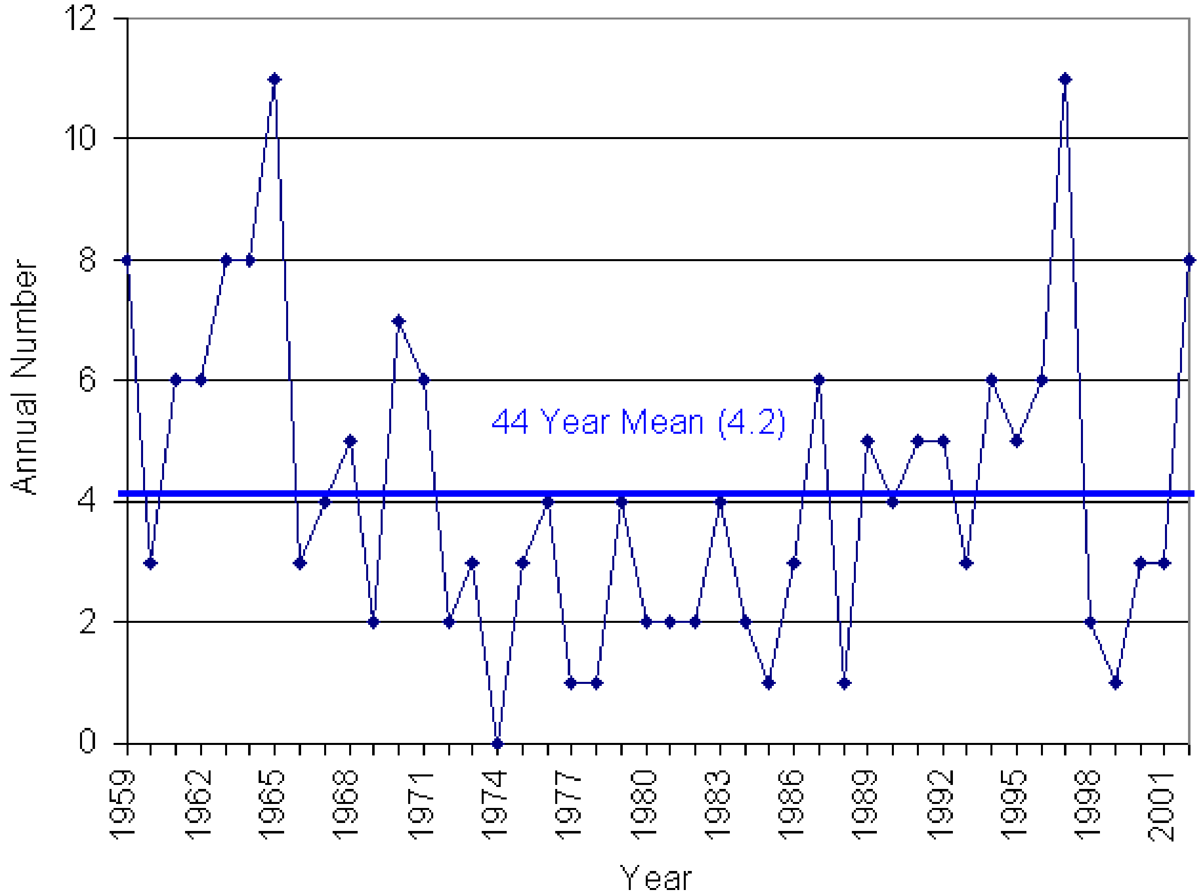


Figure 1-3. Number of western North Pacific super typhoons (1959-2002).

Contents | Summary | Chap 1 | Chap 2 | Chap 3 | Chap 4 | Chap 5 | Chap 6

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**Table 1-2**

**DISTRIBUTION OF WESTERN NORTH PACIFIC TROPICAL CYCLONES**

**FOR 1959 - 2002**

| YEAR | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | |
| **1959** | 0 | 1 | 1 | 1 | 0 | 1 | 3 | 8 | 9 | 3 | 2 | 2 | 31 |
| | 000 | 010 | 010 | 100 | 000 | 001 | 111 | 512 | 423 | 210 | 200 | 200 | 17 7 7 |
| **1960** | 1 | 0 | 1 | 1 | 1 | 3 | 3 | 9 | 5 | 4 | 1 | 1 | 30 |
| | 001 | 000 | 001 | 100 | 010 | 210 | 210 | 810 | 041 | 400 | 100 | 100 | 19 8 3 |
| **1961** | 1 | 1 | 1 | 1 | 4 | 6 | 5 | 7 | 6 | 7 | 2 | 1 | 42 |
| | 010 | 010 | 100 | 010 | 211 | 114 | 320 | 313 | 510 | 322 | 101 | 100 | 20 11 11 |
| **1962** | 0 | 1 | 0 | 1 | 3 | 0 | 8 | 8 | 7 | 5 | 4 | 2 | 39 |
| | 000 | 010 | 000 | 100 | 201 | 000 | 512 | 701 | 313 | 311 | 301 | 020 | 24 6 9 |
| **1963** | 0 | 0 | 1 | 1 | 0 | 4 | 5 | 4 | 4 | 6 | 0 | 3 | 28 |
| | 000 | 000 | 001 | 100 | 000 | 310 | 311 | 301 | 220 | 510 | 000 | 210 | 19 6 3 |
| **1964** | 0 | 0 | 0 | 0 | 3 | 2 | 8 | 8 | 8 | 7 | 6 | 2 | 44 |
| | 000 | 000 | 000 | 000 | 201 | 200 | 611 | 350 | 521 | 331 | 420 | 101 | 26 13 5 |
| **1965** | 2 | 2 | 1 | 1 | 2 | 4 | 6 | 7 | 9 | 3 | 2 | 1 | 40 |
| | 110 | 020 | 010 | 100 | 101 | 310 | 411 | 322 | 531 | 201 | 110 | 010 | 21 13 6 |
| **1966** | 0 | 0 | 0 | 1 | 2 | 1 | 4 | 9 | 10 | 4 | 5 | 2 | 38 |
| | 000 | 000 | 000 | 100 | 200 | 100 | 310 | 531 | 532 | 112 | 122 | 101 | 20 10 8 |
| **1967** | 1 | 0 | 2 | 1 | 1 | 1 | 8 | 10 | 8 | 4 | 4 | 1 | 41 |
| | 010 | 000 | 110 | 100 | 010 | 100 | 332 | 343 | 530 | 211 | 400 | 010 | 20 15 6 |
| **1968** | 0 | 1 | 0 | 1 | 0 | 4 | 3 | 8 | 4 | 6 | 4 | 0 | 31 |
| | 000 | 001 | 000 | 100 | 000 | 202 | 120 | 341 | 400 | 510 | 400 | 000 | 20 7 4 |
| **1969** | 1 | 0 | 1 | 1 | 0 | 0 | 3 | 3 | 6 | 5 | 2 | 1 | 23 |
| | 100 | 000 | 010 | 100 | 000 | 000 | 210 | 210 | 204 | 410 | 110 | 010 | 13 6 4 |
| **1970** | 0 | 1 | 0 | 0 | 0 | 2 | 3 | 7 | 4 | 6 | 4 | 0 | 27 |
| | 000 | 100 | 000 | 000 | 000 | 110 | 021 | 421 | 220 | 321 | 130 | 000 | 12 12 3 |
| **1971** | 1 | 0 | 1 | 2 | 5 | 2 | 8 | 5 | 7 | 4 | 2 | 0 | 37 |
| | 010 | 000 | 010 | 200 | 230 | 200 | 620 | 311 | 511 | 310 | 110 | 000 | 24 11 2 |
| **1972** | 1 | 0 | 1 | 0 | 0 | 4 | 5 | 5 | 6 | 5 | 2 | 3 | 32 |
| | 100 | 000 | 001 | 000 | 000 | 220 | 410 | 320 | 411 | 410 | 200 | 210 | 22 8 2 |
| **1973** | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 6 | 3 | 4 | 3 | 0 | 23 |
| | 000 | 000 | 000 | 000 | 000 | 000 | 430 | 231 | 201 | 400 | 030 | 000 | 12 9 2 |
| **1974** | 1 | 0 | 1 | 1 | 1 | 4 | 5 | 7 | 5 | 4 | 4 | 2 | 35 |
| | 010 | 000 | 010 | 010 | 100 | 121 | 230 | 232 | 320 | 400 | 220 | 020 | 15 17 3 |
| **1975** | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 6 | 5 | 6 | 3 | 2 | 25 |
| | 100 | 000 | 000 | 001 | 000 | 000 | 010 | 411 | 410 | 321 | 210 | 002 | 14 6 5 |
| **1976** | 1 | 1 | 0 | 2 | 2 | 2 | 4 | 4 | 5 | 0 | 2 | 2 | 25 |

TD 15W Kalmaegi
TS 16W Kammuri
TD 17W
TS 18W
STY19W Phanfone
TS 20W Vongfong
TY 21W Rusa
TY 22W Sinlaku
TS 23W Hagupit
TS 24W Mekkhala
STY25W Higos
TY 26W Bavi
TD 27W
TD 28W
TS 29W Maysak
TY 30W Haishen
STY31W Pongsona
HUR02C Ele
HUR03C Huko
TC 01A
TC 02B
TC 03B
TC 04B
TC 05B

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 100 | 010 | 000 | 110 | 200 | 200 | 220 | 130 | 410 | 000 | 110 | 020 | 14 11 0 |
| **1977** | 0 | 0 | 1 | 0 | 1 | 1 | 4 | 2 | 5 | 4 | 2 | 1 | 21 |
| | 000 | 000 | 010 | 000 | 001 | 010 | 301 | 020 | 230 | 310 | 200 | 100 | 11 8 2 |
| **1978** | 1 | 0 | 0 | 1 | 0 | 3 | 4 | 8 | 4 | 7 | 4 | 0 | 32 |
| | 010 | 000 | 000 | 100 | 000 | 030 | 310 | 341 | 310 | 412 | 121 | 000 | 15 13 4 |
| **1979** | 1 | 0 | 1 | 1 | 2 | 0 | 5 | 4 | 6 | 3 | 2 | 3 | 28 |
| | 100 | 000 | 100 | 100 | 011 | 000 | 221 | 202 | 330 | 210 | 110 | 111 | 14 9 5 |
| **1980** | 0 | 0 | 1 | 1 | 4 | 1 | 5 | 3 | 7 | 4 | 1 | 1 | 28 |
| | 000 | 000 | 001 | 010 | 220 | 010 | 311 | 201 | 511 | 220 | 100 | 010 | 15 9 4 |
| **1981** | 0 | 0 | 1 | 1 | 1 | 2 | 5 | 8 | 4 | 2 | 3 | 2 | 29 |
| | 000 | 000 | 100 | 010 | 010 | 200 | 230 | 251 | 400 | 110 | 210 | 200 | 16 12 1 |
| **1982** | 0 | 0 | 3 | 0 | 1 | 3 | 4 | 5 | 6 | 4 | 1 | 1 | 28 |
| | 000 | 000 | 210 | 000 | 100 | 120 | 220 | 500 | 321 | 301 | 100 | 100 | 19 7 2 |
| **1983** | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 6 | 3 | 5 | 5 | 2 | 25 |
| | 000 | 000 | 000 | 000 | 000 | 010 | 300 | 231 | 111 | 320 | 320 | 020 | 12 11 2 |
| **1984** | 0 | 0 | 0 | 0 | 0 | 2 | 5 | 7 | 4 | 8 | 3 | 1 | 30 |
| | 000 | 000 | 000 | 000 | 000 | 020 | 410 | 232 | 130 | 521 | 300 | 100 | 16 11 3 |
| **1985** | 2 | 0 | 0 | 0 | 1 | 3 | 1 | 7 | 5 | 5 | 1 | 2 | 27 |
| | 020 | 000 | 000 | 000 | 100 | 201 | 100 | 520 | 320 | 410 | 010 | 110 | 17 9 1 |
| **1986** | 0 | 1 | 0 | 1 | 2 | 2 | 2 | 5 | 2 | 5 | 4 | 3 | 27 |
| | 000 | 100 | 000 | 100 | 110 | 110 | 200 | 410 | 200 | 320 | 220 | 210 | 19 8 0 |
| **1987** | 1 | 0 | 0 | 1 | 0 | 2 | 4 | 4 | 7 | 2 | 3 | 1 | 25 |
| | 100 | 000 | 000 | 010 | 000 | 110 | 400 | 310 | 511 | 200 | 120 | 100 | 18 6 1 |
| **1988** | 1 | 0 | 0 | 0 | 1 | 3 | 2 | 5 | 8 | 4 | 2 | 1 | 27 |
| | 100 | 000 | 000 | 000 | 100 | 111 | 110 | 230 | 260 | 400 | 200 | 010 | 14 12 1 |
| **1989** | 1 | 0 | 0 | 1 | 2 | 2 | 6 | 8 | 4 | 6 | 3 | 2 | 35 |
| | 010 | 000 | 000 | 100 | 200 | 110 | 231 | 332 | 220 | 600 | 300 | 101 | 21 10 4 |
| **1990** | 1 | 0 | 0 | 1 | 2 | 4 | 4 | 5 | 5 | 5 | 4 | 1 | 32 |
| | 100 | 000 | 000 | 010 | 110 | 211 | 220 | 500 | 410 | 230 | 310 | 100 | 21 10 1 |
| **1991** | 0 | 0 | 2 | 1 | 1 | 1 | 4 | 8 | 6 | 3 | 6 | 0 | 32 |
| | 000 | 000 | 110 | 010 | 100 | 100 | 400 | 332 | 420 | 300 | 330 | 000 | 20 10 2 |
| **1992** | 1 | 1 | 0 | 0 | 0 | 3 | 4 | 8 | 5 | 6 | 5 | 0 | 33 |
| | 100 | 010 | 000 | 000 | 000 | 210 | 220 | 440 | 410 | 510 | 311 | 000 | 21 11 1 |
| **1993** | 0 | 0 | 2 | 2 | 1 | 2 | 5 | 8 | 5 | 6 | 4 | 3 | 38 |
| | 000 | 000 | 011 | 002 | 010 | 101 | 320 | 611 | 410 | 321 | 112 | 300 | 21 9 8 |
| **1994** | 1 | 0 | 1 | 0 | 2 | 2 | 9 | 9 | 8 | 7 | 0 | 2 | 41 |
| | 001 | 000 | 100 | 000 | 101 | 020 | 342 | 630 | 440 | 511 | 000 | 110 | 21 15 5 |
| **1995** | 1 | 0 | 0 | 0 | 1 | 2 | 3 | 7 | 7 | 8 | 2 | 3 | 34 |
| | 001 | 000 | 000 | 000 | 010 | 020 | 210 | 421 | 412 | 512 | 020 | 012 | 15 11 8 |
| **1996** | 0 | 1 | 0 | 2 | 2 | 0 | 7 | 10 | 7 | 5 | 6 | 3 | 43 |
| | 000 | 001 | 000 | 011 | 110 | 000 | 610 | 433 | 610 | 212 | 132 | 111 | 21 12 10 |
| **1997** | 1 | 0 | 0 | 2 | 3 | 3 | 4 | 8 | 4 | 6 | 1 | 1 | 33 |
| | 010 | 000 | 000 | 110 | 120 | 300 | 310 | 611 | 310 | 411 | 100 | 100 | 23 8 2 |
| **1998** | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 8 | 6 | 3 | 4 | 27 |
| | 000 | 000 | 000 | 000 | 000 | 000 | 012 | 210 | 413 | 213 | 030 | 112 | 9 8 10 |
| **1999** | 1 | 1 | 0 | 3 | 0 | 1 | 5 | 9 | 6 | 2 | 3 | 3 | 34 |
| | 010 | 010 | 000 | 210 | 000 | 100 | 113 | 423 | 240 | 110 | 111 | 003 | 12 12 10 |
| **2000** | 0 | 0 | 0 | 0 | 4 | 0 | 8 | 9 | 6 | 3 | 3 | 1 | 34 |
| | 000 | 000 | 000 | 000 | 112 | 000 | 233 | 432 | 411 | 210 | 111 | 100 | 15 10 9 |
| **2001** | 0 | 1 | 0 | 1 | 1 | 2 | 6 | 7 | 5 | 3 | 3 | 4 | 33 |
| | 000 | 001 | 000 | 001 | 010 | 200 | 411 | 331 | 500 | 300 | 120 | 220 | 20 9 4 |
| **2002** | 1 | 1 | 1 | 1 | 1 | 3 | 6 | 9 | 3 | 5 | 1 | 1 | 33 |
| | 010 | 100 | 001 | 001 | 101 | 300 | 321 | 431 | 120 | 302 | 100 | 100 | 18 8 7 |
| (1959-2002) | | | | | | | | | | | | | |
| **MEAN** | 0.6 | 0.3 | 0.5 | 0.8 | 1.3 | 1.9 | 4.7 | 6.2 | 5.7 | 4.7 | 2.9 | 1.6 | 31.8 |
| **CASES** | 25 | 14 | 24 | 36 | 57 | 88 | 207 | 293 | 251 | 207 | 127 | 71 | 1400 |

| The criteria used in TABLE 1-2 are as follows: |
|---|
| 1) If a tropical cyclone was first warned on during the last two days of a particular month and continued into the next month for longer than two days, then that system was attributed to the second month. |
| 2) If a tropical cyclone was warned on prior to the last two days of a month, it was attributed to the first month, regardless of how long the system lasted. |
| 3) If a tropical cyclone began on the last day of the month and ended on the first day of the next month, that system was attributed to the first month. However, if a tropical cyclone began on the last day of the month and continued into the next month for only two days, then it was attributed to the second month. |

| Table 1-2 Legend: | | |
|---|---|---|
| | Total month/year | |
| GTE 64 knots (Typhoon) | 35 to 63 knots (Tropical Storm) | LTE 34 knots (Tropical Depression) |

## 1.2 NORTH INDIAN OCEAN TROPICAL CYCLONES

Tropical cyclone genesis regions are compared to the overall 25-year average in Figure 1-4. This year's North Indian Ocean tropical cyclones are listed in Table 1-5. The monthly distribution of tropical cyclones for each year since 1975 is shown in Table 1-6. Composites of the tropical cyclone best tracks for the Northern Indian Ocean appear following Table 1-6.

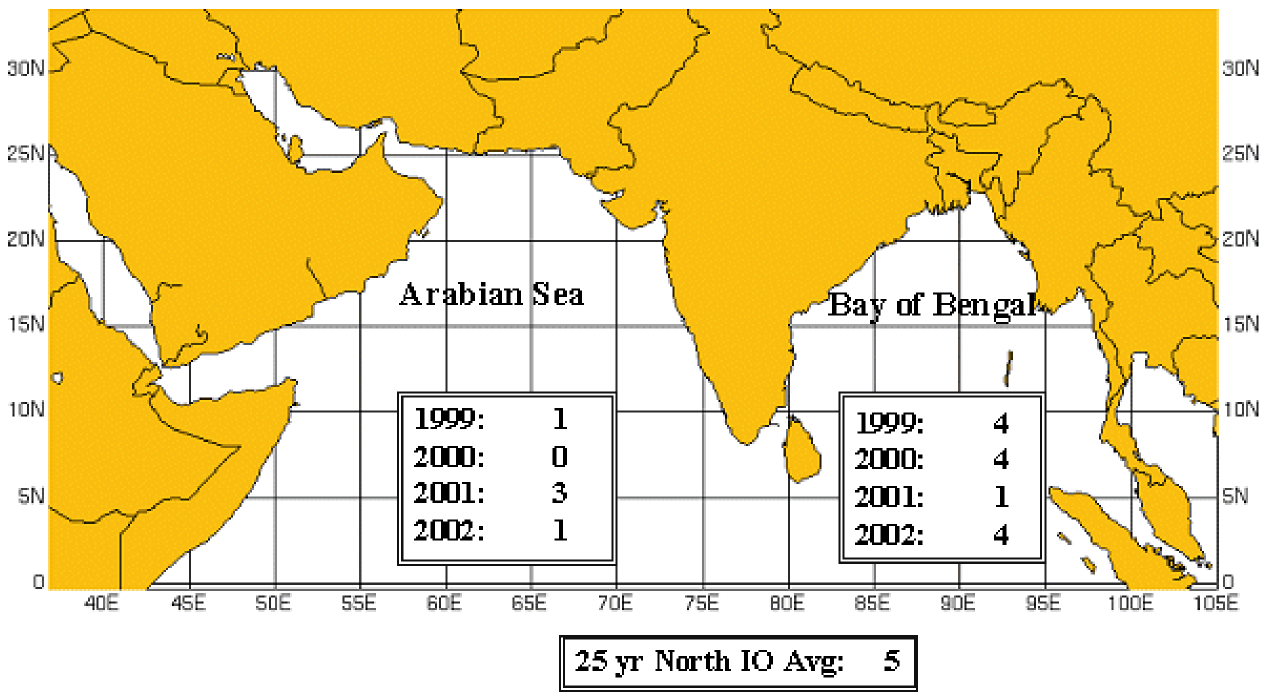


Figure 1-4. Comparison of the number of tropical cyclones that developed in Bay of Bengal and Arabian Sea for 1999, 2000, 2001, 2002 and the 25-year average.

TD 15W Kalmaegi
TS 16W Kammuri
TD 17W
TS 18W
STY19W Phanfone
TS 20W Vongfong
TY 21W Rusa
TY 22W Sinlaku
TS 23W Hagupit
TS 24W Mekkhala
STY25W Higos
TY 26W Bavi
TD 27W
TD 28W
TS 29W Maysak
TY 30W Haishen
STY31W Pongsona
HUR02C Ele
HUR03C Huko
TC 01A
TC 02B
TC 03B
TC 04B
TC 05B

**Table 1-5**

**NORTH INDIAN OCEAN SIGNIFICANT TROPICAL CYCLONES FOR 2002**

**(01 JAN 2002 - 31 DEC 2002)**

| TC | NAME | PERIOD | WARNINGS ISSUED | EST MAX SFC WINDS KTS (M/SEC) | MSLP (MB)* |
|---|---|---|---|---|---|
| 01A | - | 06 May - 10 May | 15 | 45 (23) | 991 |
| 02B | - | 10 May - 12 May | 8 | 45 (23) | 991 |
| 03B | - | 11 Nov - 12 Nov | 5 | 55 (28) | 984 |
| 04B | - | 23 Nov - 25 Nov | 9 | 45 (23) | 991 |
| 05B | - | 23 Dec - 25 Dec | 5 | 35 (18) | 987 |
| | | | | | |
| | | **JTWC Total** | 42 | | |

*MSLP Converted from estimated maximum surface winds using Atkinson/Holiday wind-pressure relationship

**Table 1-6**

**DISTRIBUTION OF NORTHERN INDIAN OCEAN TROPICAL CYCLONES**

**FOR 1975 - 2002**

| YEAR | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | |
| **1975** | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | **6** |
| | 0 1 0 | 0 0 0 | 0 0 0 | 0 0 0 | 2 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 1 0 0 | 0 2 0 | 0 0 0 | 3 3 0 |
| **1976** | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | **5** |
| | 0 0 0 | 0 0 0 | 0 0 0 | 0 1 0 | 0 0 0 | 0 1 0 | 0 0 0 | 0 0 0 | 0 1 0 | 0 1 0 | 0 0 0 | 0 1 0 | 0 5 0 |
| **1977** | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 2 | **5** |
| | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 1 0 | 0 1 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 1 0 | 0 0 0 | 1 1 0 | 1 4 0 |
| **1978** | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | **4** |
| | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 1 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 1 0 | 2 0 0 | 0 0 0 | 2 2 0 |
| **1979** | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 1 | 2 | 0 | **7** |
| | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 1 0 0 | 0 1 0 | 0 0 0 | 0 0 0 | 0 1 1 | 0 1 0 | 0 1 1 | 0 0 0 | 1 4 2 |
| **1980** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | **2** |
| | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 1 0 | 0 1 0 | 0 2 0 |
| **1981** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | **3** |
| | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 1 0 | 0 0 0 | 1 0 0 | 1 0 0 | 2 1 0 |
| **1982** | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 2 | 1 | 0 | **5** |
| | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 1 0 0 | 0 1 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 2 0 | 1 0 0 | 0 0 0 | 2 3 0 |
| **1983** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | **3** |
| | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 1 0 | 0 0 0 | 0 1 0 | 0 1 0 | 0 0 0 | 0 3 0 |
| **1984** | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | **4** |
| | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 1 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 1 0 | 2 0 0 | 0 0 0 | 2 2 0 |
| **1985** | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | 1 | 1 | **6** |
| | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 2 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 2 0 | 0 1 0 | 0 1 0 | 0 6 0 |
| **1986** | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | **3** |
| | 0 1 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 2 0 | 0 0 0 | 0 3 0 |
| **1987** | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 1 | 2 | **8** |
| | 0 0 0 | 0 1 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 2 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 2 0 | 0 1 0 | 0 2 0 | 0 8 0 |
| **1988** | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 2 | 1 | **5** |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 1 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 1 0 | 1 1 0 | 0 1 0 | 1 4 0 |
| **1989** | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | **3** |
| | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 1 0 | 0 1 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 1 0 0 | 0 0 0 | 1 2 0 |
| **1990** | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | **4** |
| | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 1 | 1 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 1 | 0 1 0 | 1 1 2 |
| **1991** | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | **4** |
| | 0 1 0 | 0 0 0 | 0 0 0 | 1 0 0 | 0 0 0 | 0 1 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 1 0 0 | 0 0 0 | 2 2 0 |
| **1992** | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 0 | 1 | 3 | 3 | 2 | **13** |
| | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 1 0 0 | 0 2 0 | 0 1 0 | 0 0 0 | 0 0 1 | 0 2 1 | 2 1 0 | 0 2 0 | 3 8 2 |
| **1993** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | **2** |
| | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 2 0 0 | 0 0 0 | 2 0 0 |
| **1994** | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | **5** |
| | 0 0 0 | 0 0 0 | 0 1 0 | 1 0 0 | 0 0 0 | 0 1 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 1 0 | 0 1 0 | 0 0 0 | 1 4 0 |
| **1995** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 0 | **4** |
| | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 1 0 | 0 1 0 | 2 0 0 | 0 0 0 | 2 2 0 |
| **1996** | 0 | 0 | 0 | 0 | 1 | 3 | 0 | 0 | 0 | 2 | 2 | 0 | **8** |
| | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 1 0 | 1 2 0 | 0 0 0 | 0 0 0 | 0 0 0 | 1 1 0 | 2 0 0 | 0 0 0 | 4 4 0 |
| **1997** | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | **4** |
| | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 1 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 1 0 0 | 0 1 0 | 0 1 0 | 0 0 0 | 2 2 0 |
| **1998** | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 1 | 1 | 2 | 1 | **8** |
| | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 1 1 0 | 1 0 0 | 0 0 0 | 0 0 0 | 0 1 0 | 0 1 0 | 2 0 0 | 1 0 0 | 5 3 0 |
| **1999** | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | **5** |
| | 0 0 0 | 0 1 0 | 0 0 0 | 0 0 0 | 1 0 0 | 0 1 0 | 0 0 0 | 0 0 0 | 0 0 0 | 2 0 0 | 0 0 0 | 0 0 0 | 3 2 0 |
| **2000** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 1 | **4** |
| | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 2 0 | 1 0 0 | 0 1 0 | 1 3 0 |
| **2001** | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | **4** |
| | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 1 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 1 0 | 0 1 0 | 0 0 1 | 0 0 0 | 1 2 1 |
| **2002** | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | **5** |
| | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 2 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | 0 2 0 | 0 1 0 | 0 5 0 |
| (1975-2002) | | | | | | | | | | | | | |
| **MEAN** | 0.1 | 0.1 | 0.0 | 0.2 | 0.7 | 0.6 | 0.0 | 0.0 | 0.3 | 1.0 | 1.4 | 0.5 | 5.0 |
| **CASES** | 3 | 2 | 1 | 4 | 20 | 17 | 1 | 1 | 9 | 28 | 38 | 15 | 139 |

**The criteria used in TABLE 1-6 are as follows:**

1) If a tropical cyclone was first warned on during the last two days of a particular month and continued into the next month for longer than two days, then that system was attributed to the second month.

2) If a tropical cyclone was warned on prior to the last two days of a month, it was attributed to the first month, regardless of how long the system lasted.

3) If a tropical cyclone began on the last day of the month and ended on the first day of the next month, that system was attributed to the first month. However, if a tropical cyclone began on the last day of the month and continued into the next month for only two days, then it was attributed to the second month.

| **Table 1-6 Legend:** | | |
|---|---|---|
| | **Total month/year** | |
| **GTE 64 knots (Typhoon)** | **35 to 63 knots (Tropical Storm)** | **LTE 34 knots (Tropical Depression)** |

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1.1 WESTERN NORTH PACIFIC OCEAN TROPICAL CYCLONES

1.2 NORTH INDIAN OCEAN TROPICAL CYCLONES

1.3 SUMMARY OF WESTERN NORTH PACIFIC AND NORTH INDIAN OCEAN TROPICAL CYCLONES

TS 01W Tapah

STY02W Mitag

TD 03W

TD 04W

STY05W Hagibis

TD 06W

TY 07W Noguri

STY08W Chataan

TY 09W Rammasun

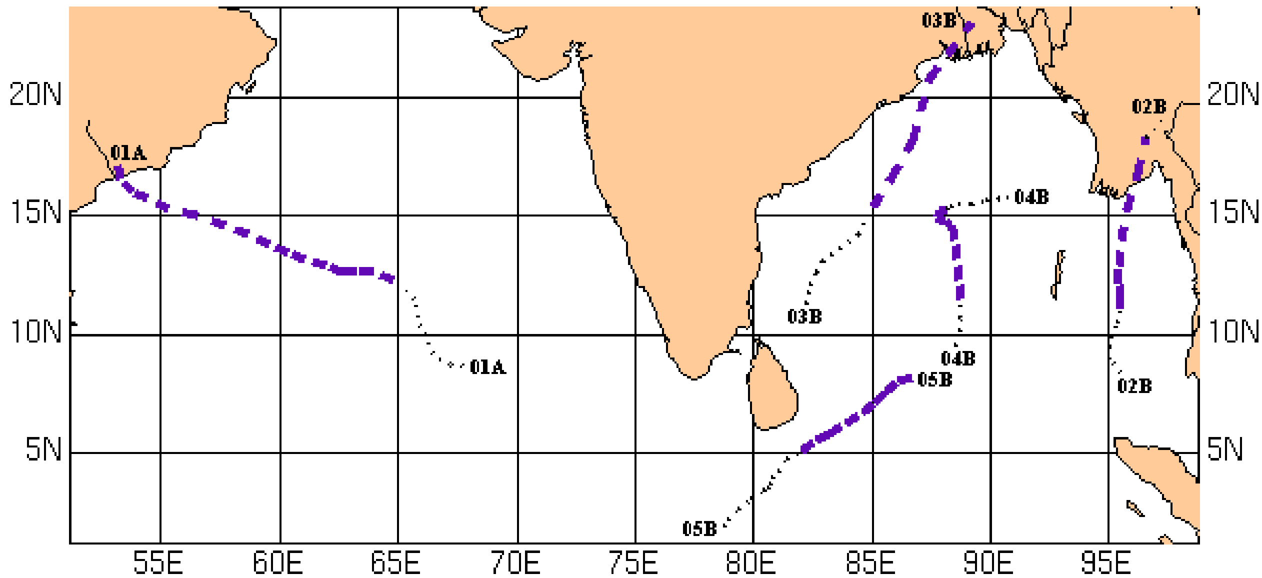
STY10W Halong

TS 11W Nakri

STY12W Fengshen

TS 13W

TY 14W Fung-Wong




NORTHERN INDIAN OCEAN
TROPICAL CYCLONES
06 MAY - 25 DEC

| MAXIMUM SUSTAINED SURFACE WIND |
|---|
| 64KT (33M/SEC) OR GREATER |
| 34 TO 63KT (18 TO 32M/SEC) |
| 33KT (17M/SEC) OR LESS |

| | |
|---|---|
| 01A TC | 06 MAY - 10 MAY |
| 02B TC | 10 MAY - 12 MAY |
| 03B TC | 11 NOV - 12 NOV |
| 04B TC | 23 NOV - 25 NOV |
| 05B TC | 23 DEC - 25 DEC |

## 1.3 SUMMARY OF WESTERN NORTH PACIFIC AND NORTH INDIAN OCEAN TROPICAL CYCLONES

# Tropical Storm (TS) 01W (Tapah)

Verification Statistics

First Poor : 0600Z 08 Jan 02
First Fair : 0030Z 09 Jan 02
First TCFA : 2030Z 09 Jan 02
First Warning : 1200Z 10 Jan 02
Last Warning : 0000Z 14 Jan 02
Max Intensity : 50 kts, gusts to 65 kts
Landfall : 1320Z 13 Jan 02
Total Warnings : 15
Remarks:
(1) TS 01W formed in the Caroline Islands within a broad monsoon trough. The first warning was issued with an intensity of 30 knots.
(2) Maximum intensity of 50 knots was attained at 1200Z 12 January when the cyclone was just east of Catanduanes Island, Philippines. The subtropical ridge north of the cyclone caused west-northwestward movement from the central Carolines to Luzon Island. The passage of a mid-latitude trough weakened this ridge and thus caused the cyclone to change direction and move north into Luzon Strait.
(3) Vertical wind shear and interaction with northern Luzon caused the cyclone to dissipate in the Luzon Strait.
(4) No damage or fatalities were reported with this cyclone.

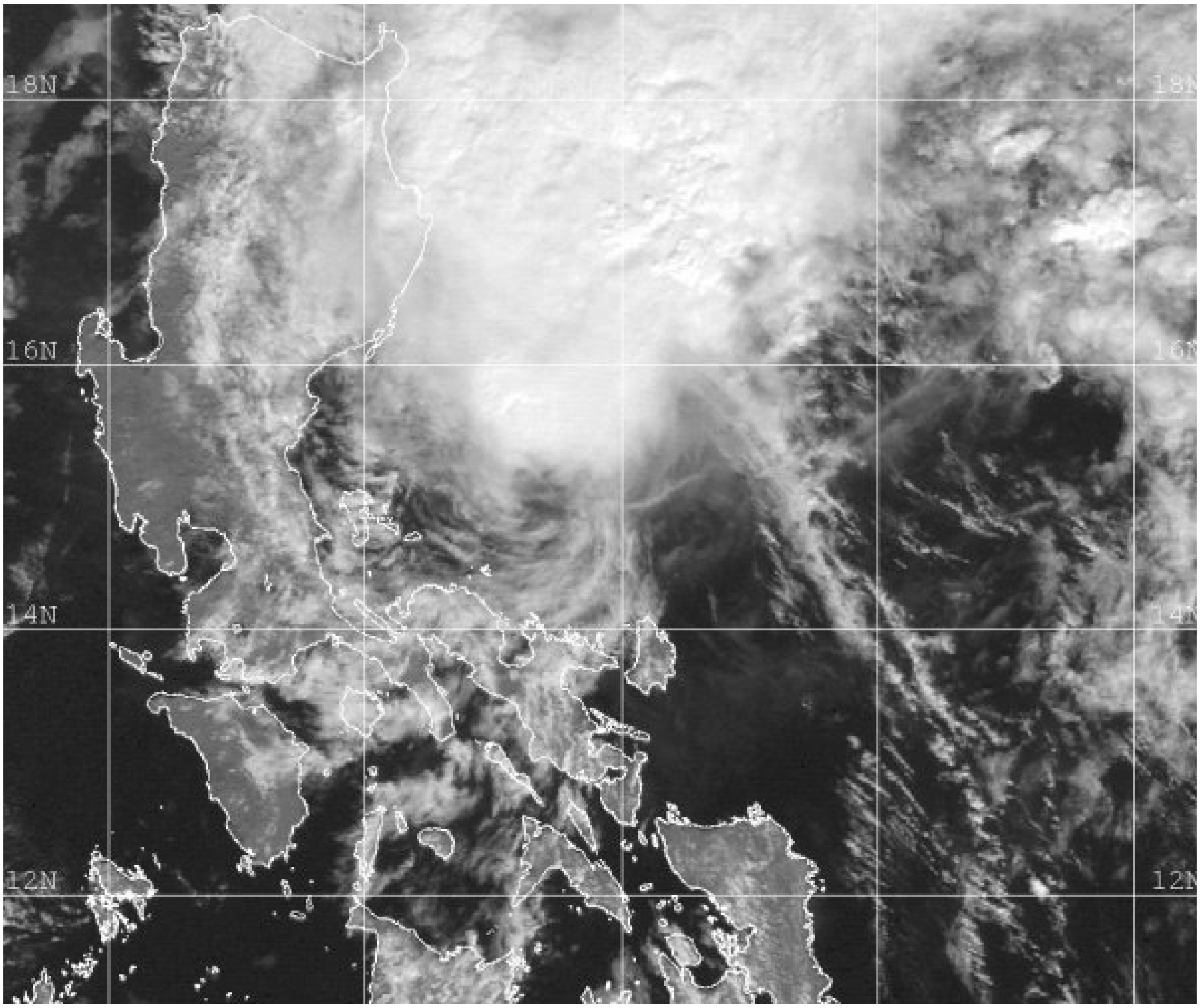



Figure 1-01W-1. 130231Z January 2002 GMS-5 Visible image of TS 01W (Tapah) North of Luzon with an estimated intensity of 45 knots.

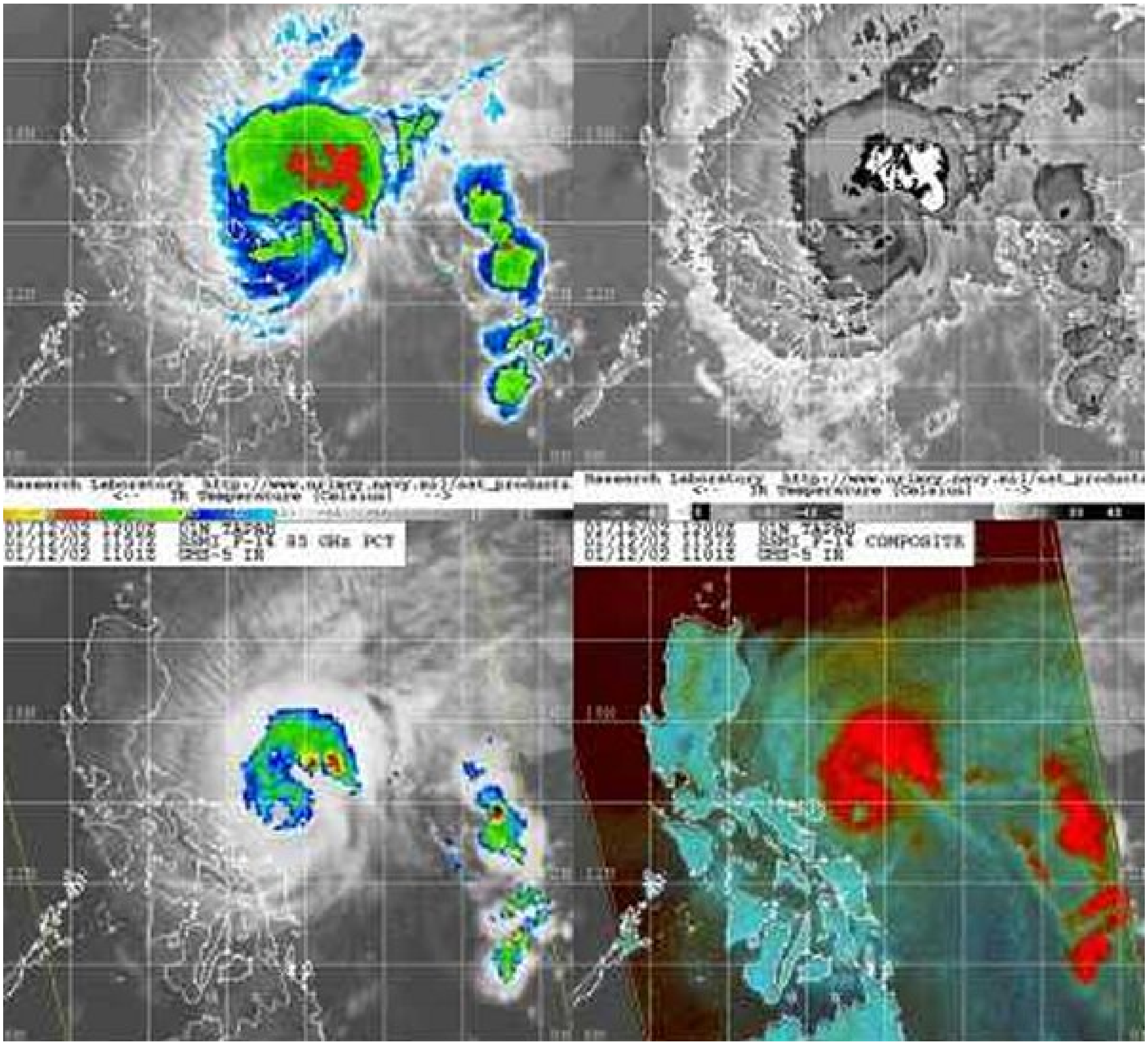
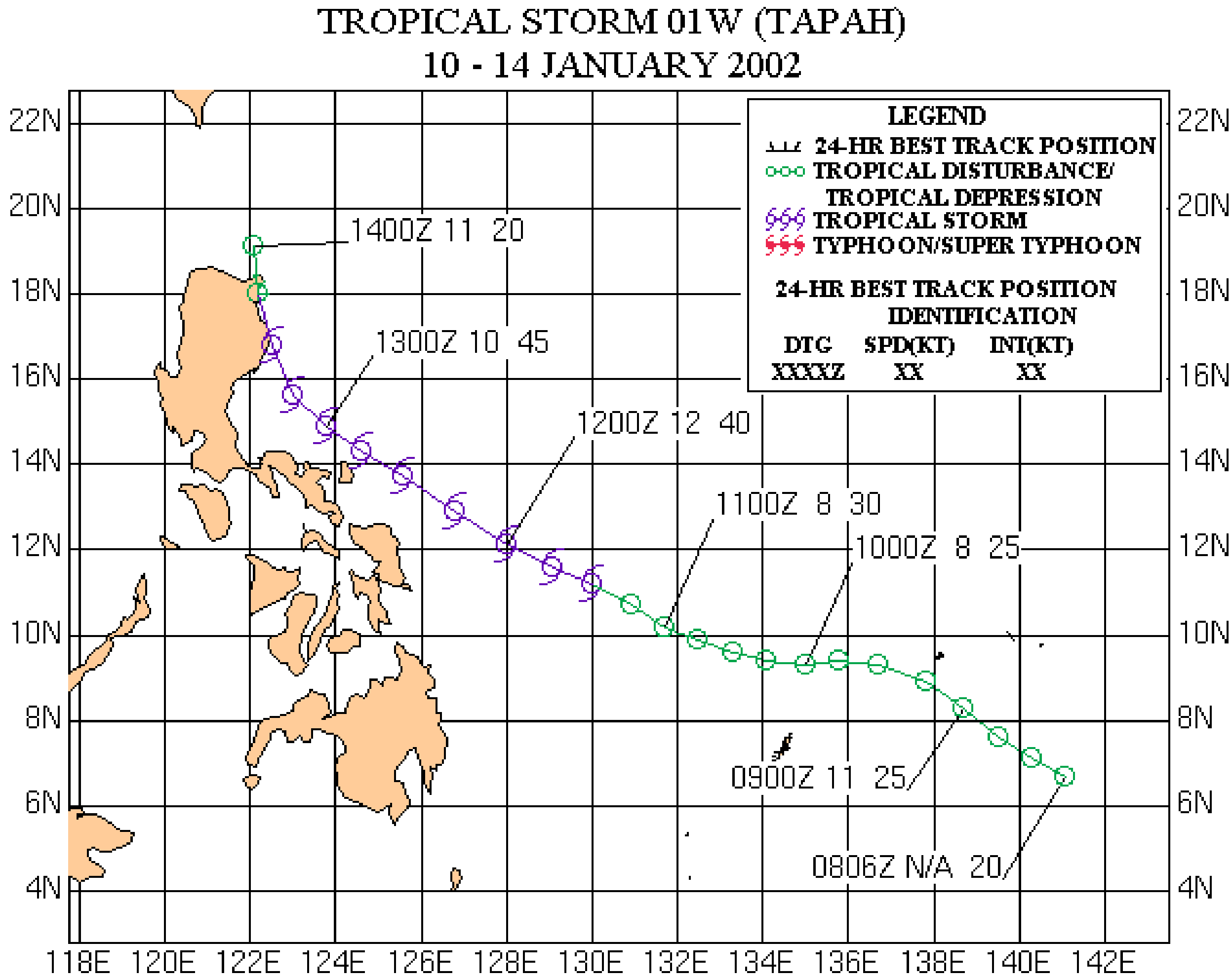


Figure 1-01W-2. 121157Z January 2002 Multisensor image of TS 01W (Tapah) east of Luzon with an estimated intensity of 50 knots.


TROPICAL STORM 01W (TAPAH)
10 - 14 JANUARY 2002
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 XX
1400Z 11 20
1300Z 10 45
1200Z 12 40
1100Z 8 30
1000Z 8 25
0900Z 11 25
0806Z N/A 20
22N
20N
18N
16N
14N
12N
10N
8N
6N
4N
118E 120E 122E 124E 126E 128E 130E 132E 134E 136E 138E 140E 142E

# Super-Typhoon (STY) 02W (Mitag)

Verification Statistics

First Poor : 1200Z 25 Feb 02
First Fair : 0130Z 26 Feb 02
First TCFA : 1430Z 26 Feb 02
First Warning : 1800Z 26 Feb 02
Last Warning : 1200Z 08 Mar 02
Max Intensity : 140 kts, gusts to 170 kts
Landfall : None
Total Warnings : 39
Remarks:
(1) STY 02W (Mitag) developed in a near-equatorial trough established along 6 N on 26 February 2002. The system moved slowly westward for two days under the influence of a low to mid level ridge to the north of STY 02W then increased speed to 10-14 knots. On 05 March, the cyclone reached super typhoon intensity as it approached the recurvature point near 130 E longitude
(2) Intensification occurred at a rate slightly faster than one Dvorak T number a day up to maximum intensity of 140 knots at 0600Z on 05 March. Intense storms so early in the season are rare in the Western Pacific and worthy of note.
(3) A deepening mid-latitude trough upstream modified the environmental steering pattern which allowed STY 02W to recurve into the westerlies. STY 02W maintained 140 knot intensity for approximately 12 hours during recurvature before weakening in response to increasing vertical wind shear and cool, dry air entrainment associated with the mid-latitudes. Cool air entrainment and high vertical wind shear resulted in a weakening trend of nearly 60 knots or 3 T numbers in a 24 period (1800Z 6 March-1800Z 7 March) and the dissipation of the cyclone in the Philippine Sea. A strong northeast monsoon surge combined with upper level westerlies completely sheared the upper level circulation from the low level cyclone and pushed the low level remnants back to the south.
(4) Available reports indicate no casualties or damage associated with this cyclone.

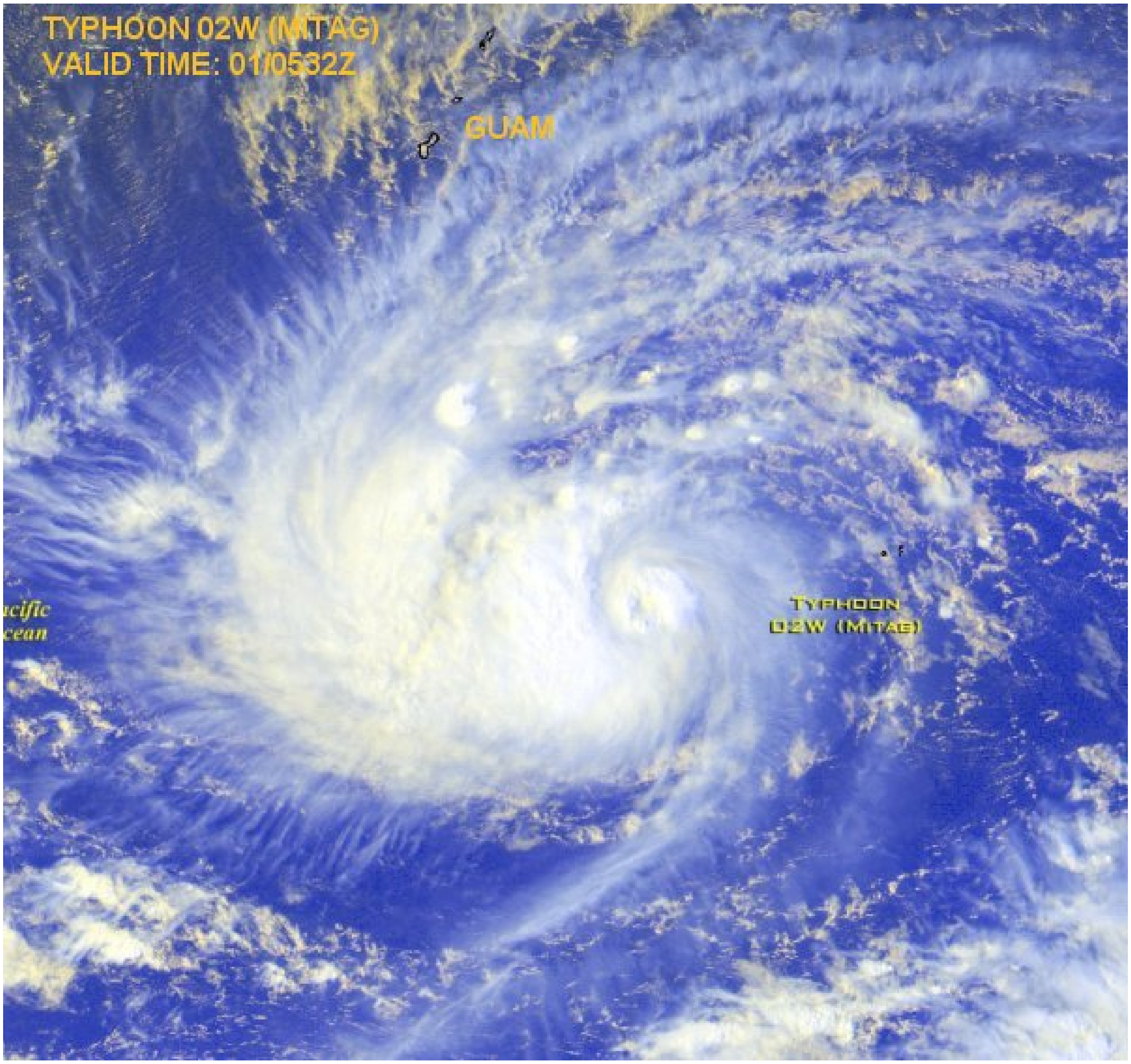



Figure 1-02W-1. 010532Z March 2002 Multi-Spectral satellite imagery of TY 02W Mitag 531nm SSE of Guam with an estimated intensity of 70 knots.

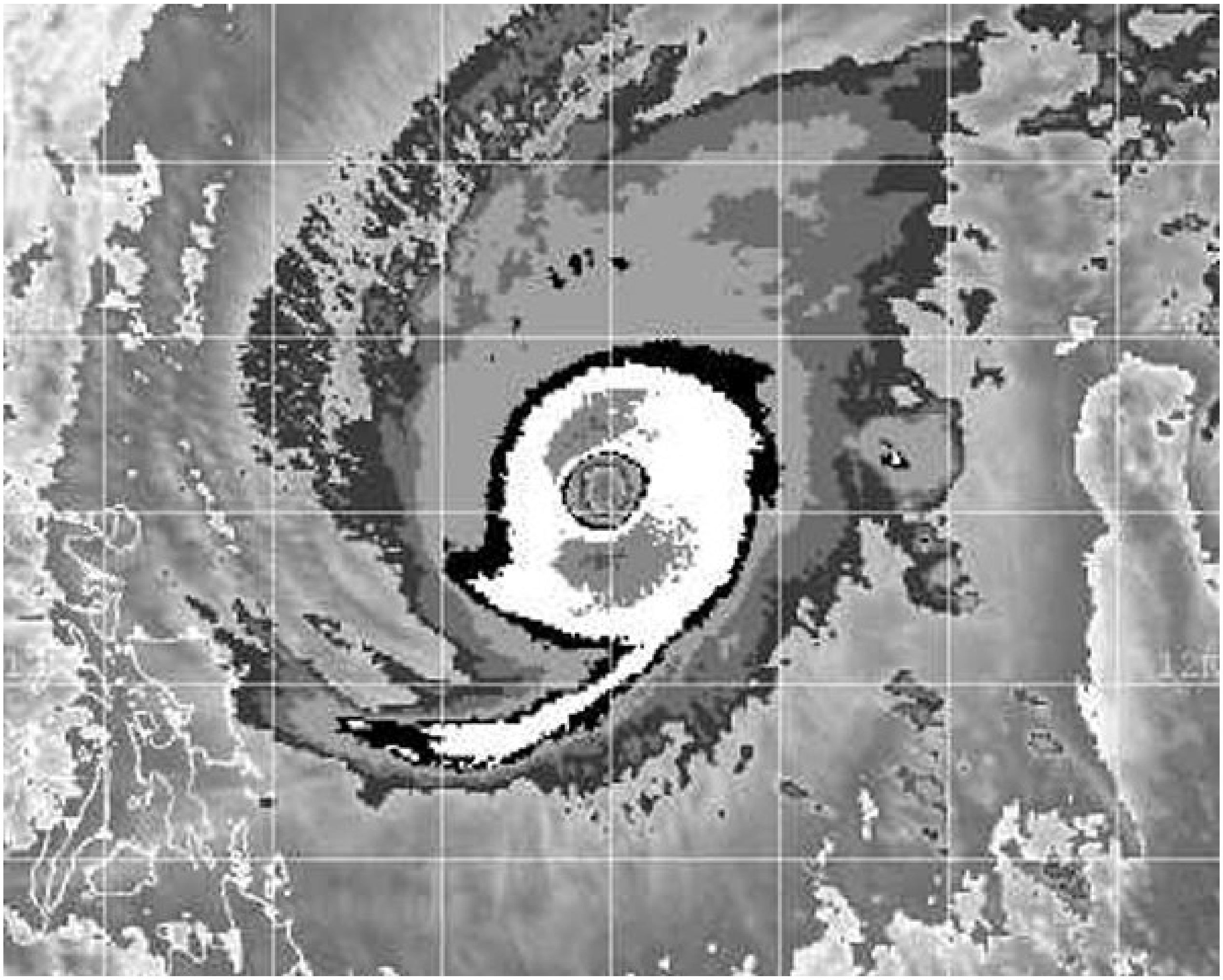


Figure 1-02W-2. 051214Z March 2002 BD Enhanced IR satellite imagery of STY 02W Mitag 874nm W of Guam with an estimated maximum intensity of 140 knots.

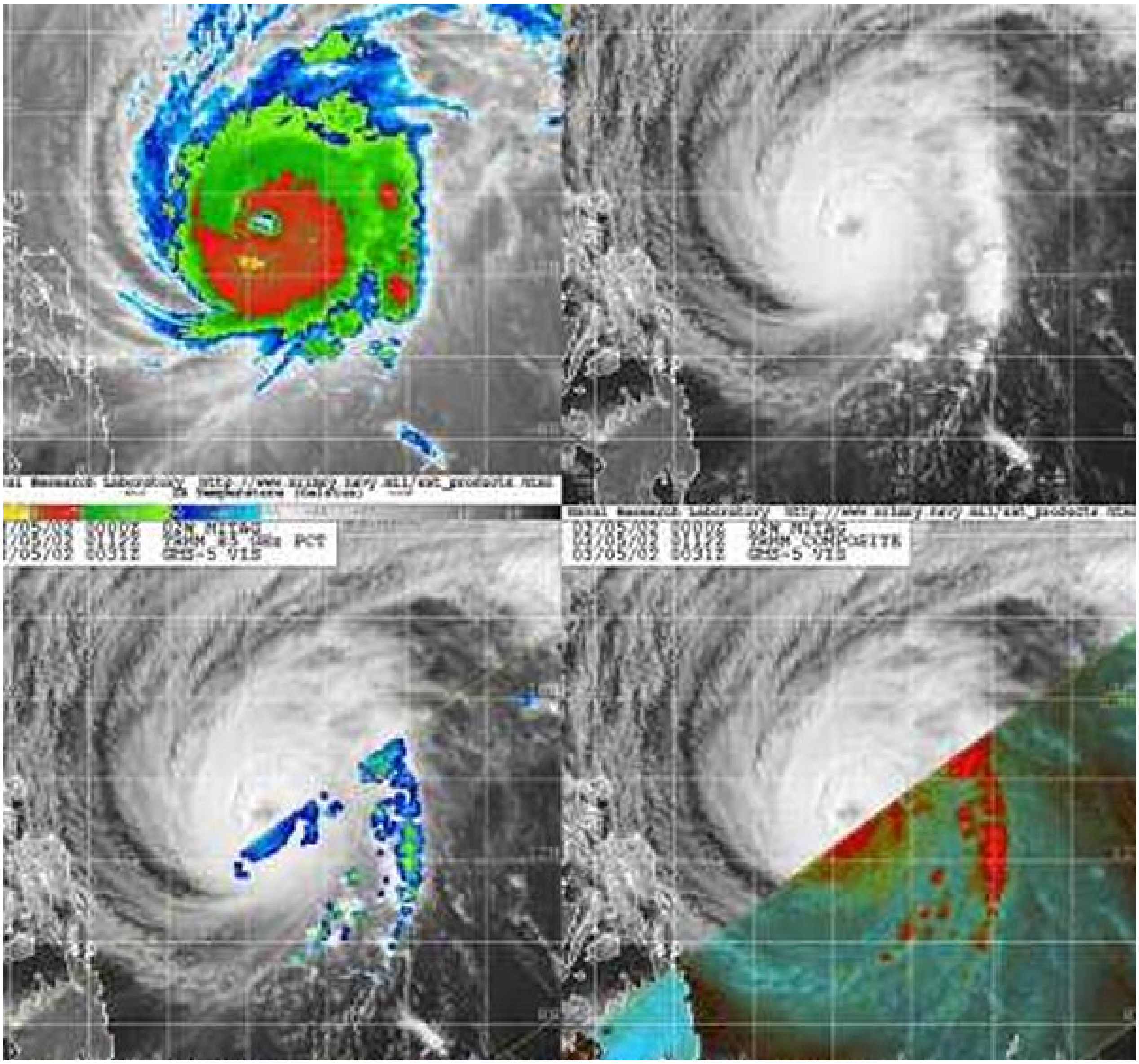


Figure 1-02W-3. 050112Z March 2002 multi-sensor satellite imagery of STY 02W Mitag 852nm W of Guam with an estimated maximum intensity of 140 knots.

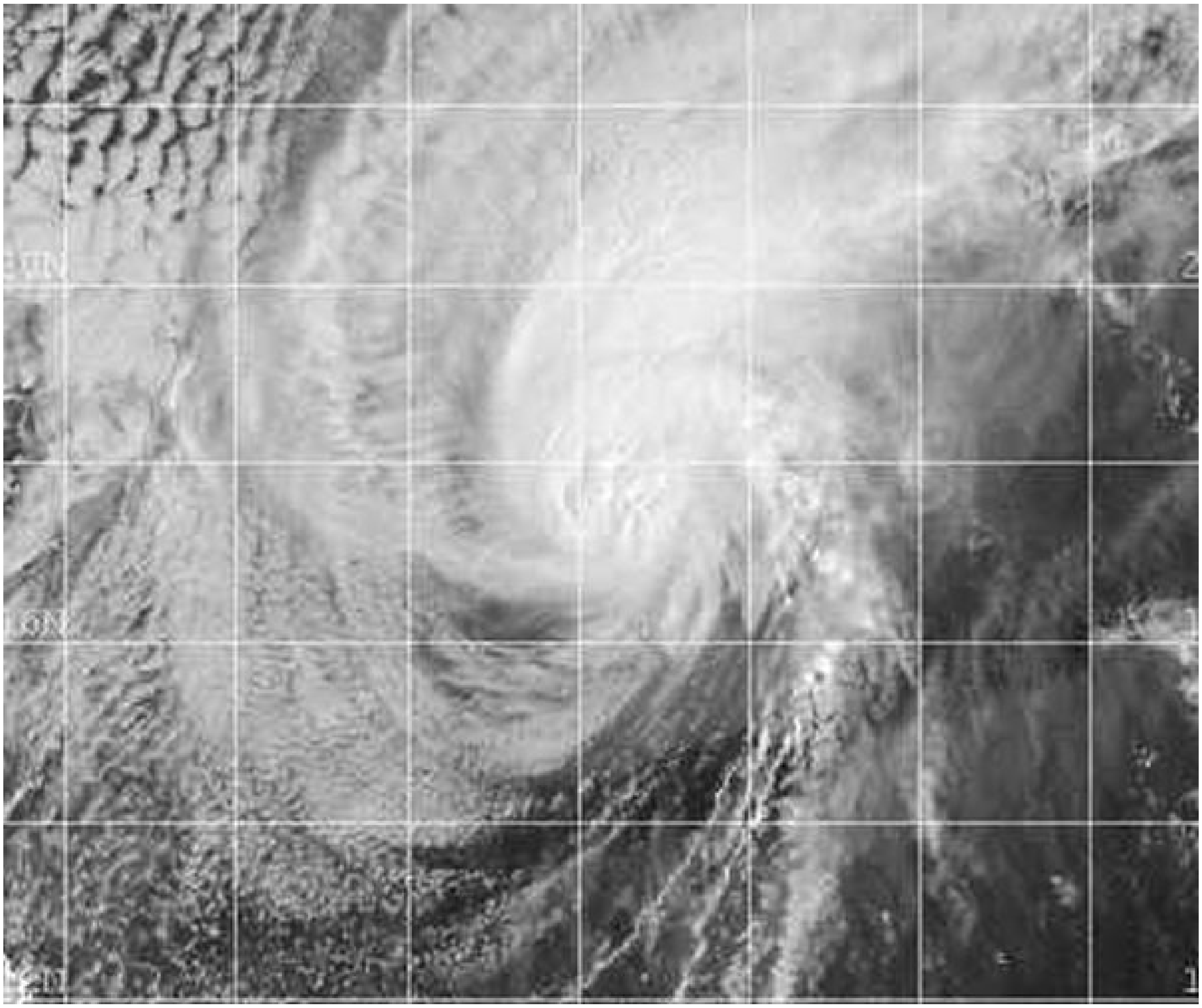
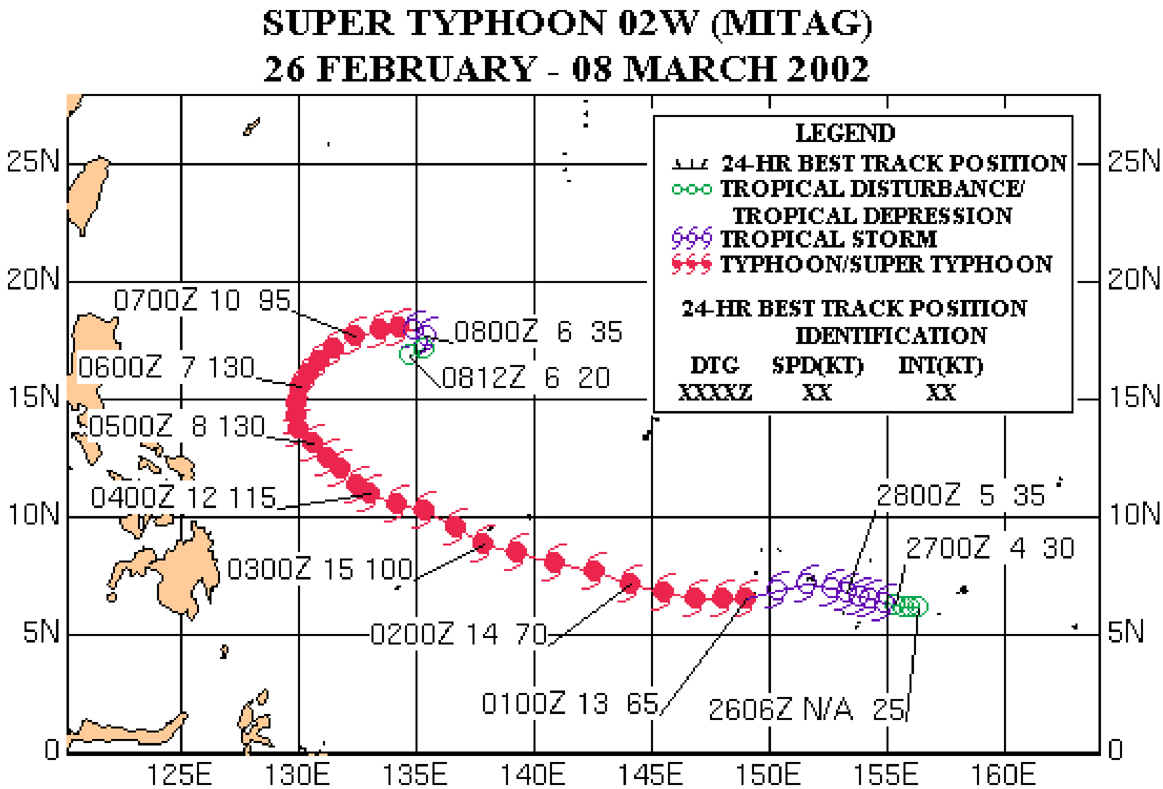


Figure 1-02W-4. 070034Z March 2002 Visible satellite imagery of TY 02W Mitag 684nm NW of Guam with an estimated maximum intensity of 95 knots.


SUPER TYPHOON 02W (MITAG)
26 FEBRUARY - 08 MARCH 2002
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
XX
0700Z 10 95
0800Z 6 35
0600Z 7 130
0812Z 6 20
0500Z 8 130
0400Z 12 115
2800Z 5 35
2700Z 4 30
0300Z 15 100
0200Z 14 70
0100Z 13 65
2606Z N/A 25
25N
20N
15N
10N
5N
0
125E
130E
135E
140E
145E
150E
155E
160E

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# Tropical Depression (TD) 03W

Verification Statistics

First Poor : 0600Z 15 Mar 02
First Fair : 1330Z 18 Mar 02
First TCFA : 0530Z 19 Mar 02
First Warning : 1200Z 19 Mar 02
Last Warning : 1200Z 25 Mar 02
Max Intensity : 30 kts, gusts to 40 kts
Landfall : 0800Z 21 Mar 02
Total Warnings : 25
Remarks:
(1) The first warning issued on 1200Z 19 March had an intensity of 25 knots gusting to 35 knots in the Philippine Sea. TD 03W attained maximum intensity of 30 knots at 0600Z 20 March and held this intensity for 4 days before dissipating in the South China Sea.
(2) TD 03W moved west-northwestward from the Philippine Sea, across the Philippine Islands and into the South China Sea under the steering influence of the subtropical ridge. After moving into the South China Sea an approaching mid-latitude trough weakened this ridge causing the system to turn north-northwestward.
(3) TD 03W dissipated under strong vertical wind shear and was absorbed by the mid-latitude trough.
(4) TD 03W caused 1.7 million dollars of damage. 1,000 homes were destroyed and 35 fatalities were reported. Press reports further indicated that many casualties occurred at sea due to rough weather.

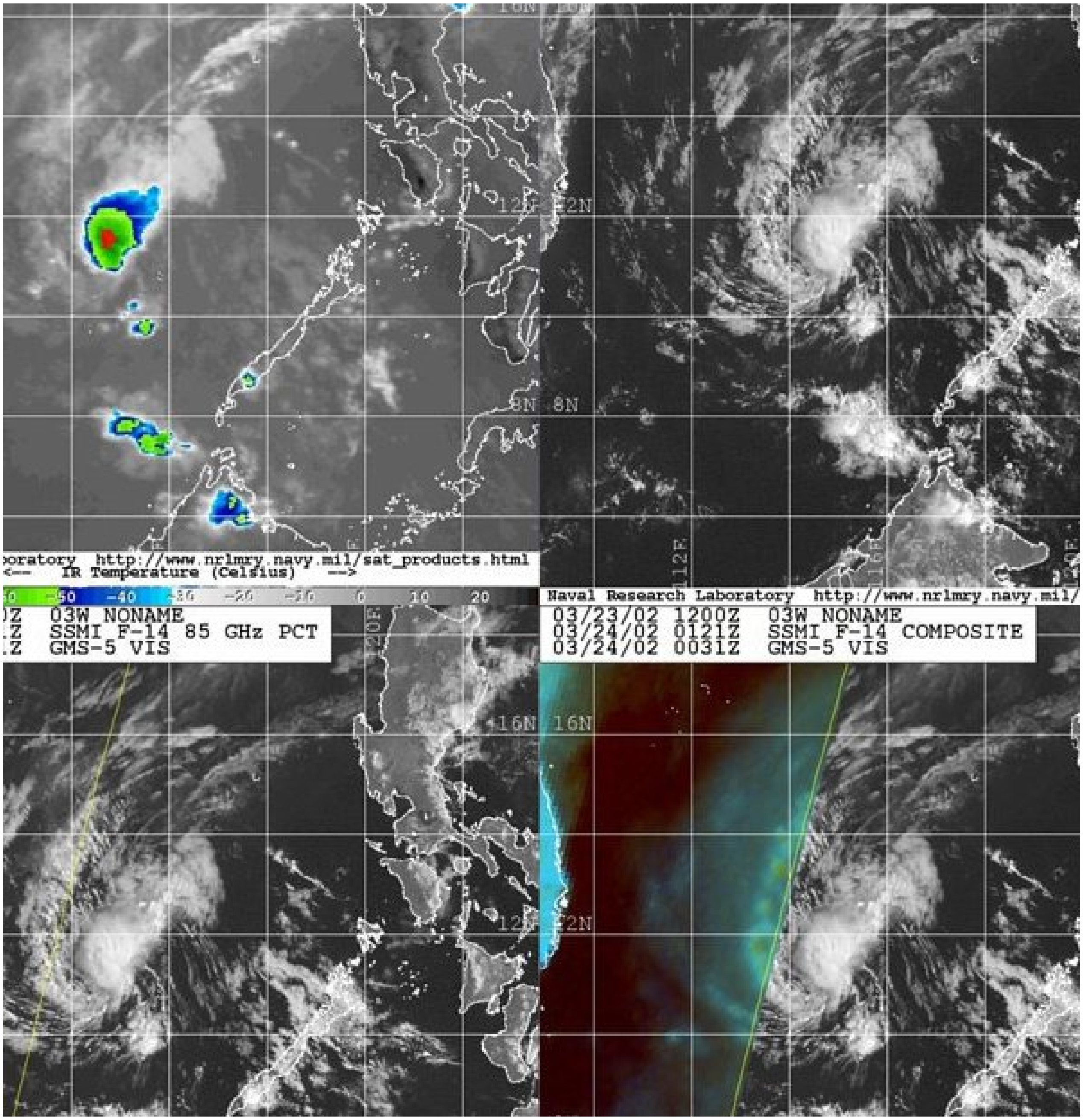



Figure 1-03W-1. 240121Z March 2002 multi-sensor satellite imagery of TD 03W (No Name), located 323nm WSW of Luzon. At this time, the system has a maximum intensity of 30 knots.

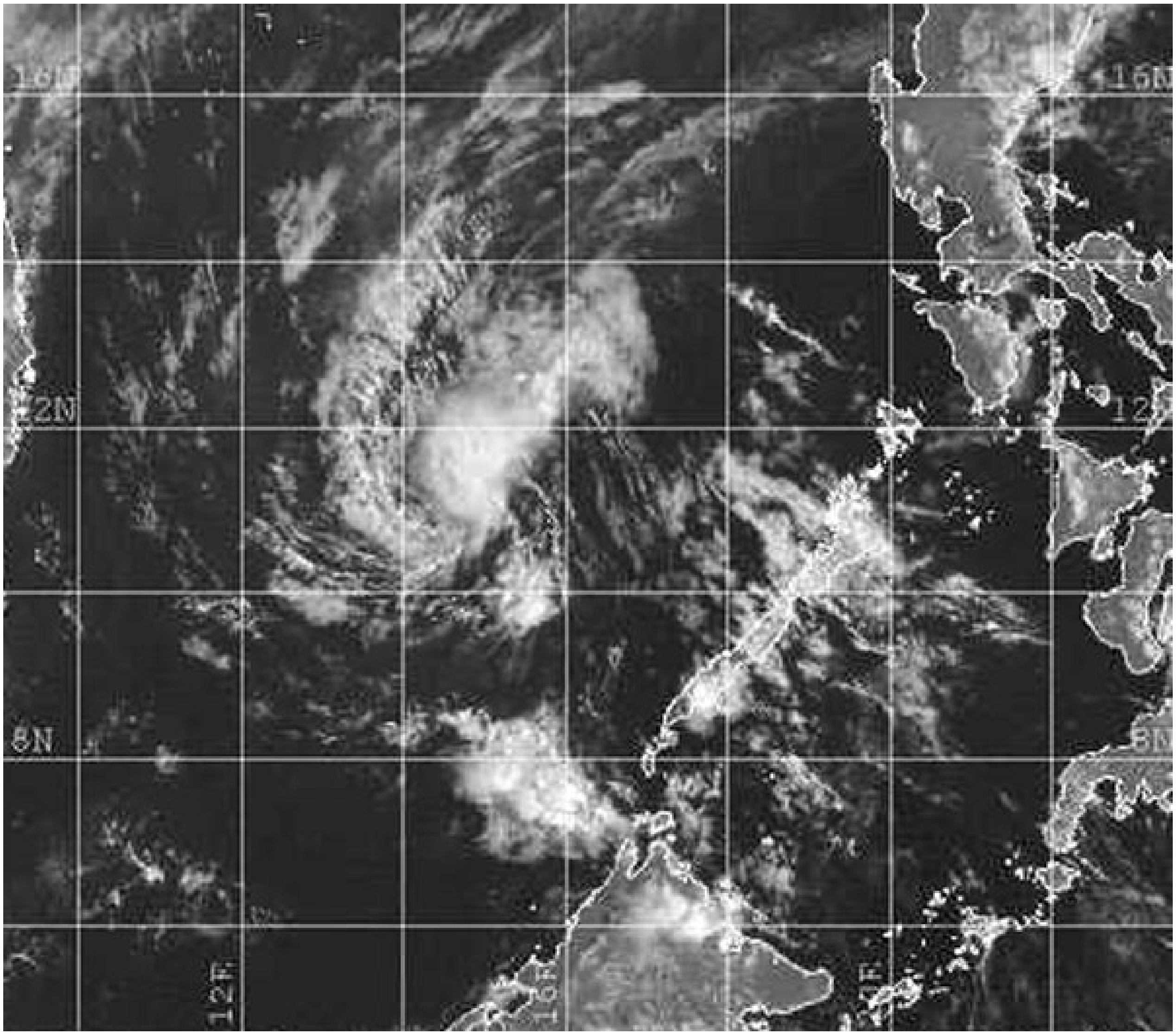
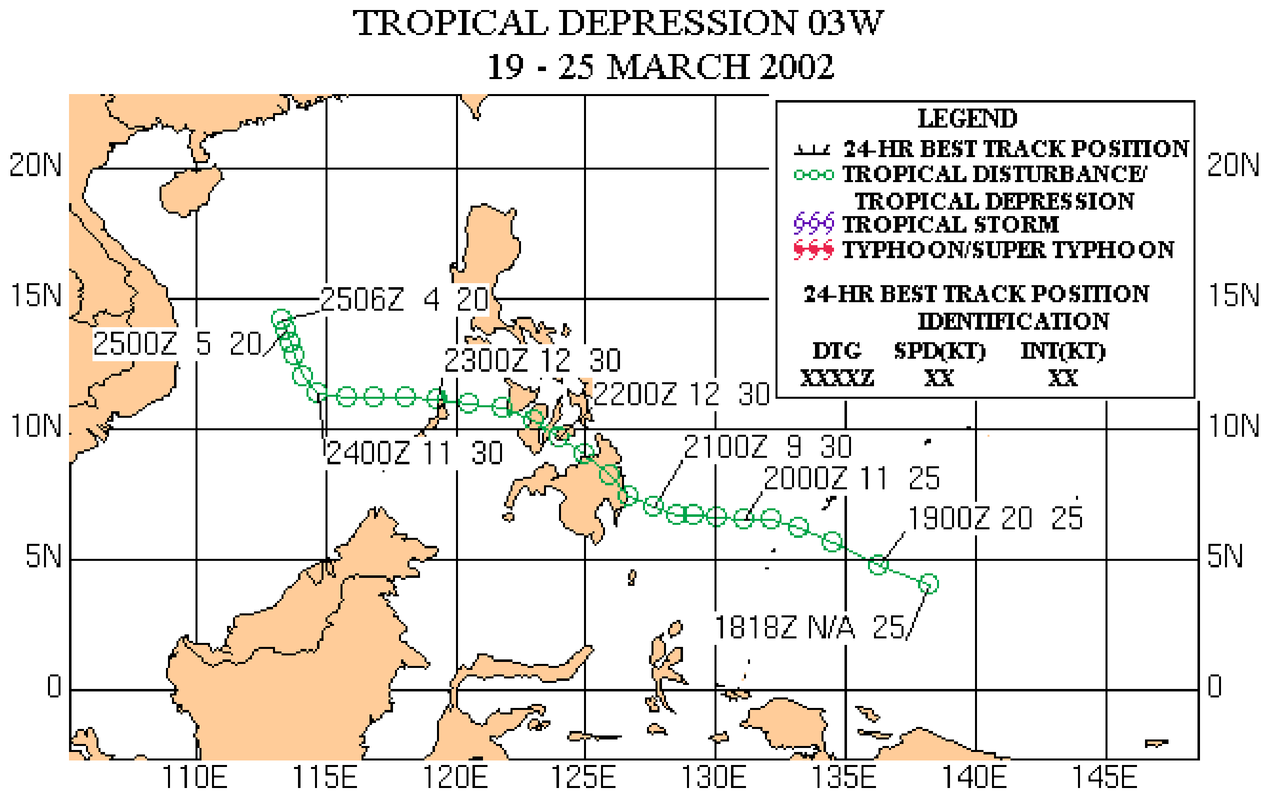



Figure 1-03W-2. 2400031Z March 2002 visible satellite imagery of TD 03W (No Name), located 313nm west-southwest of Luzon. At this time, the system is at its peak intensity of 30 knots.


TROPICAL DEPRESSION 03W
19 - 25 MARCH 2002
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 XX
2506Z 4 20
2500Z 5 20
2300Z 12 30
2200Z 12 30
2400Z 11 30
2100Z 9 30
2000Z 11 25
1900Z 20 25
1818Z N/A 25
20N
15N
10N
5N
0
110E
115E
120E
125E
130E
135E
140E
145E

# Tropical Depression (TD) 04W

Verification Statistics

First Poor : 0600Z 01 Apr 02
First Fair : 0600Z 05 Apr 02
First TCFA : 1730Z 05 Apr 02
First Warning : 1800Z 05 Apr 02
Last Warning : 0000Z 07 Apr 02
Max Intensity : 30 kts, gusts to 40 kts
Landfall : None
Total Warnings : 6
Remarks:
(1) TD 04W was a weak and short lived cyclone which developed at the southern end of a shearline west of Eniwetok.
(2) The first warning for this cyclone was issued at 1800Z on 5 April with and intensity of 30 knots. TD 04W maintained this 30 knot intensity for 30 hours before becoming an extratropical cyclone approximately 350 nm west-southwest of Wake Island.
(3) TD 04W's northwest movement was due to interaction with a baroclinic cyclone to the north-northeast. This same baroclinic cyclone and associated trough was the main cause of TD 04W becoming extratropical.
(4) There were no reported casualties.

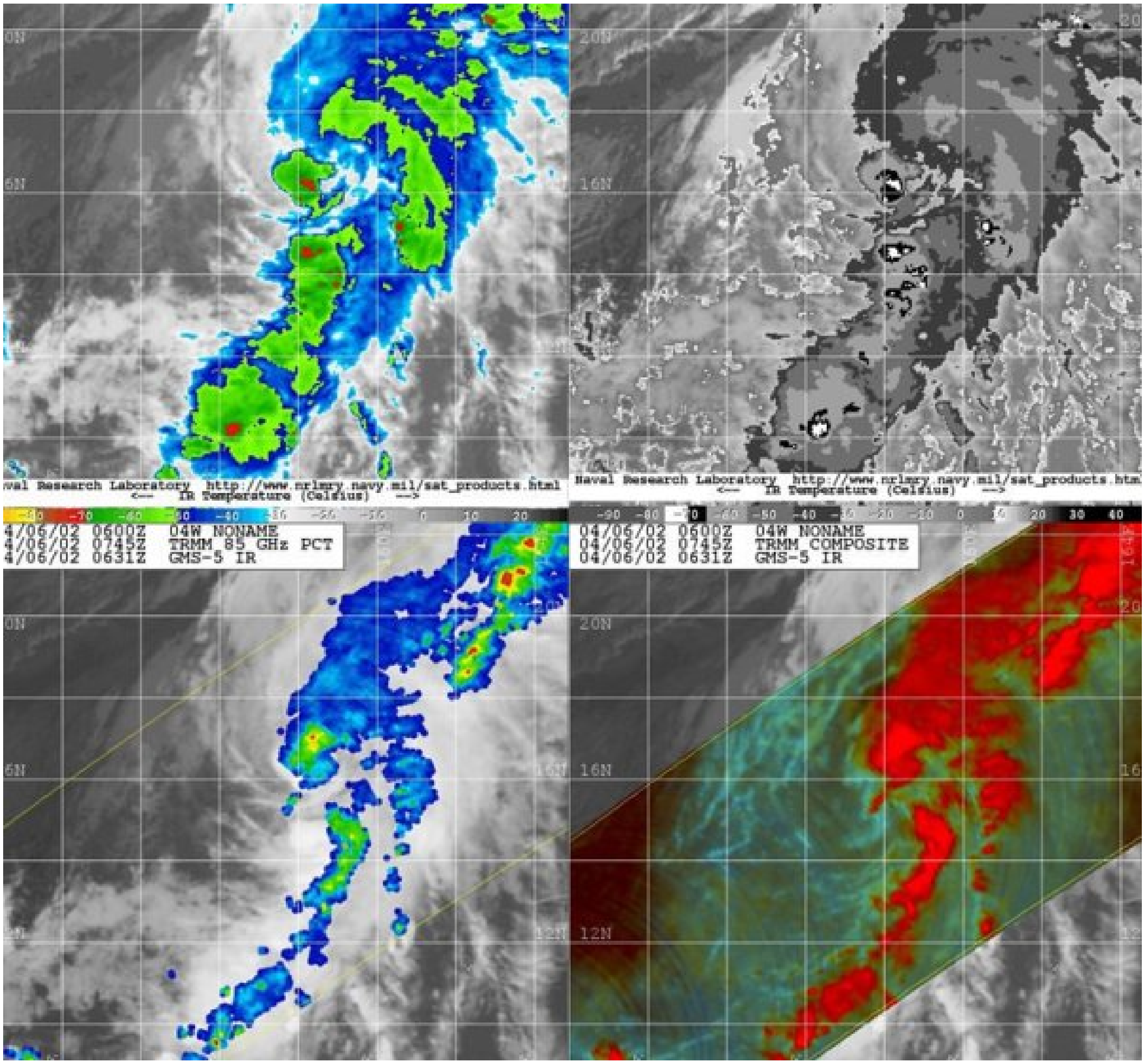
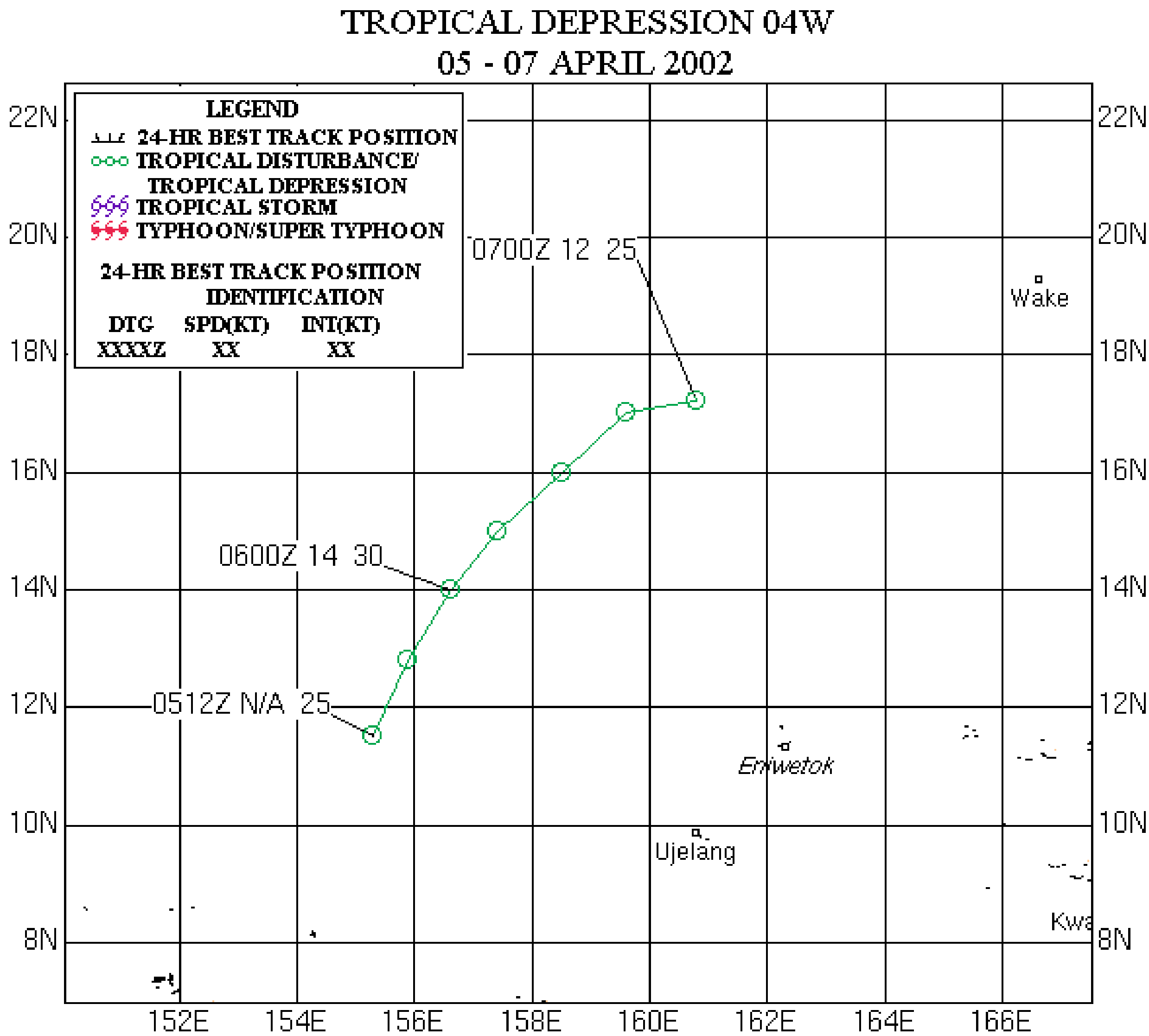



Figure 1-04W-1. 060745Z April 2002 multi-sensor image of TD 04W approximately 510nm southwest of Wake island at its peak intensity of 30 kts.


TROPICAL DEPRESSION 04W
05 - 07 APRIL 2002
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 XX
0700Z 12 25
0600Z 14 30
0512Z N/A 25
Wake
Eniwetok
Ujelang
22N
20N
18N
16N
14N
12N
10N
8N
152E
154E
156E
158E
160E
162E
164E
166E

# Super Typhoon (STY) 05W (Hagibis)

Verification Statistics

First Poor : 0100Z 13 May 02
First Fair : 0600Z 13 May 02
First TCFA : 1600Z 13 May 02
First Warning : 0000Z 15 May 02
Last Warning : 0600Z 21 May 02
Max Intensity : 140 kts, gusts to 170 kts
Landfall : None
Total Warnings : 26
Remarks:
(1) STY 05W formed near the Caroline Islands within a broad monsoon trough. On 0000Z 15 May the first warning was issued with an intensity of 25 knots near 6 N 149 E. STY 05W attained maximum intensity of 140 knots gusting to 170 knots at 1200Z on 19 May. STY 05W maintained maximum intensity for 06 hours and then weakened rapidly before extratropical transition.
(2) STY 05W tracked to the northwest under the steering influence of a mid-level ridge. STY 05W then recurved to the northeast under the influence of a mid-level ridge to the east and deep mid-latitude trough near the coast of China.
(3) Extratropical transition and rapid acceleration occurred as a result of the approaching mid-latitude trough.
(4) No casualties or damage were reported.

TD 15W Kalmaegi

TS 16W Kammuri

TD 17W

TS 18W

STY19W Phanfone

TS 20W Vongfong

TY 21W Rusa

TY 22W Sinlaku

TS 23W Hagupit

TS 24W Mekkhala

STY25W Higos

TY 26W Bavi

TD 27W

TD 28W

TS 29W Maysak

TY 30W Haishen

STY31W Pongsona

HUR02C Ele

HUR03C Huko

TC 01A

TC 02B

TC 03B

TC 04B

TC 05B

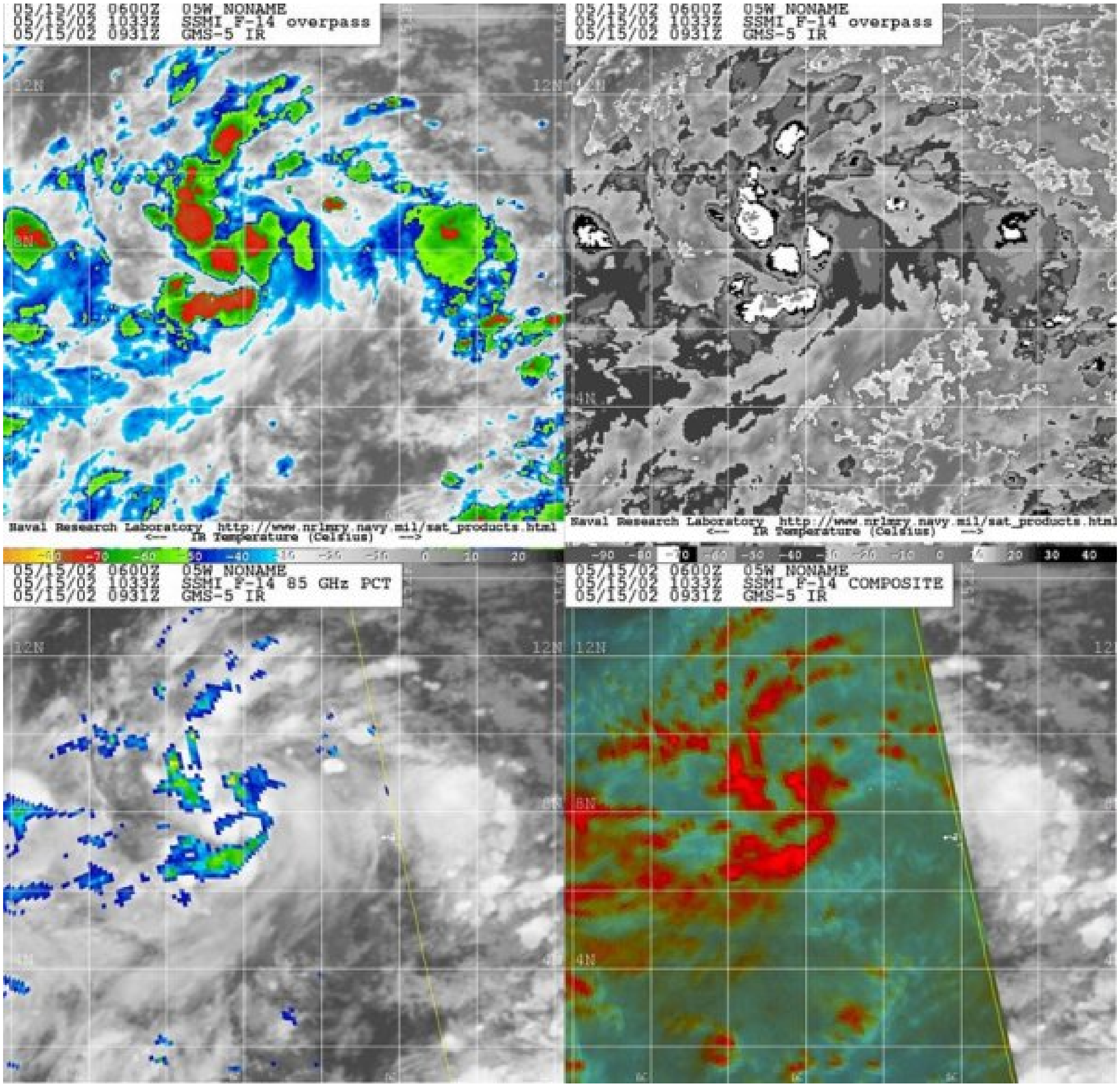



Figure 1-05W-1. 151033Z May 2002 multi-sensor satellite images of TC 05W (Hagibis) approximately 248 nm southeast of Guam, with an estimated intensity of 30 knots. At this time, the convection was increasing and becoming more consolidated over the low-level circulation center.

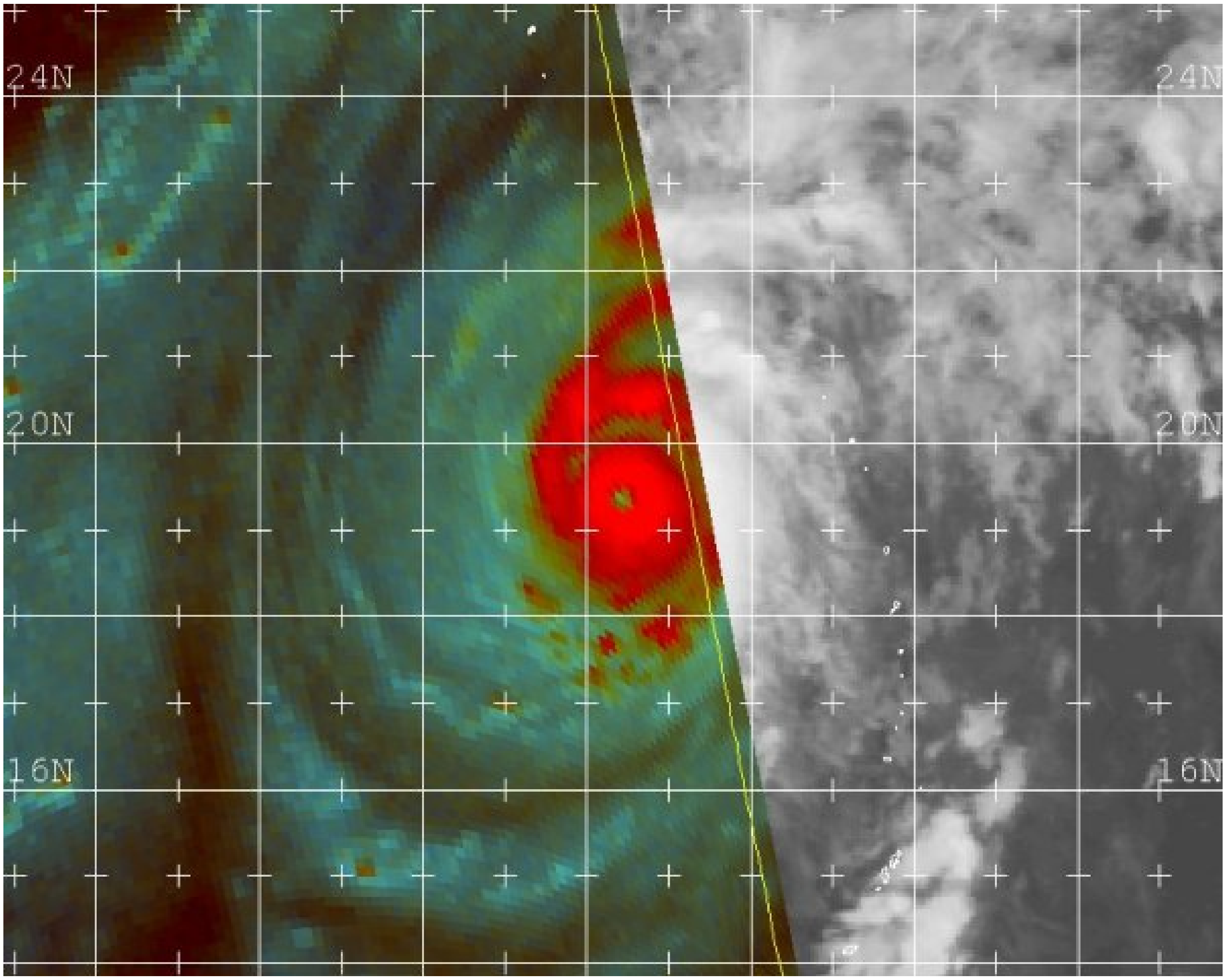
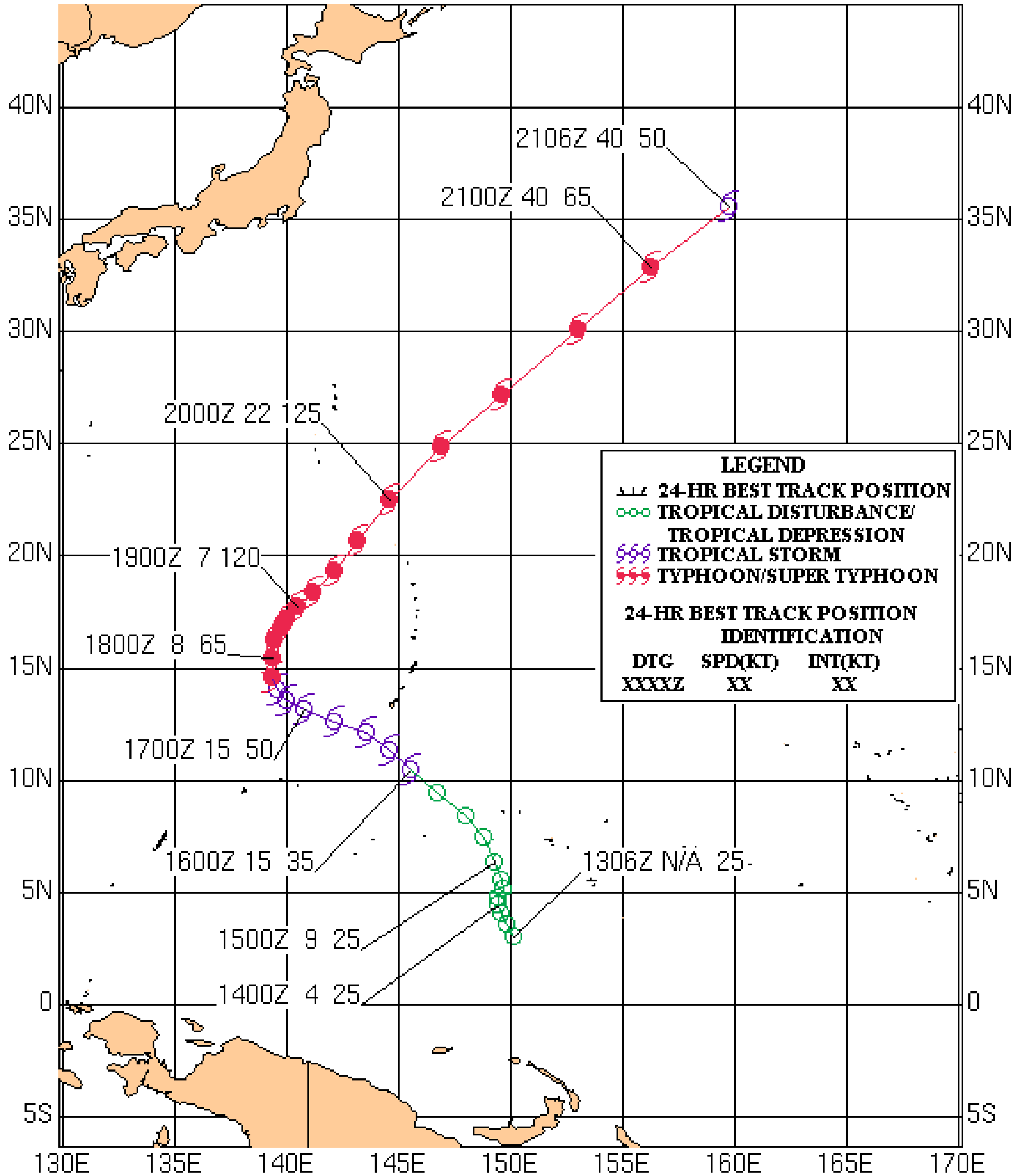



Figure 1-05W-2. 191212Z May 2002 SSM/I imagery of TY 05W (Hagibis), located 327 nm south-east of Iwo Jima, just after it starts its north-easterly track, with a peak intensity of 140 knots.

SUPER TYPHOON 05W (HAGIBIS)
15 - 21 MAY 2002



# Tropical Depression (TD) 06W

Verification Statistics

First Poor : 1430Z 23 May 02
First Fair : 0600Z 27 May 02
First TCFA : 2130Z 27 May 02
First Warning : 0000Z 28 May 02
Last Warning : 1200Z 29 May 02
Max Intensity : 25 kts, gusts to 35 kts
Landfall : 0000Z 30 May 02
Total Warnings : 7
Remarks:
(1) At 0000Z 28 May the first warning was issued on this cyclone with an intensity of 25 knots near 19 N 116 E. TD 06W did not intensity and the final warning was issued 36 hours later. The system tracked northeast out of the South China Sea and made landfall in southwest Taiwan.
(2) TD 06W tracked to the northeast under the steering influence of a low to mid level ridge located to the southeast of the system.
(3) Vertical wind shear and land interaction resulted in dissipation near Kaohsiung, Taiwan.
(4) No casualties or damage were reported.

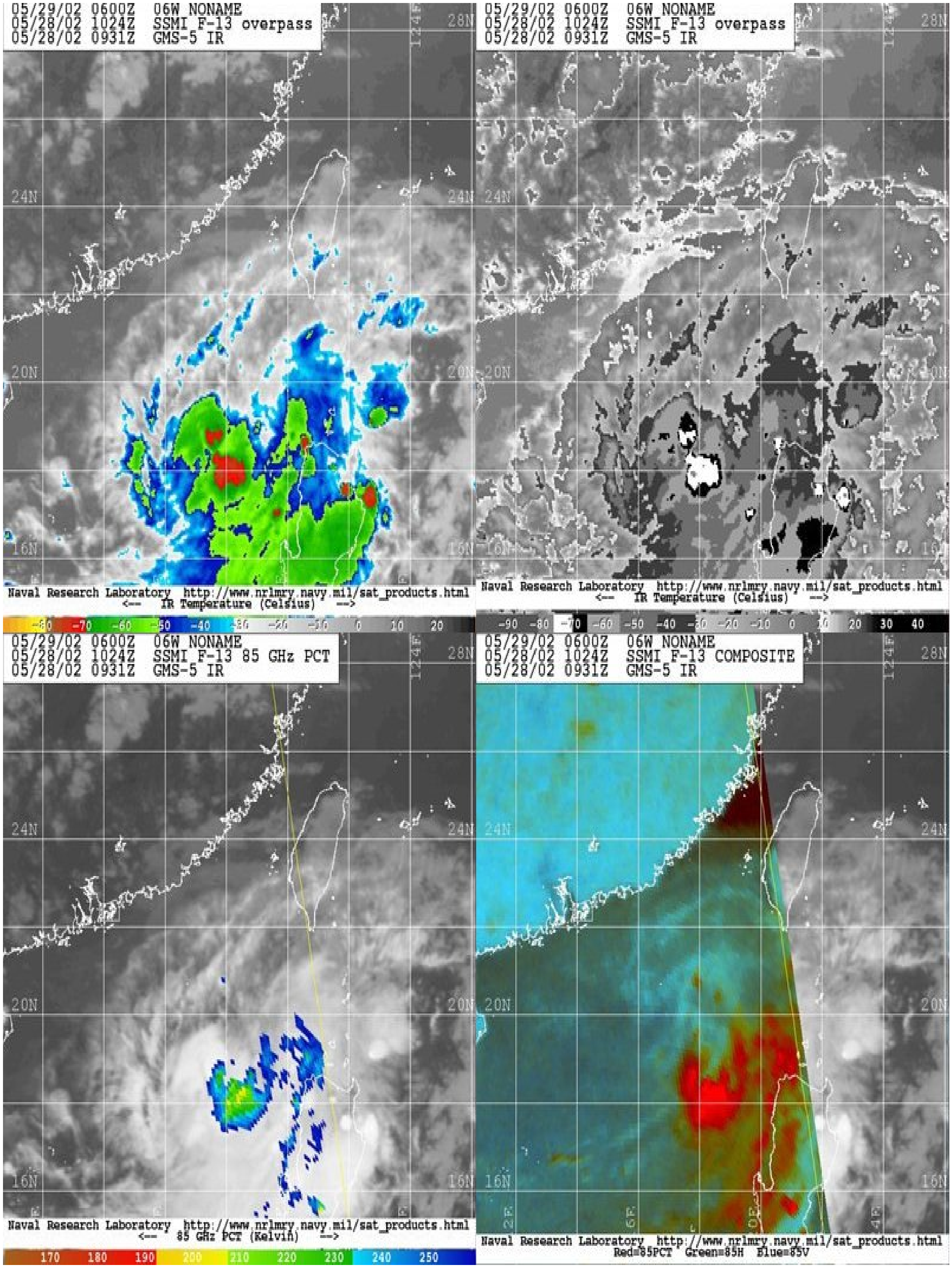
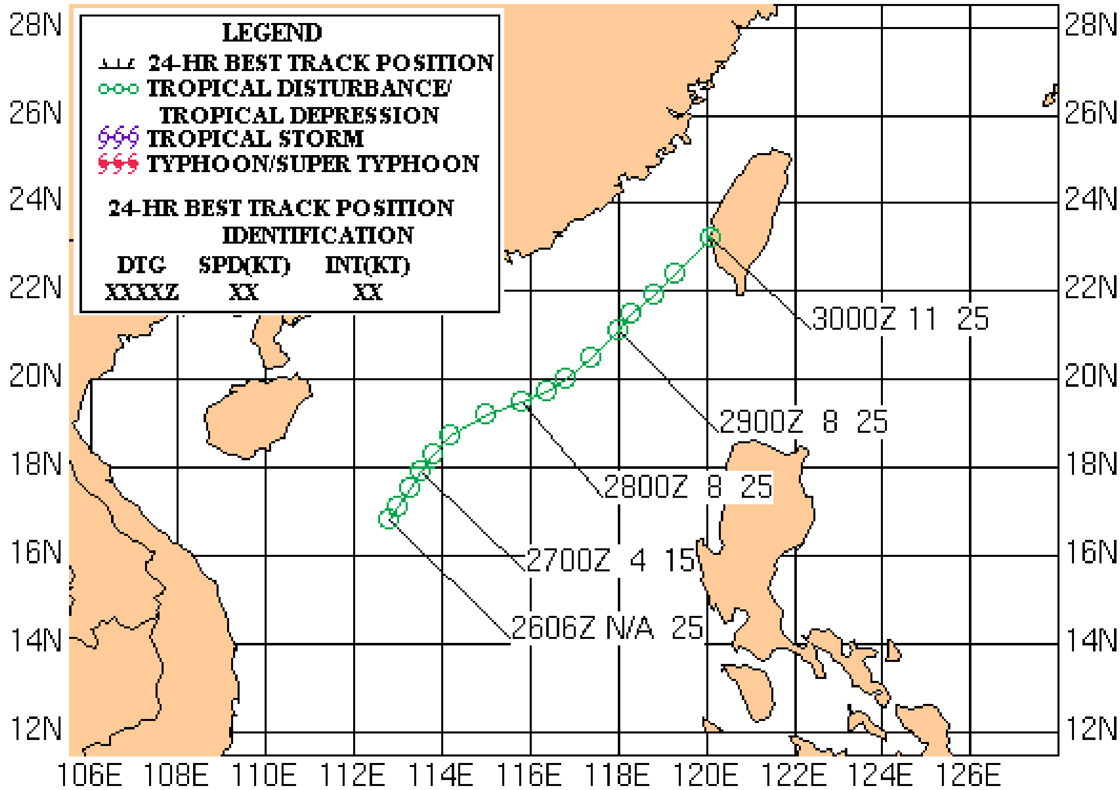



Figure 1-06W-1. 281024Z May 2002 multi-sensor satellite images of TD 06W about 296 nm southwest of Taiwan in the south China sea, with an estimated intensity of 25 knots.

# TROPICAL DEPRESSION 06W
## 28 - 29 MAY 2002



# Typhoon (TY) 07W (Noguri)

Verification Statistics

First Poor : 0000Z 24 May 02
First Fair : 0600Z 27 May 02
First TCFA : 0000Z 05 Jun 02
First Warning : 0000Z 06 Jun 02
Last Warning : 0000Z 11 Jun 02
Max Intensity : 85 kts, gusts to 105 kts
Landfall : None
Total Warnings : 21
Remarks:
(1) TY 07W formed in the South China Sea east of Hainan Island. On 0000Z 06 June the first warning was issued with an intensity of 30 knots near 20 N 114 E. TY 07W tracked east into the Luzon Strait under the influence of a low to mid-level ridge south-southeast of the system. TY 07W's track shifted to the northeast into a weakness in the subtropical ridge.
(2) For the first four days TY 07W intensified slowly. TY 07W then intensified from 45 knots to 85 knots on 09 June, as an upper tropospheric poleward outflow channel enhanced ventilation. After this short period of rapid intensification, the system weakened rapidly as it merged with a mid-latitude trough.
(3) TY 07W weakened rapidly as it moved over cooler sea surface temperatures and into increasing vertical wind shear. Extratropical transition occurred as it merged with the mid-lat trough.
(4) No casualties or damage were reported.

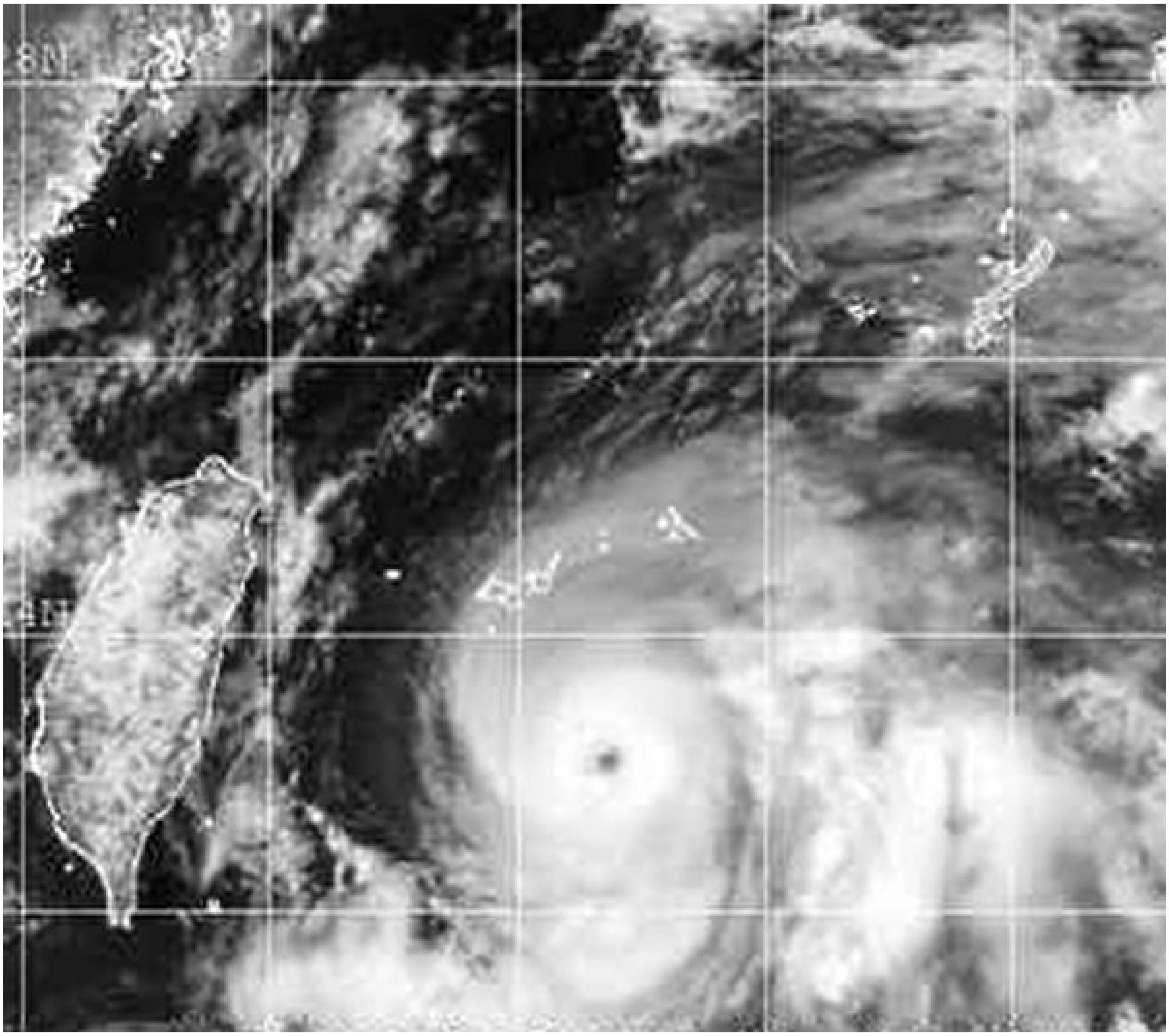
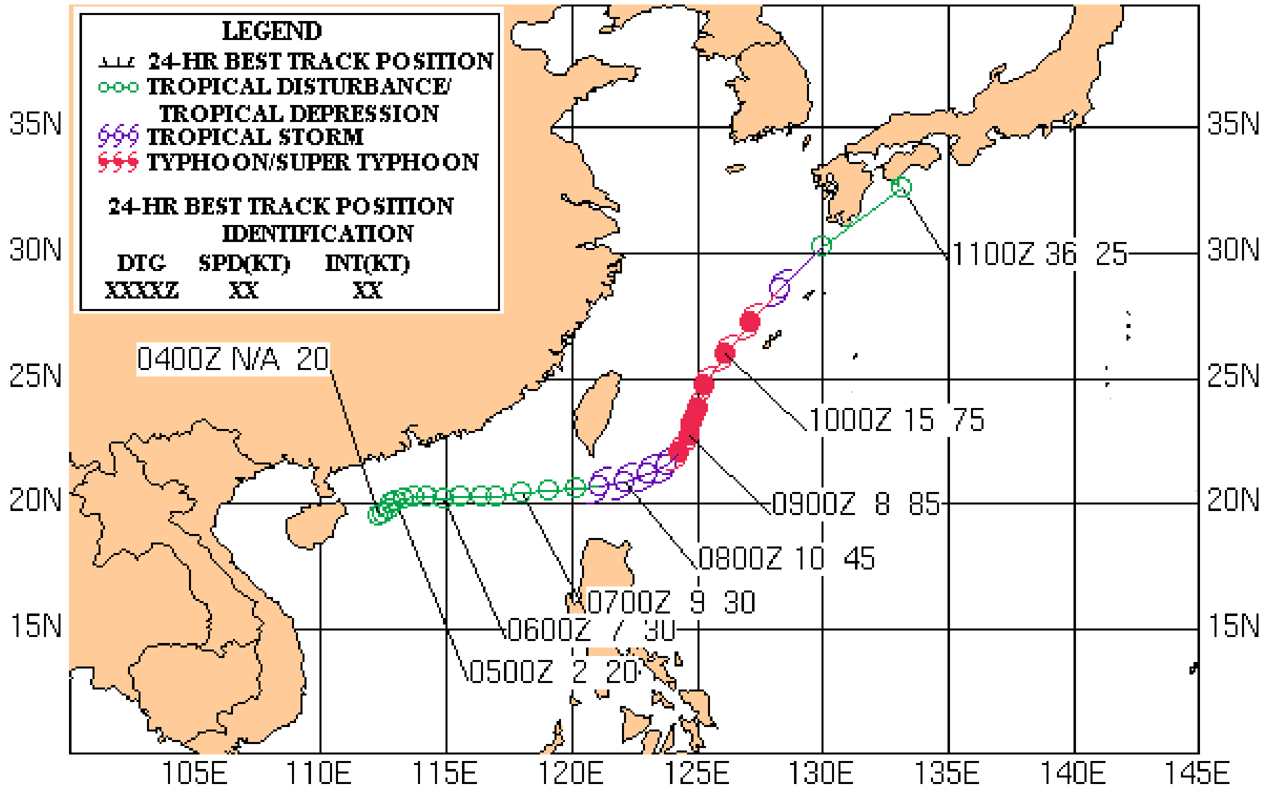


Figure 1-07W-1. 090346Z June 2002 GMS-5 visible satellite imagery of TY 07W (Noguri) about 260 nm southwest of Okinawa, Japan at its peak intensity of an estimated 70 knots.

TYPHOON 07W (NOGURI)
06 - 11 JUNE 2002



# Super Typhoon (STY) 08W (Chataan)

Verification Statistics

First Poor : 0100Z 27 Jun 02
First Fair : 0930Z 27 Jun 02
First TCFA : 2000Z 27 Jun 02
First Warning : 0000Z 28 Jun 02
Last Warning : 0000Z 11 Jul 02
Max Intensity : 130 kts, gusts to 160 kts
Landfall : 1500Z 10 July 02
Total Warnings : 53
Remarks:

(1) STY 08W developed in the monsoon trough situated along 4 N on 0000Z 27 June. The system drifted, first westward, and then eastward within the trough over the next three days. The system then further consolidated over a 24-hour period (291200Z-301200Z) and intensified to tropical storm strength approximately 140 nm west-southwest of Pohnpei. Thereafter, the system moved out of the monsoon trough and tracked westward. STY 08W reached a max intensity of 130 knots on 1800Z 07 July.

(2) STY 08W, while only at tropical storm strength, passed to the north of the Chuuk islands causing heavy rains. After tracking by the Chuuk islands, STY 08W turned to the north-northwest. A dominant subtropical ridge situated over the Mariana Islands turned STY 08W to the northwest. STY 08W passed over the northern end of Guam with an estimated intensity of 90 kts. After passing Guam, further development occurred as it approached the subtropical ridge axis along 25 N. STY 08W recurved south of Japan and underwent extratropical transition as skirted the east coast of Honshu.

(3) STY 08W made landfall at 1500Z 10 July along the coast of the Boso peninsula. Maximum sustained winds were estimated at 35 knots. Toyko reported only light winds and rain as STY 08W passed within 55 nm of Toyko.

(4) The press reported that mudslides on the Chuuk islands killed 37 people and injured more than 100. Reports indicate that Guam received as much as 8 inches of rain, causing significant flooding. The governor of Guam declared a state of emergency to deal with the clean-up effort. In Japan, the press reported heavy rains across the country and 15,000 people evacuated from Ogaki, where heavy rains caused a river to flood.

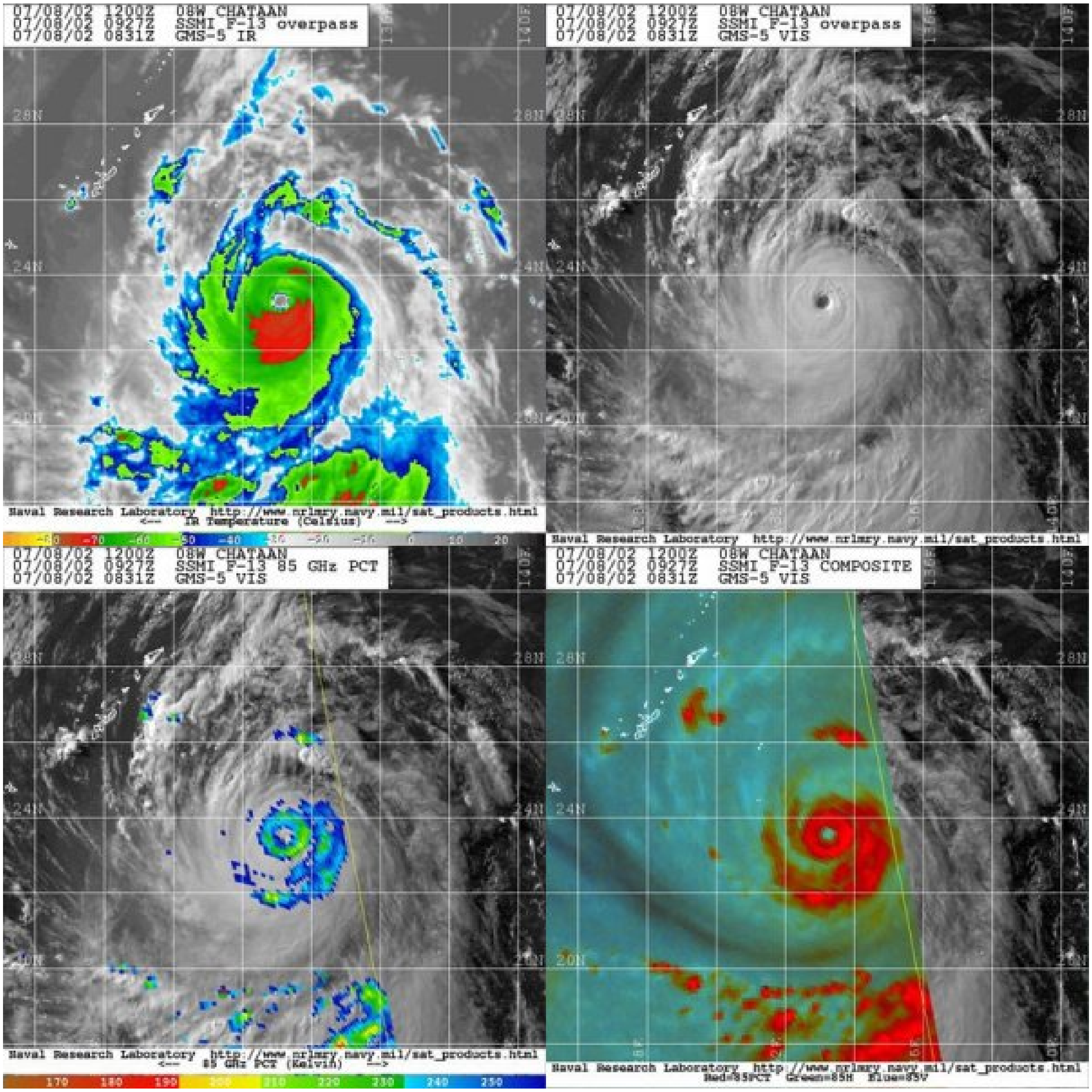
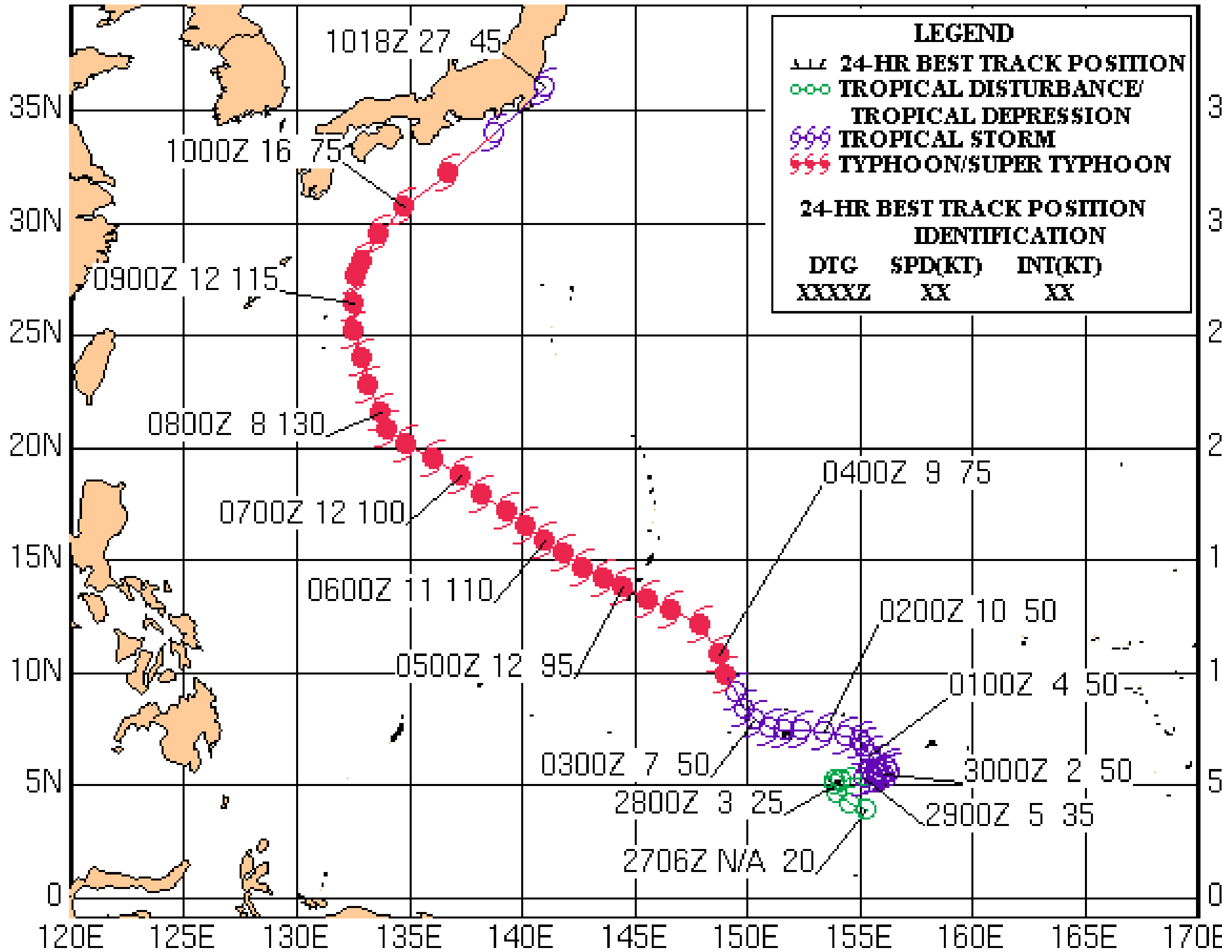



Figure 1-08W-1. 080927Z July 2002 multi-sensor satellite images of TY 08W (Chataan) about 370 nm southeast of Okinawa, Japan at its peak intensity of an estimated 120 knots.

SUPER TYPHOON 08W (CHATAAN)
28 JUNE - 11 JULY 2002



# Typhoon (TY) 09W (Rammasun)

Verification Statistics

First Poor : 0100Z 27 Jun 02
First Fair : 0930Z 27 Jun 02
First TCFA : 2100Z 27 Jun 02
First Warning : 0600Z 28 Jun 02
Last Warning : 0600Z 06 Jul 02
Max Intensity : 110 kts, gusts to 135 kts
Landfall : 2330Z 05 Jul 02
Total Warnings : 33
Remarks:

(1) TY 09W formed in the Caroline Islands. At 0600Z 28 June, the first warning was issued with an intensity of 25 knots near 09 N 135 E. TY 09W attained a maximum intensity of 110 knots on 0000Z 03 July. The system maintained intensity for 24 hours and then weakened rapidly as it tracked over cooler sea surface temperatures and increasing vertical wind shear in the Yellow Sea region.

(2) TY 09W tracked northwestward after forming under the influence of a low to mid-level ridge located north-northeast of the system. A brief shift in track to the northeast occurred in the early stages due to a strong westerly wind burst. The system quickly resumed a northwest course and recurved near Taiwan.

(3) TY 09W made landfall at 2330Z 05 July, just south of the city of Sosan, approximately 45 miles southwest of Seoul. TY 09W struck the coast with tropical storm strength and rapidly dissipated on the peninsula.

(4) As TY 09W passed within 80 miles of the coast of Shanghai, China heavy rains and strong winds were responsible for 5 reported deaths, structural damage and flooding in the Shanghai area. US military reported the deaths of 2 U.S. Navy Sailors on the island of Okinawa, due to drowning in rough seas. In South Korea the National Disaster Prevention and Countermeasures Headquarters (NDPCH) reported 3 deaths in the southwestern corner of the peninsula and another on the island of Cheju-do. NDPCH also reported a total of 11.4 billion won ($9.5 million) in damage nationwide.

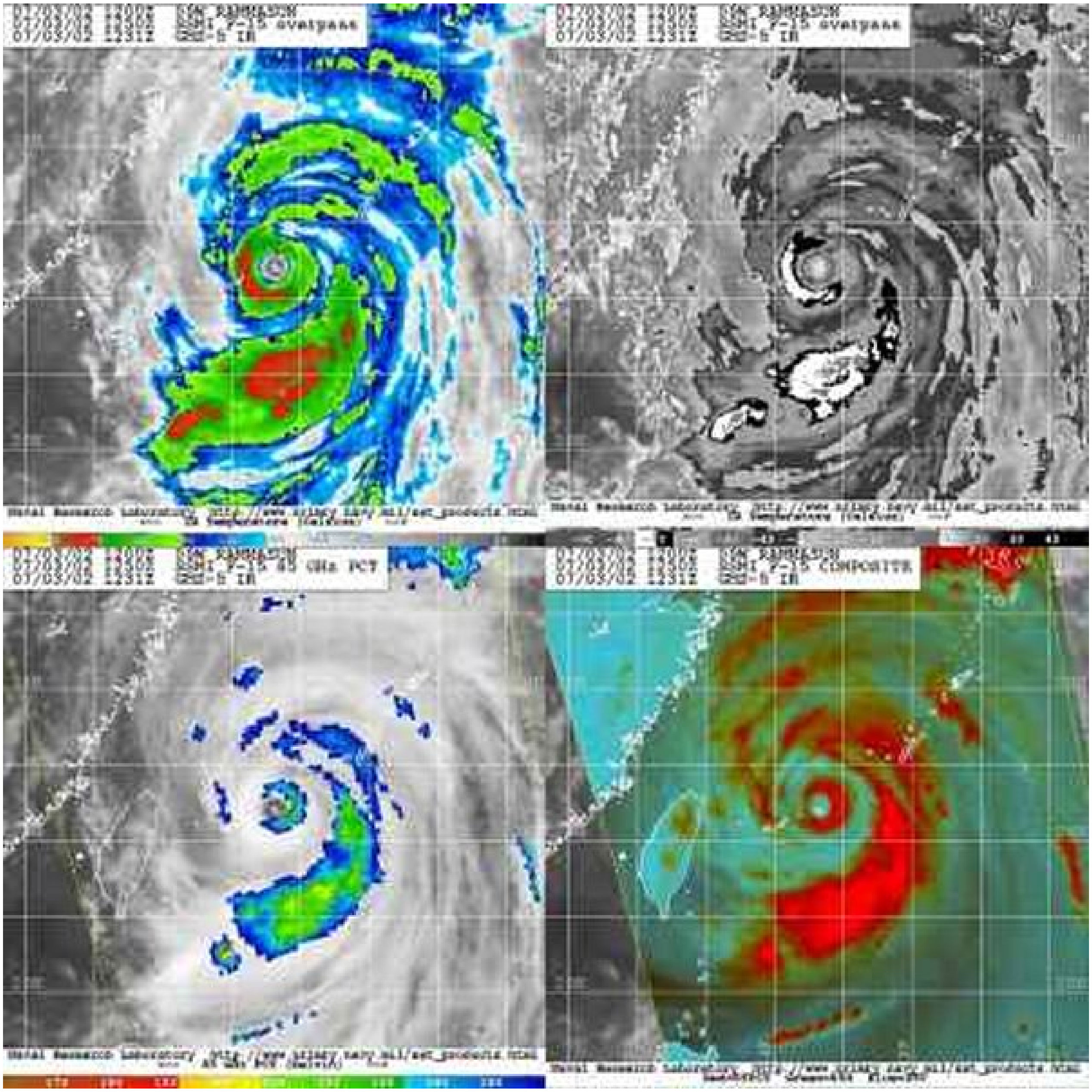


Figure 1-09W-1. 031250Z July 2002 multi-sensor satellite images of TY 09W (Rammasun) about 170 nm southwest of Okinawa, Japan at its peak intensity of an estimated 110 knots.

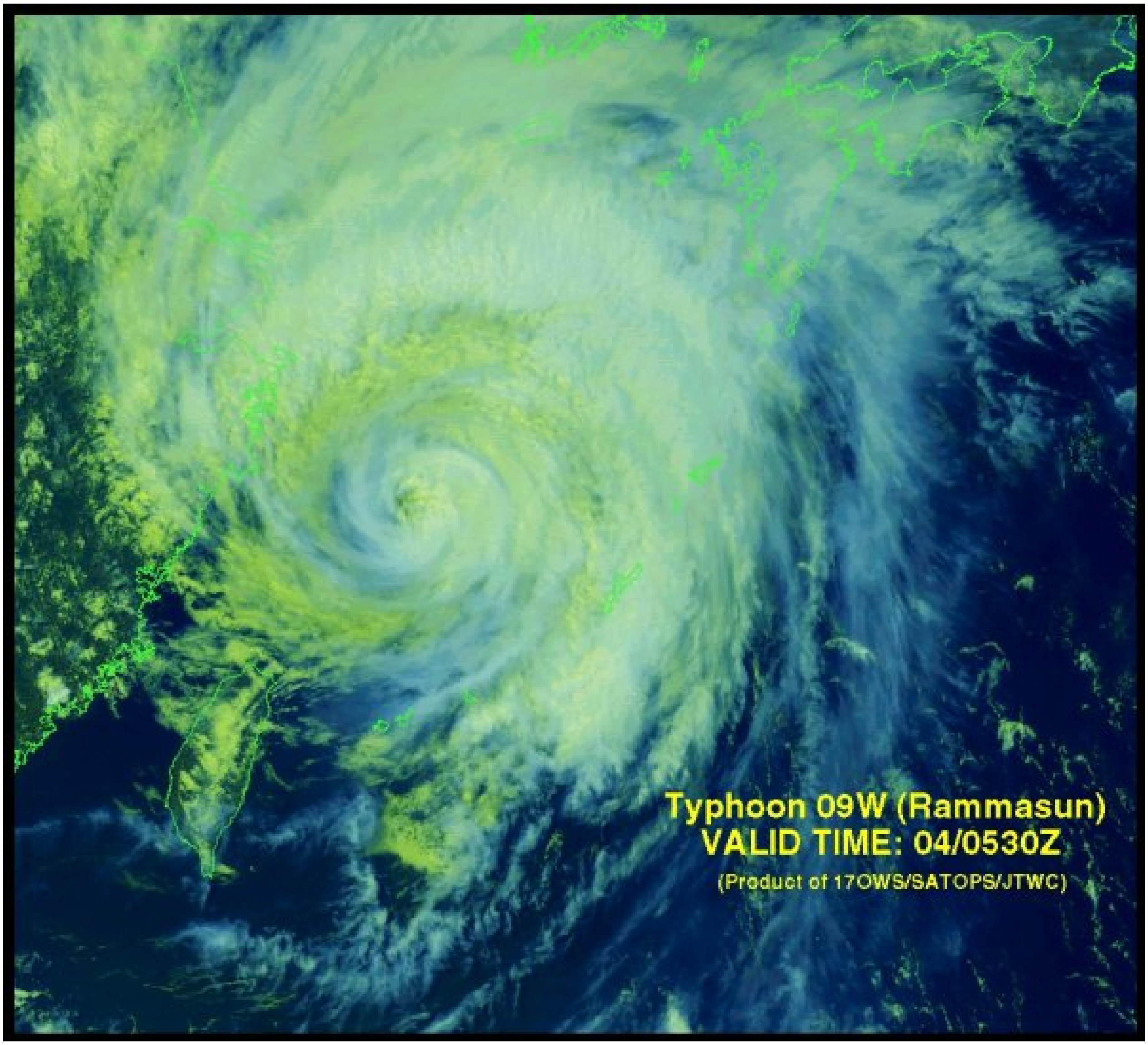
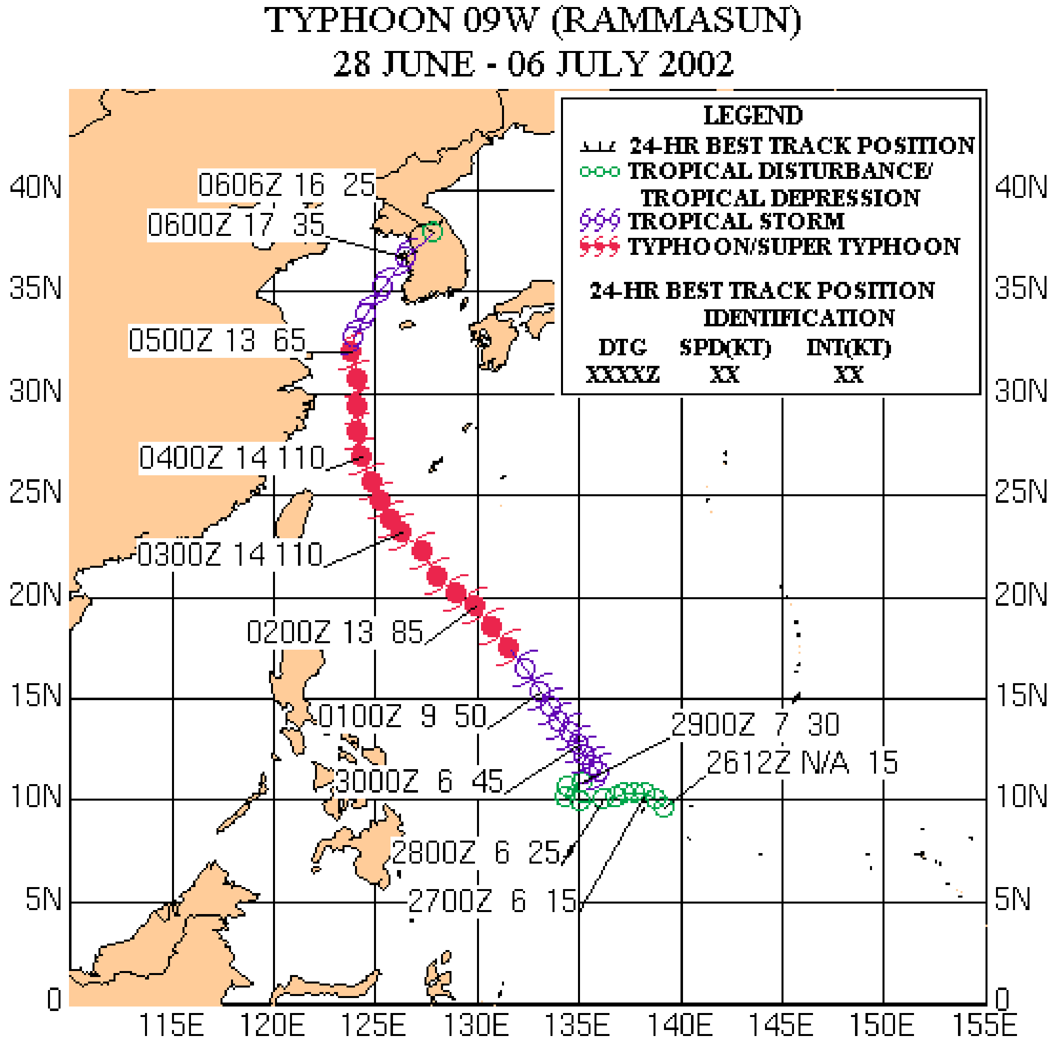



Figure 1-09W-2. 040530Z July 2002 multi-spectral satellite imagery of TY 09W (Rammasun) about 170 nm west-northwest of Okinawa, Japan at an intensity of an estimated 100 knots.


TYPHOON 09W (RAMMASUN)
28 JUNE - 06 JULY 2002
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 XX
0606Z 16 25
0600Z 17 35
0500Z 13 65
0400Z 14 110
0300Z 14 110
0200Z 13 85
0100Z 9 50
3000Z 6 45
2900Z 7 30
2612Z N/A 15
2800Z 6 25
2700Z 6 15
40N
35N
30N
25N
20N
15N
10N
5N
0
115E
120E
125E
130E
135E
140E
145E
150E
155E

# Super Typhoon (TY) 10W (Halong)

Verification Statistics

First Poor : 0600Z 04 Jul 02
First Fair : 0600Z 05 Jul 02
First TCFA : None
First Warning : 0000Z 07 Jul 02
Last Warning : 1800Z 15 Jul 02
Max Intensity : 135 kts, gusts to 155 kts
Landfall : 1200Z 14 Jul 02
Total Warnings : 36
Remarks:
(1) . STY 10W (Halong) formed in the Micronesian Islands. At 0000Z 07 July the first warning was issued with an intensity of 25 knots near 08 N 158 E. STY 10W attained a maximum intensity of 135 knots on 0600Z 13 July and maintained maximum intensity for 6 hours before rapidly weakening.
(2) STY 10W moved equatorward as it developed before turning to the west and further developing to tropical storm strength. As it passed close to Guam radar fixes from Guam verified the system’s location. After passing Guam, STY 10W tracked northwest until recurving near Okinawa. Extratropical transition occurred as it made landfall on the east coast of Japan near the Boso Peninsula.
(3) STY 10W weakened as it approached the Kanto Plain as it moved over cooler waters and entrained cool, dry air.
(4) No casualties were reported.

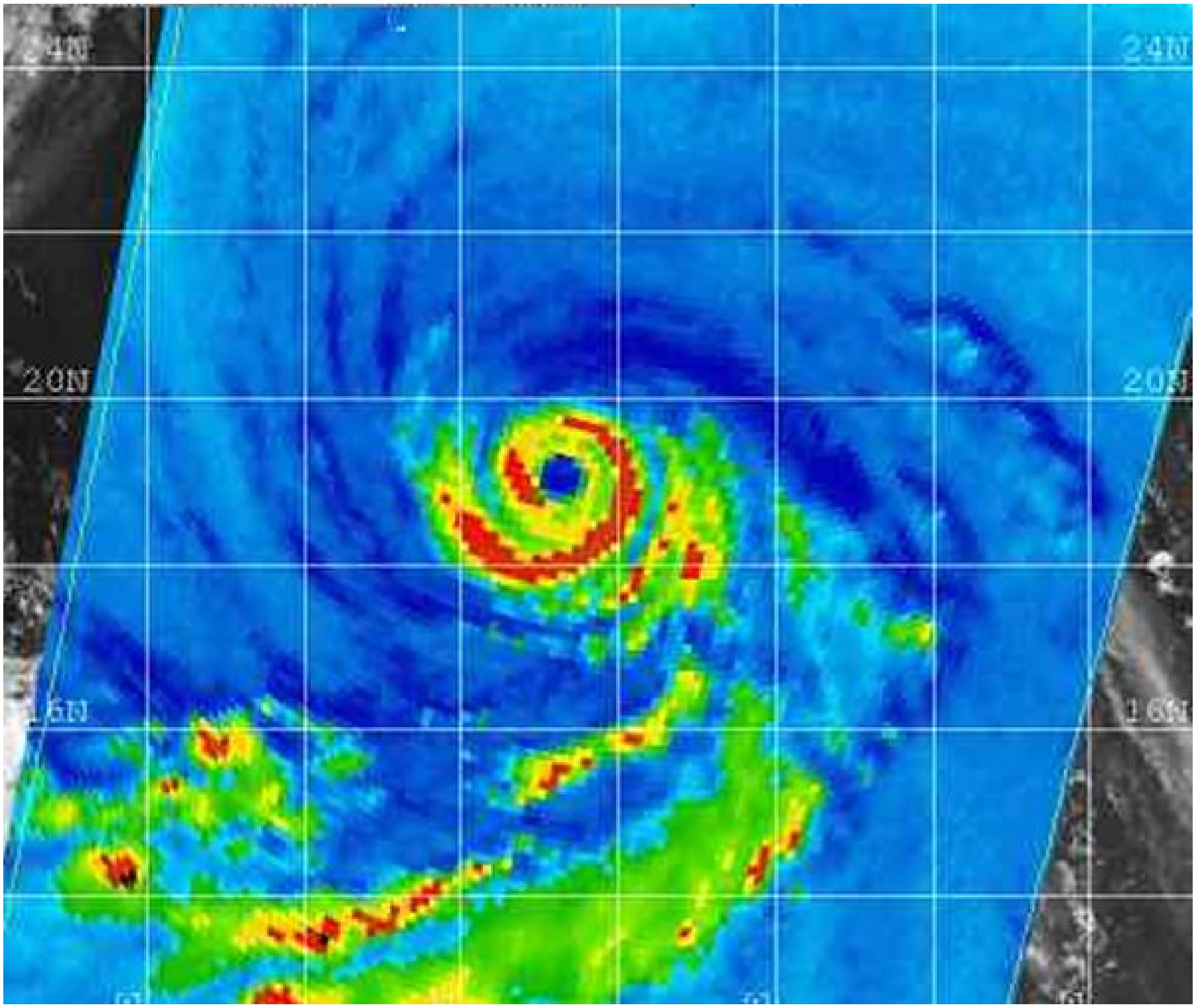



Figure 1-10W-1. 130047Z July 2002 85 GHz SSM/I image of TY 10W (Halong), 570 nm southeast of Okinawa, Japan at peak intensity of 130 knots.

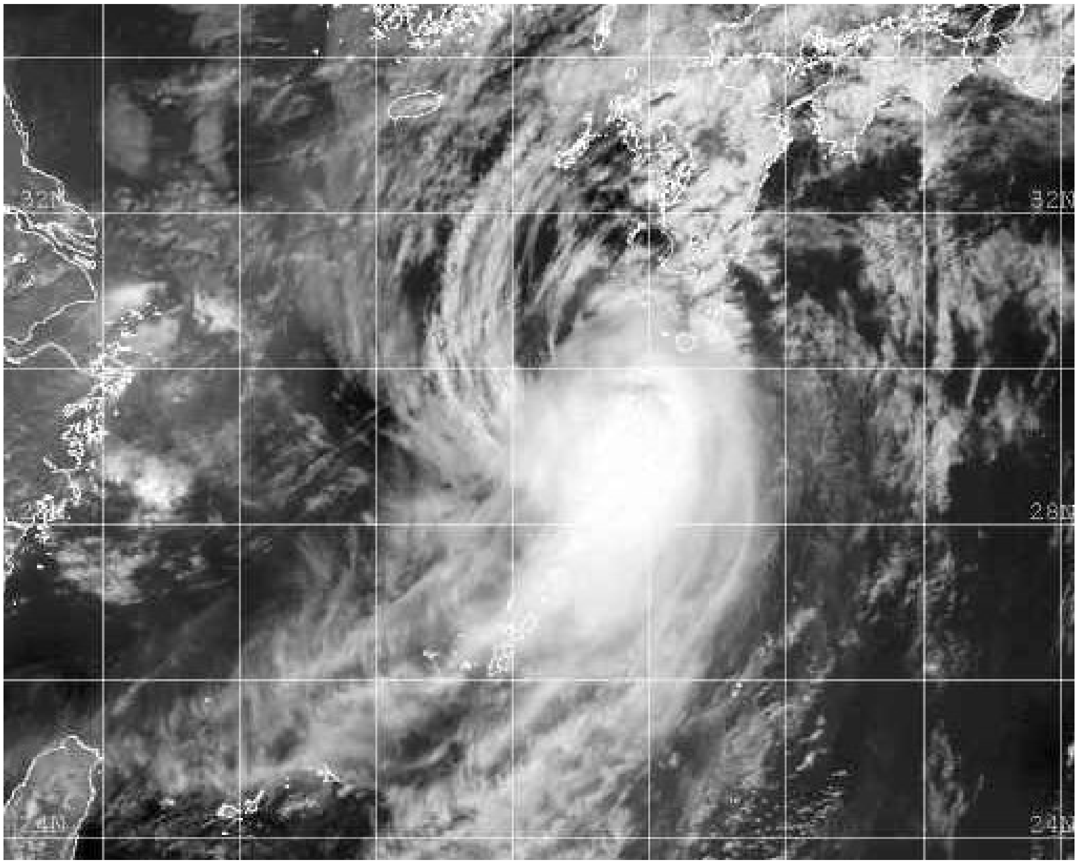
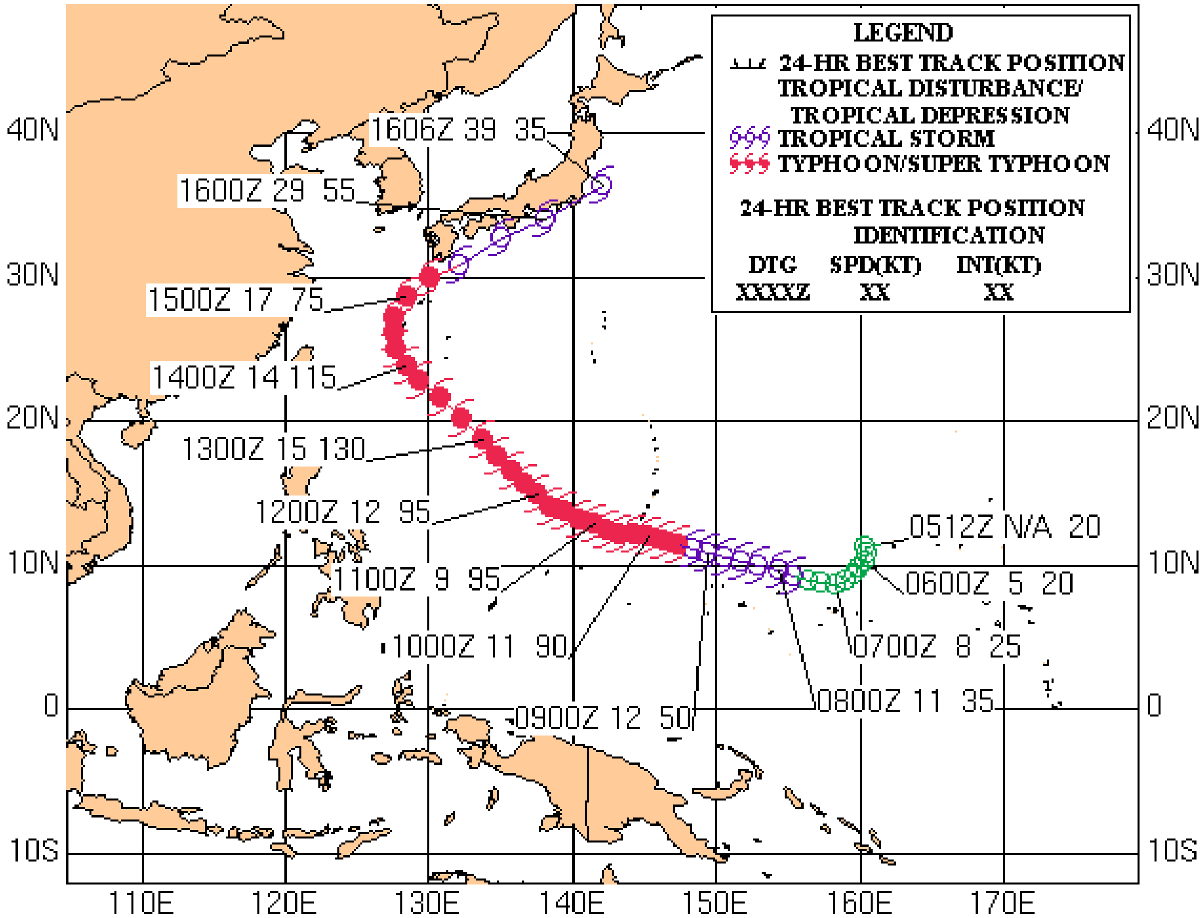



Figure 1-10W-2. 150031Z July 2002 GMS-5 visible imagery of TY 10W (Halong), 140 nm northeast of Okinawa, Japan. Intensity was estimated at 75 knots.

## SUPER TYPHOON 10W (HALONG)
## 07-15 JULY 2002



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# Tropical Storm (TS) 11W (Nakri)

Verification Statistics

First Poor : 1130Z 07 Jul 02
First Fair : 1730Z 07 Jul 02
First TCFA : 2030Z 07 Jul 02
First Warning : 1200Z 08 Jul 02
Last Warning : 0600Z 13 Jul 02
Max Intensity : 40 kts, gusts to 55 kts
Landfall : 2130Z 09 Jul 02
Total Warnings : 20
Remarks:
(1) At 1200Z 08 July the first warning was issued on this cyclone with an intensity of 25 knots near 22 N 118 E. TS 11W attained maximum intensity of 40 knots at 1800Z 10 July. This system tracked northeast from the South China Sea over the northern tip of Taiwan and into the East China Sea.
(2) TS 11W tracked to the northeast in response to the sub-equatorial ridge over Mindanao. After moving across Taiwan, a surge in the southwest monsoon steered the system to the east for 36 hours and then the cyclone tracked poleward into a weakness in the subtropical ridge.
(3) Cooler sea surface temperatures and increasing vertical wind shear caused the storm to dissipate southwest of Kyushu.
(4) No casualties or damage were reported.

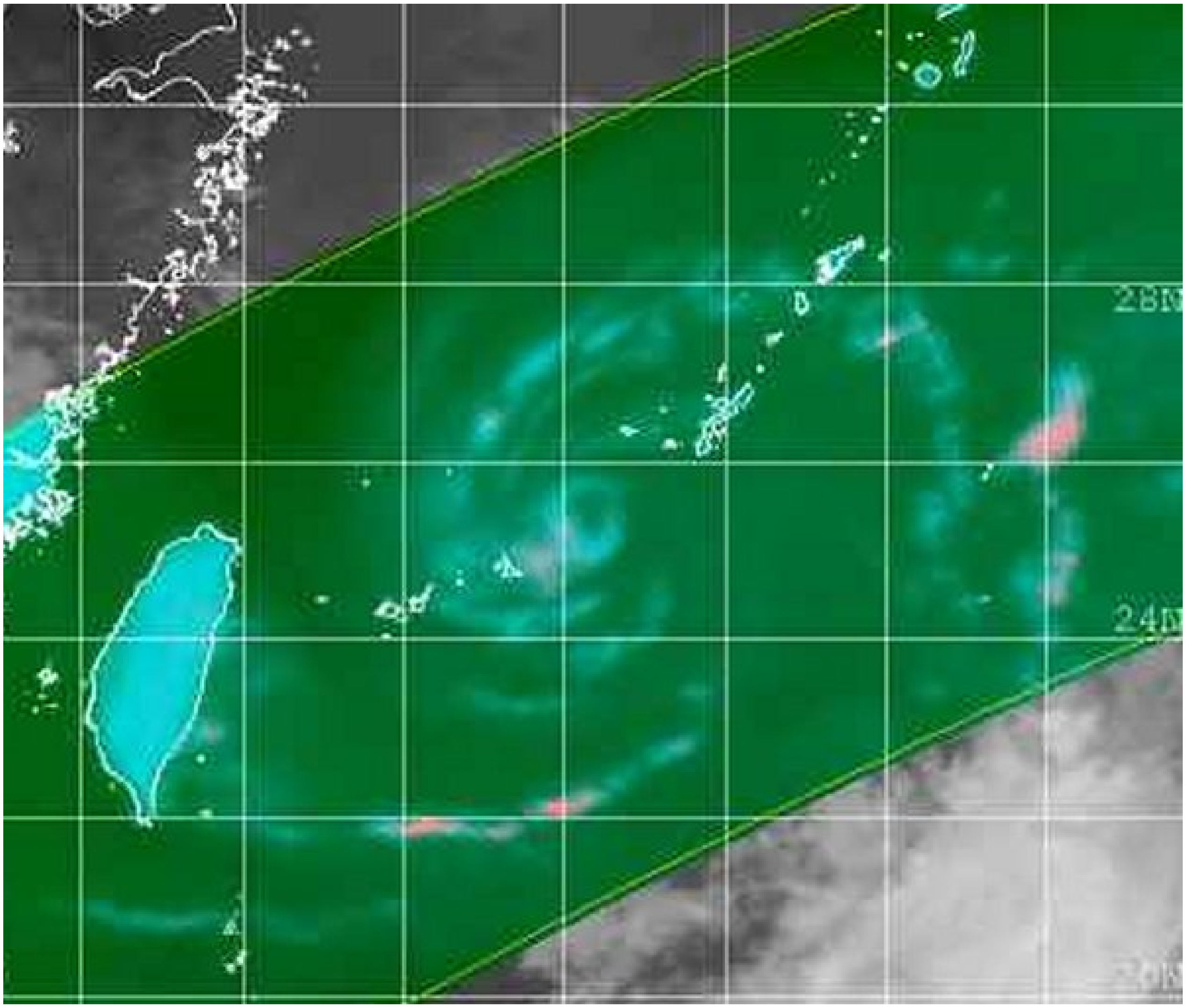



Figure 1-11W-1. 111029Z July 2002 85 GHz TRMM image of TS 11W (Nakri), 110 nm southwest of Okinawa, Japan. The partially exposed low level circulation center was at peak estimated intensity of 40 knots.

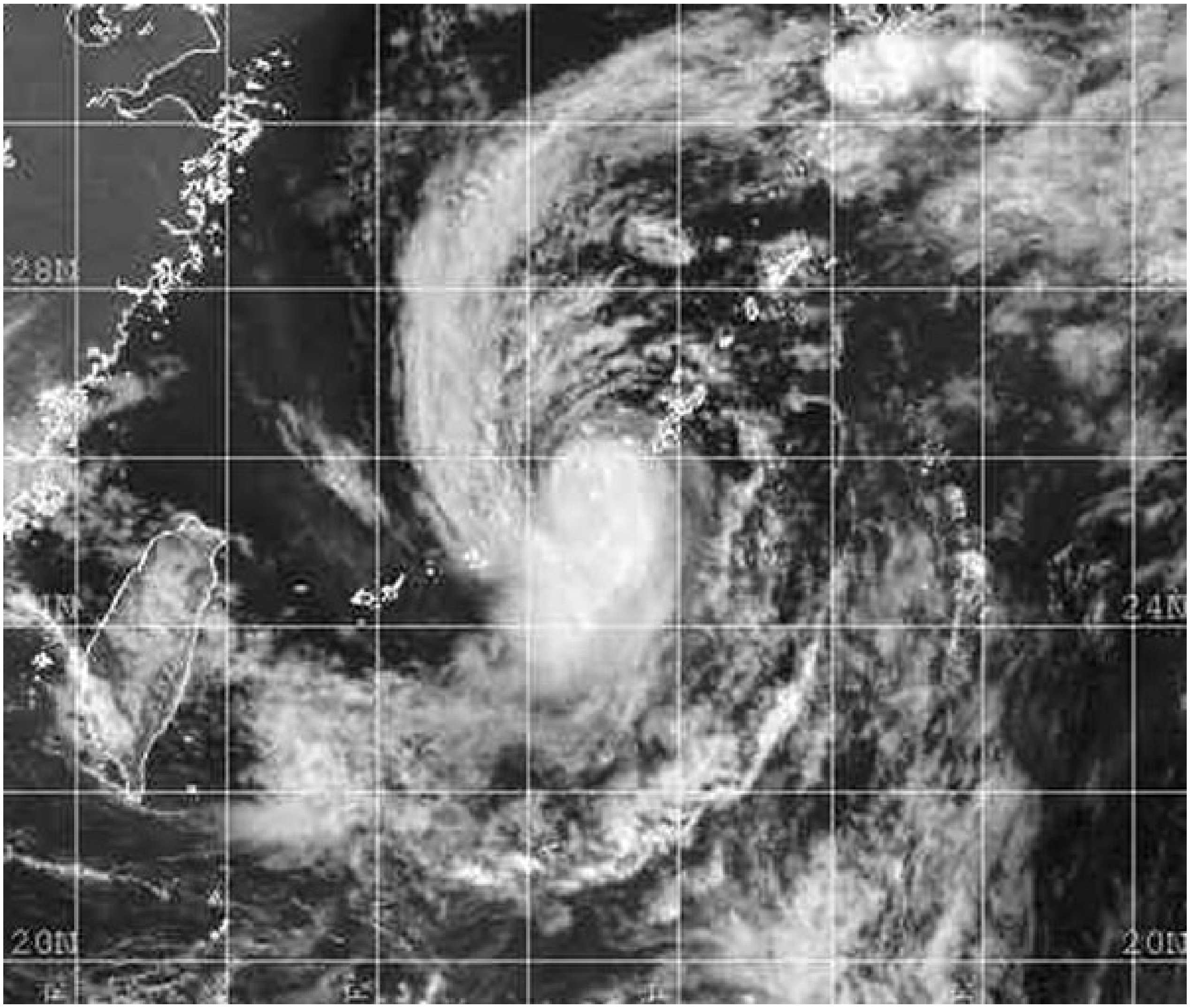
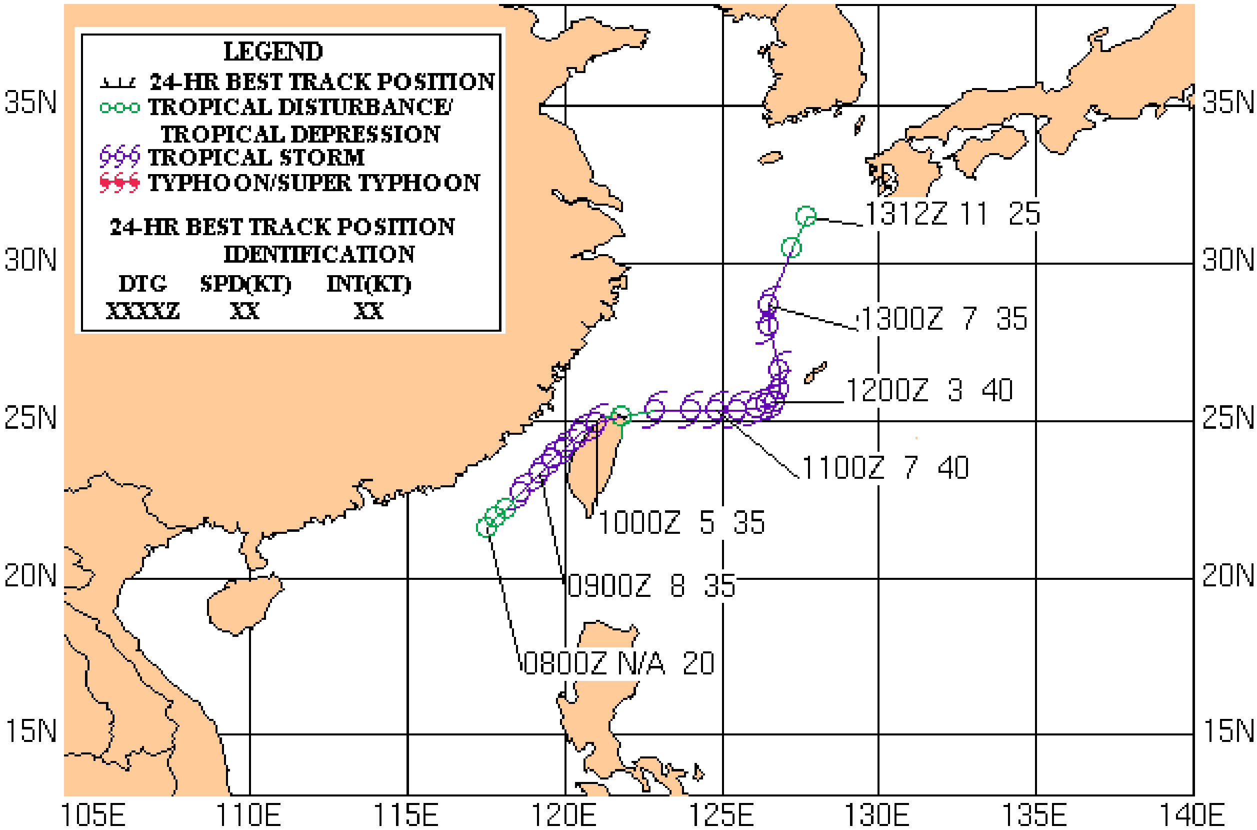



Figure 1-11W-2. 120031Z July 2002 GMS-5 visible imagery of TS 11W (Nakri), 100 nm southwest of Okinawa, Japan. The partially exposed low level circulation center had a peak intensity of 40 knots.

# TROPICAL STORM 11W (NAKRI)
## 08-13 JULY 2002



# Super Typhoon (STY) 12W (Fengshen)

Verification Statistics

First Poor : None
First Fair : None
First TCFA : 0400Z 14 Jul 02
First Warning : 0600Z 14 Jul 02
Last Warning : 0600Z 27 Jul 02
Max Intensity : 145 kts, gusts to 175 kts
Landfall : None
Total Warnings : 53
Remarks:

(1) STY 12W developed northeast of Kwajalein Atoll on 0600Z 14 July in the monsoon trough. STY 12W rapidly developed as a midget-sized system, tracking north northwestward out of the monsoon trough during the first 12 hours. STY 12W tracked poleward for a short period along the southwest quadrant of the subtropical ridge located to the northeast. Then the subtropical ridge built westward and STY 12W tracked west-northwestward. By 20 July the system was tracking northwestward toward eastern China.

(2) STY 12W rapidly intensified over the first 24 hours by 60 knots or 3 T-numbers, as the system moved out of the influence of the monsoon trough. Outflow continued to be enhanced by an upper level low that developed northwest of the system and tracked westward with the system. The storm became a super-typhoon at 1800Z on 17 July and remained a super-typhoon for five days. STY 12W peaked at 145 knots gusting to 175 knots at 1200Z 21 July.

(3) On 22 July, STY 12W started to slowly weaken. The system continued to weaken as it approached the coast of China and dissipated over water in the Yellow Sea.

(4) STY 12W produced high winds and heavy rains over Kyushu, causing a Panamanian-registered freighter to run aground.

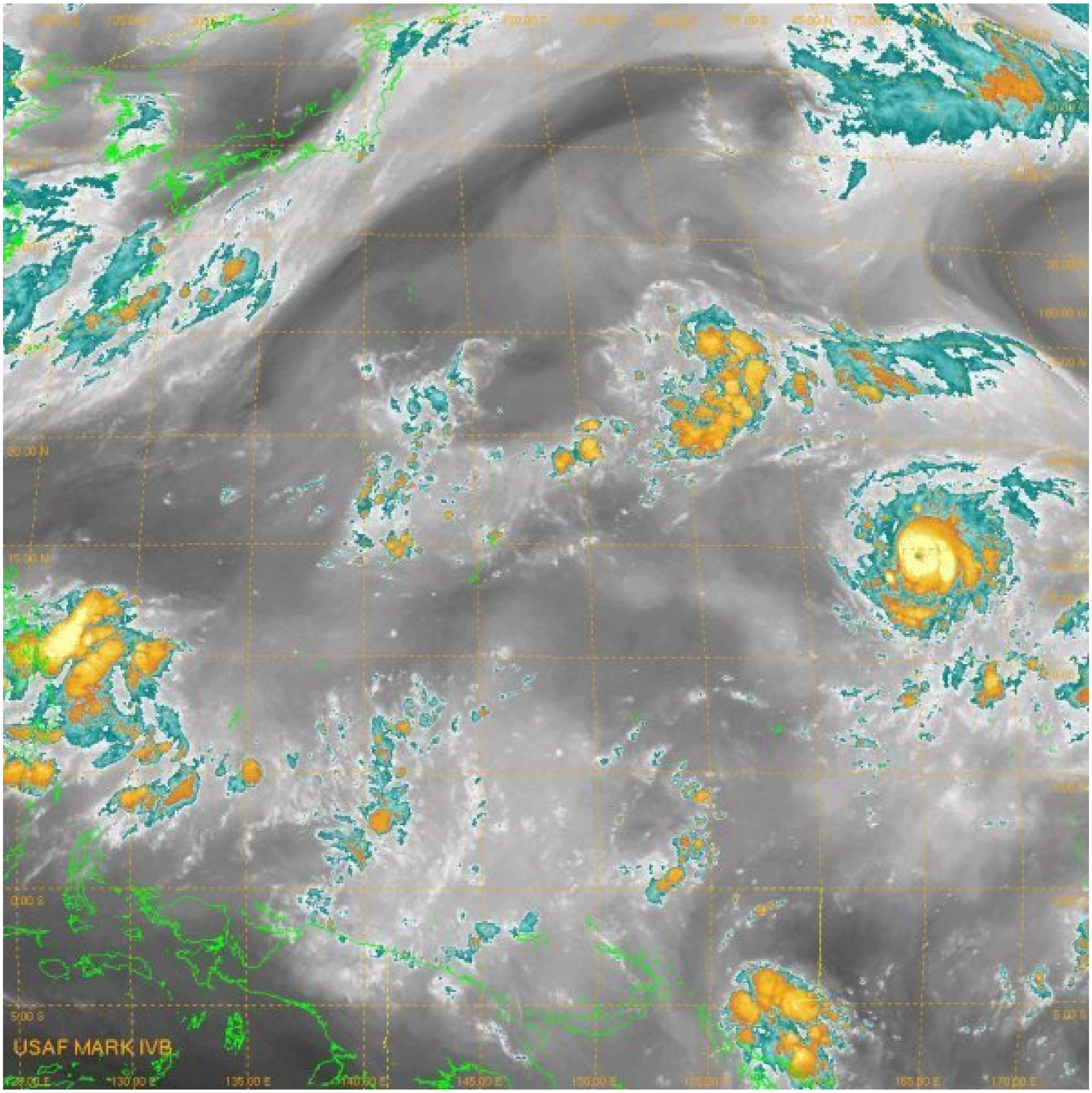



Figure 1-12W-1. 170532Z July 2002 GMS-5 water vapor image TY 12W (Fengshen), 1280 nm east of Guam with an estimated intensity of 125 knots.

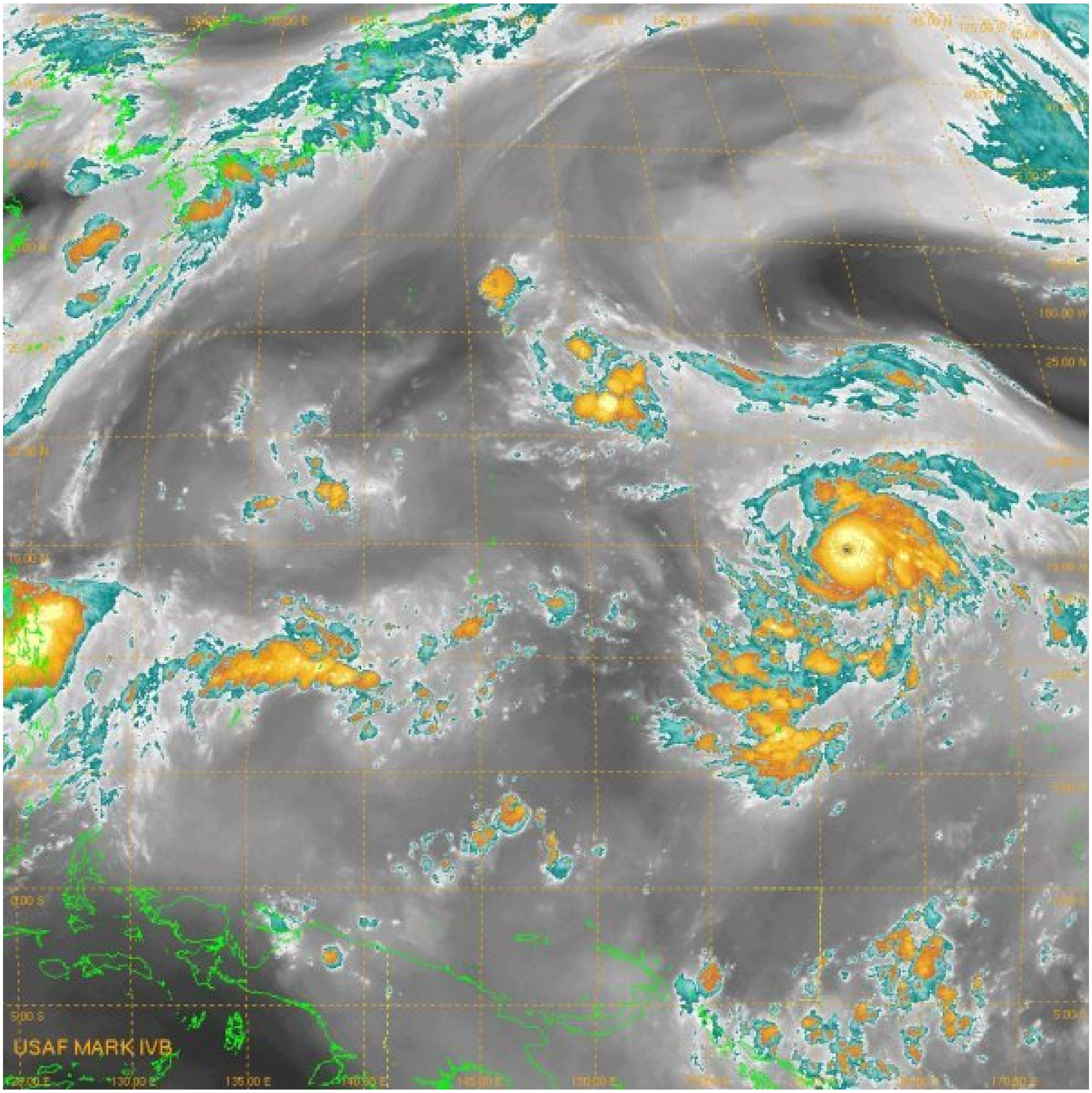



Figure 1-12W-2. 181702Z July 2002 GMS-5 water vapor image TY 12W (Fengshen), 1000 nm east of Guam with an estimated intensity of 140 knots.

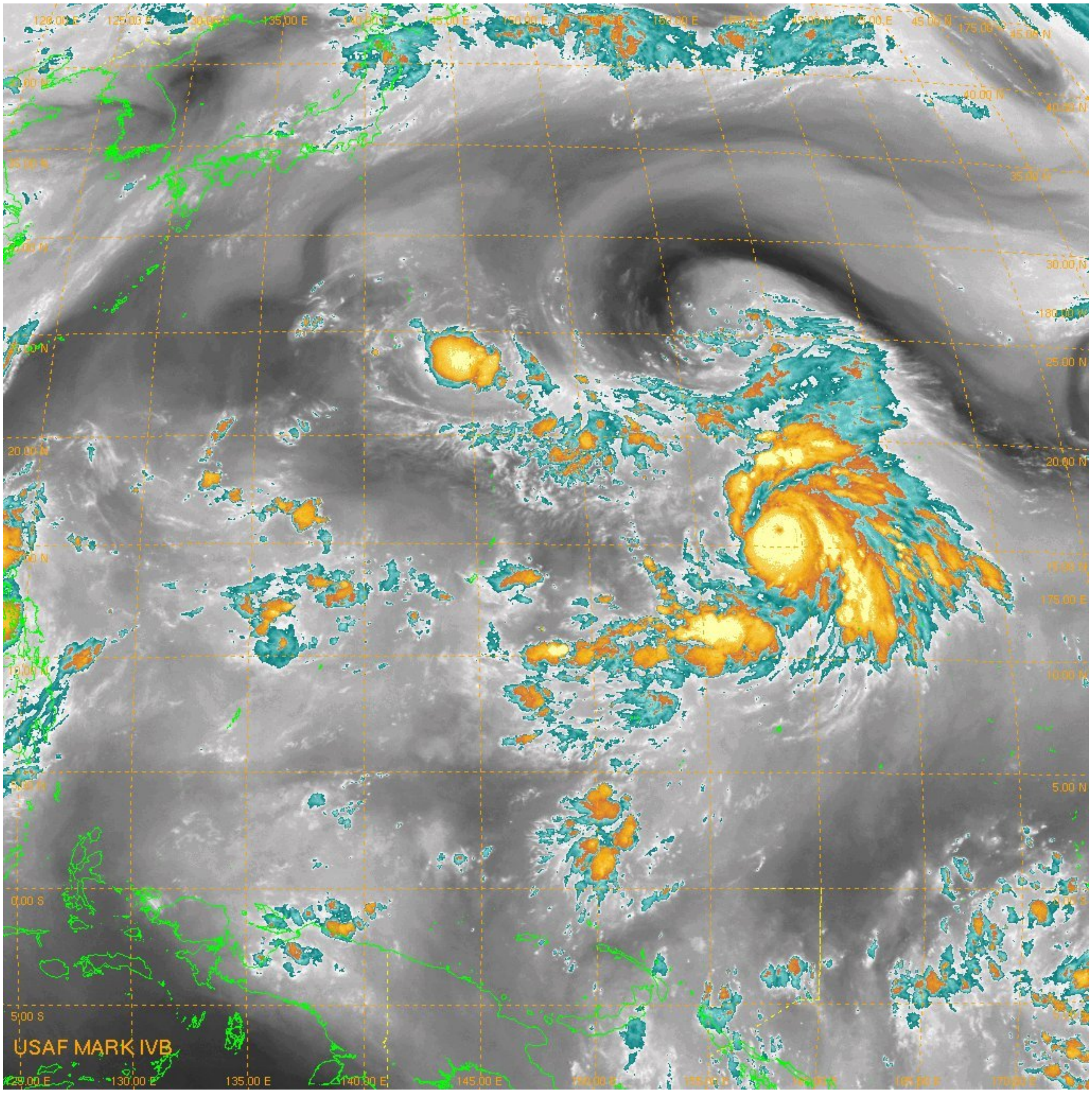



Figure 1-12W-3. 191832Z July 2002 GMS-5 water vapor image TY 12W (Fengshen), 865 nm east of Guam with an estimated intensity of 140 knots.

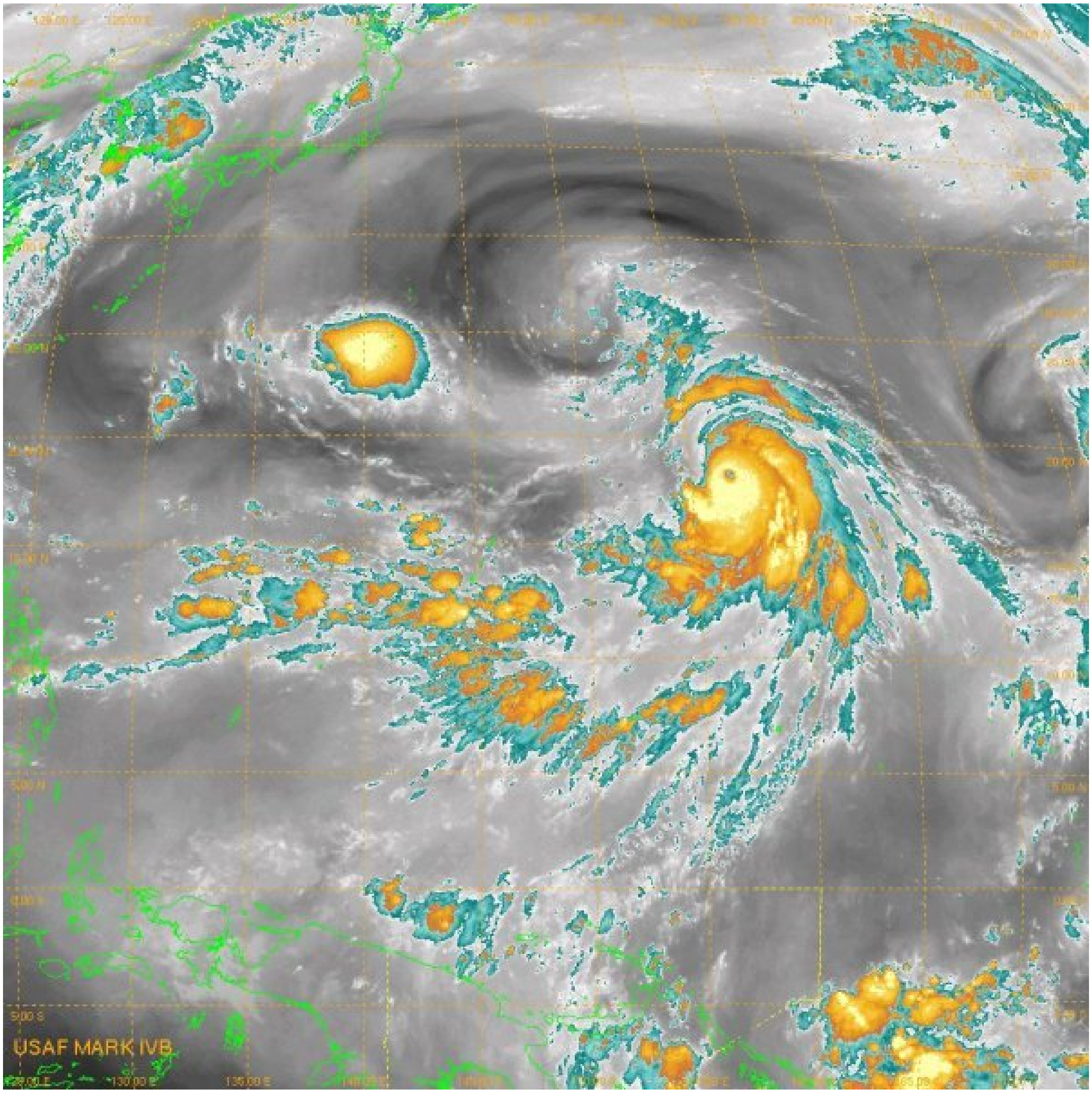



Figure 1-12W-4. 201932Z July 2002 GMS-5 water vapor image TY 12W (Fengshen), 745 nm northeast of Guam with an estimated intensity of 140 knots.

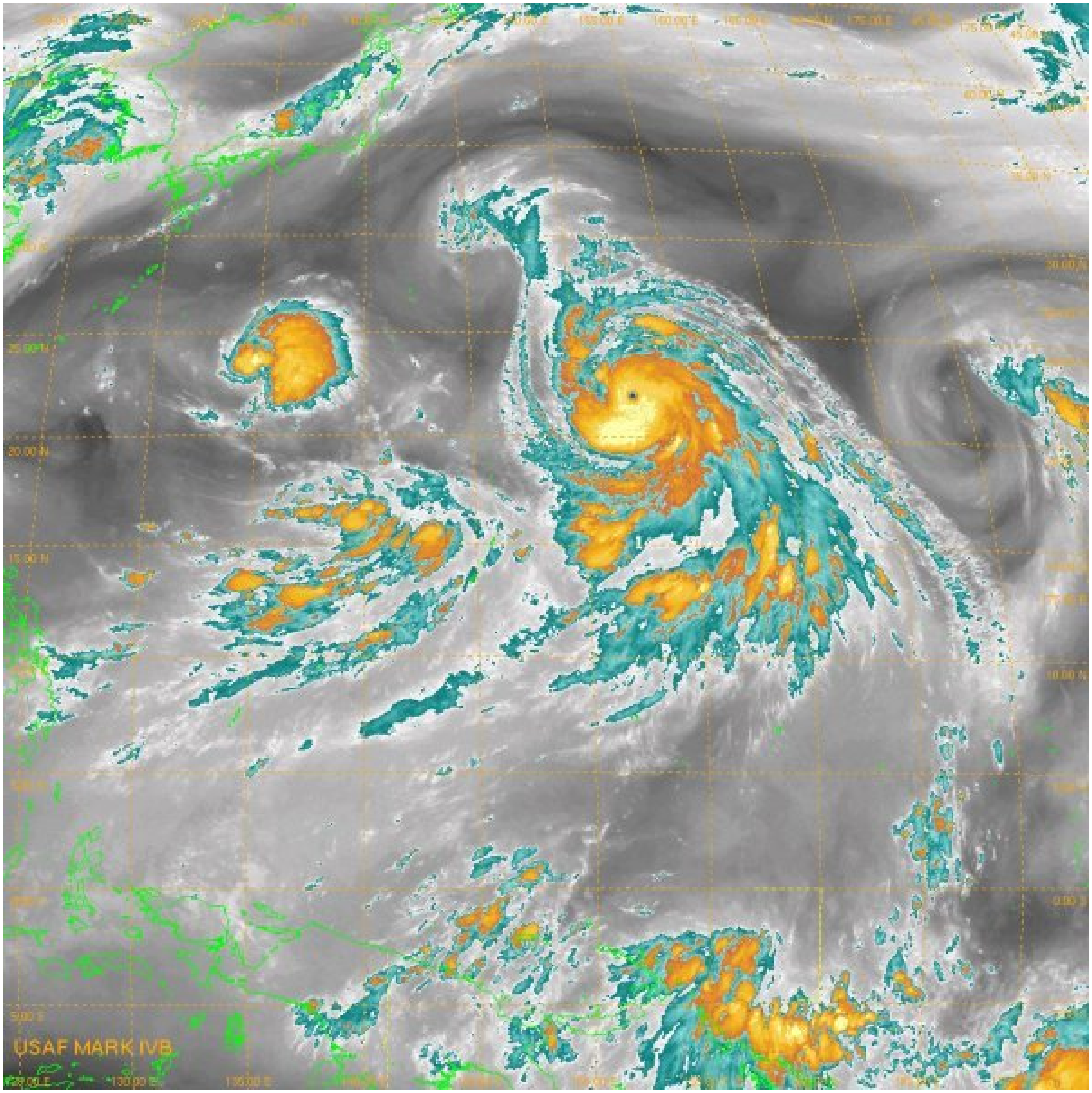



Figure 1-12W-5. 212132Z July 2002 GMS-5 water vapor image TY 12W (Fengshen), 670 nm northeast of Guam with an estimated intensity of 140 knots.

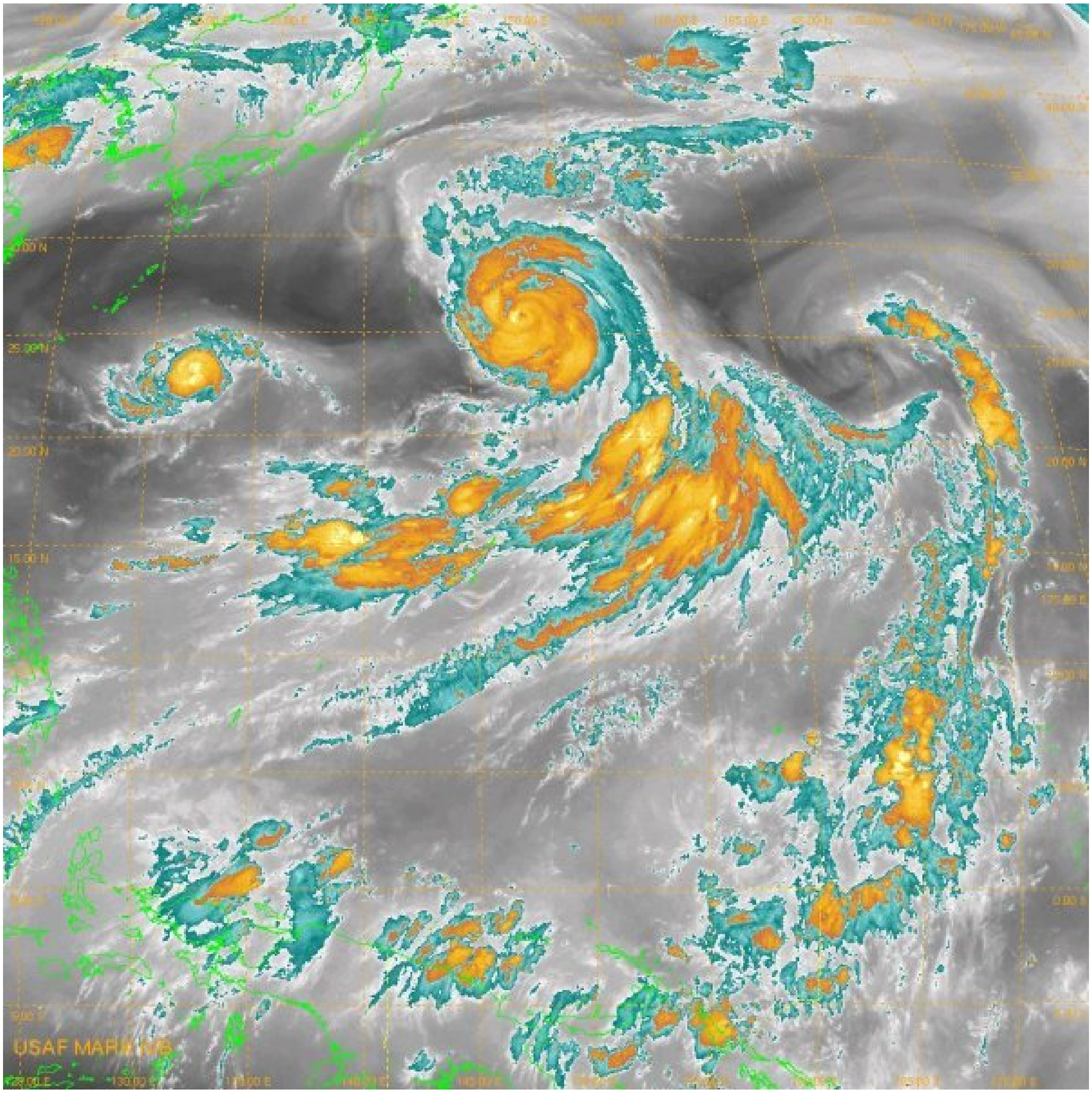



Figure 1-12W-6. 222302Z July 2002 GMS-5 water vapor image TY 12W (Fengshen), 1070 nm east of Okinawa, Japan with an estimated intensity of 120 knots.

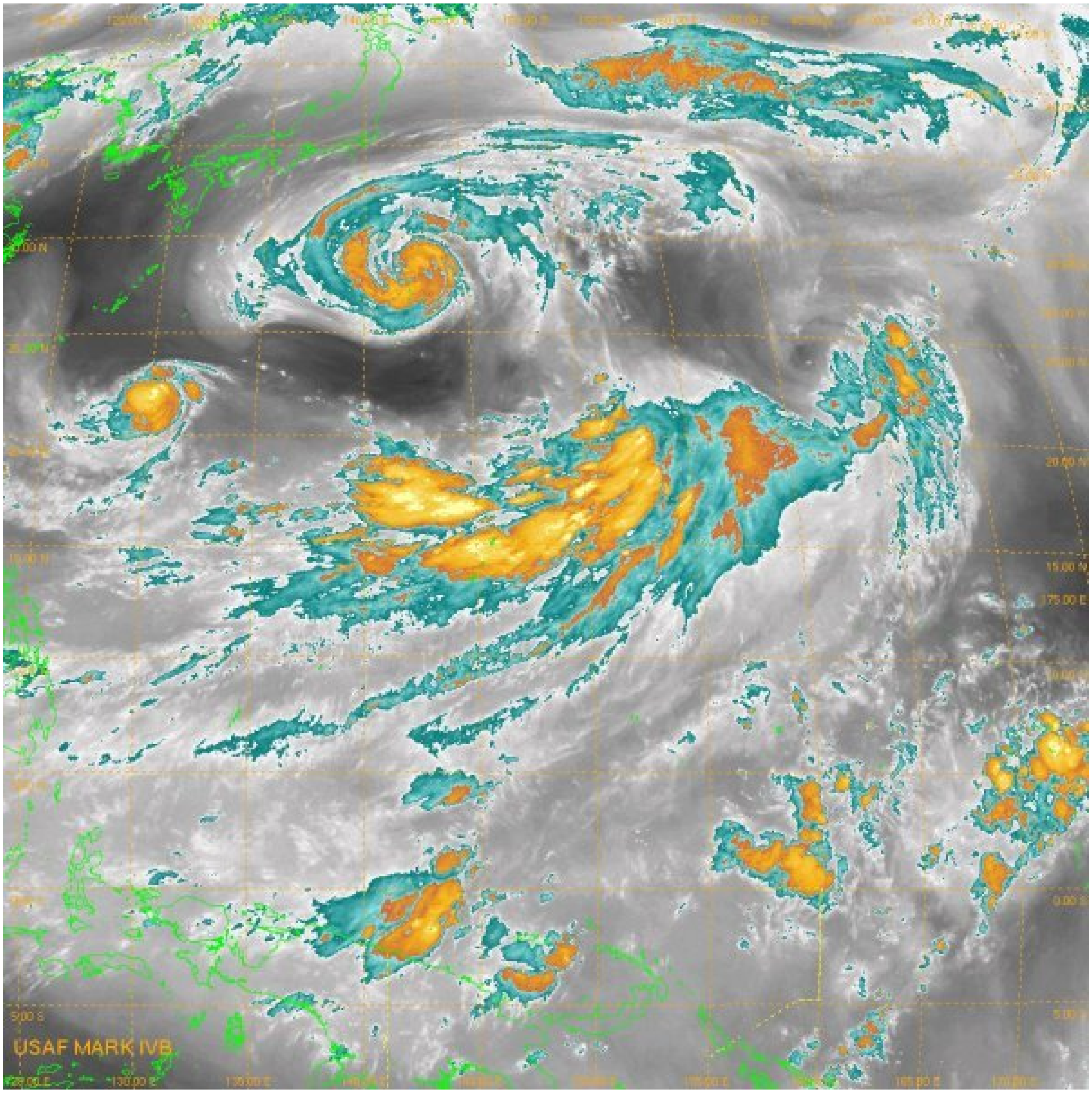
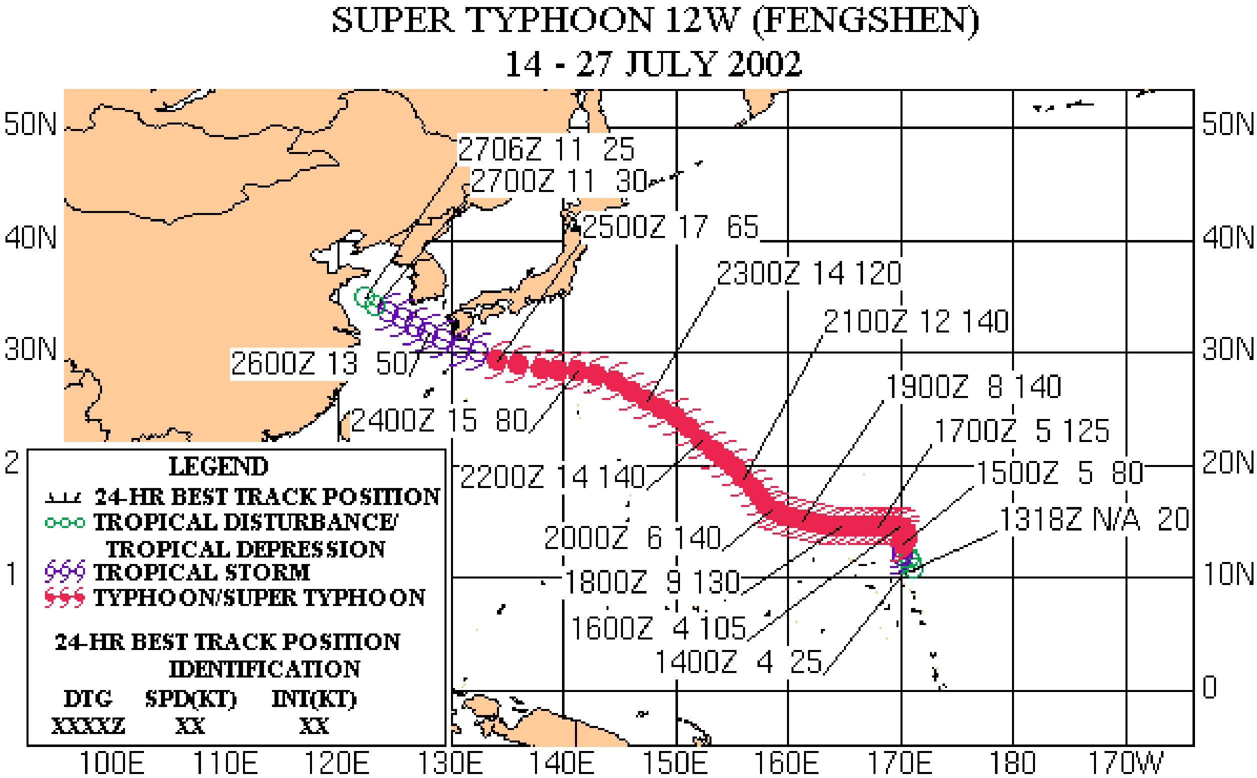



Figure 1-12W-7. 232032Z July 2002 GMS-5 water vapor image TY 12W (Fengshen), 760 nm east of Okinawa, Japan with an estimated intensity of 110 knots.


SUPER TYPHOON 12W (FENGSHEN)
14 - 27 JULY 2002
2706Z 11 25
2700Z 11 30
2500Z 17 65
2300Z 14 120
2100Z 12 140
2600Z 13 50
1900Z 8 140
2400Z 15 80
1700Z 5 125
2200Z 14 140
1500Z 5 80
1318Z N/A 20
2000Z 6 140
1800Z 9 130
1600Z 4 105
1400Z 4 25
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 XX
50N
40N
30N
20N
10N
0
100E
110E
120E
130E
140E
150E
160E
170E
180
170W

# Tropical Storm (TS) 13W

Verification Statistics

First Poor : 1230Z 16 Jul 02
First Fair : 1800Z 17 Jul 02
First TCFA : 2230Z 17 Jul 02
First Warning : 1200Z 18 Jul 02
Last Warning : 0000Z 22 Jul 02
Max Intensity : 35 kts, gusts to 45 kts
Landfall : 0300Z 19 Jul 02
Total Warnings : 15
Remarks:
(1) TS 13W developed in the Philippine Sea, west of Palau, then tracked northwestward over Leyte Gulf and then Luzon island before dissipating in the Lingayen Gulf. On 1200Z 18 July the first warning was issued on this cyclone with an intensity of 30 knots gusting to 40 knots near 09 N 127 E. TS 13W attained maximum intensity of 35 knots at 1200Z 20 July.
(2) TS 13W tracked northwestward in response to flow associated with the subtropical ridge located southeast of the Ryukyu Islands.
(3) Moderate vertical shear, weak outflow, and land interaction aided in the storm's dissipation as it tracked across Luzon.
(4) No casualties were reported. Reports indicated property damage from heavy rains.

TD 15W Kalmaegi
TS 16W Kammuri
TD 17W
TS 18W
STY19W Phanfone
TS 20W Vongfong
TY 21W Rusa
TY 22W Sinlaku
TS 23W Hagupit
TS 24W Mekkhala
STY25W Higos
TY 26W Bavi
TD 27W
TD 28W
TS 29W Maysak
TY 30W Haishen
STY31W Pongsona
HUR02C Ele
HUR03C Huko
TC 01A
TC 02B
TC 03B
TC 04B
TC 05B

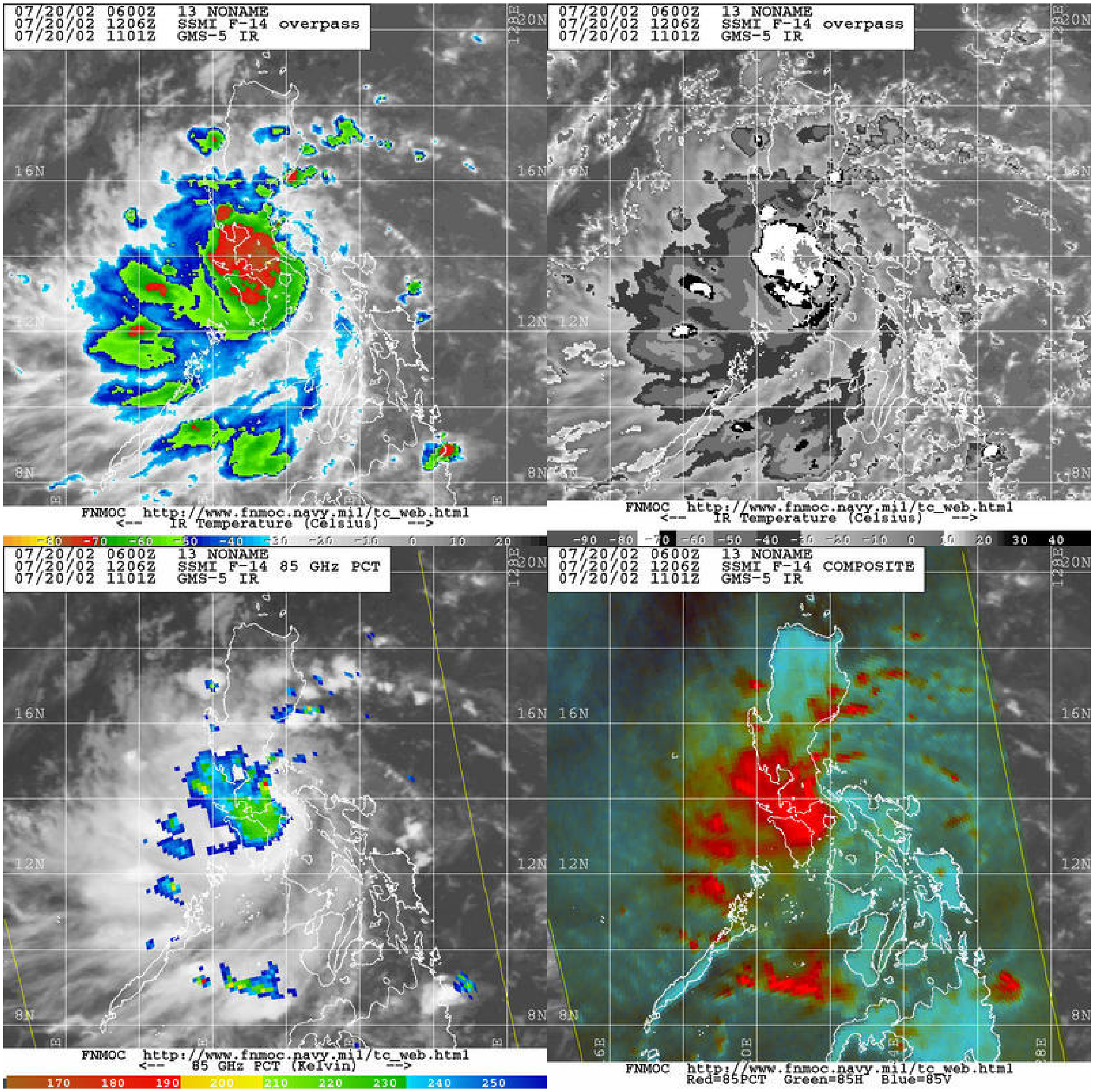
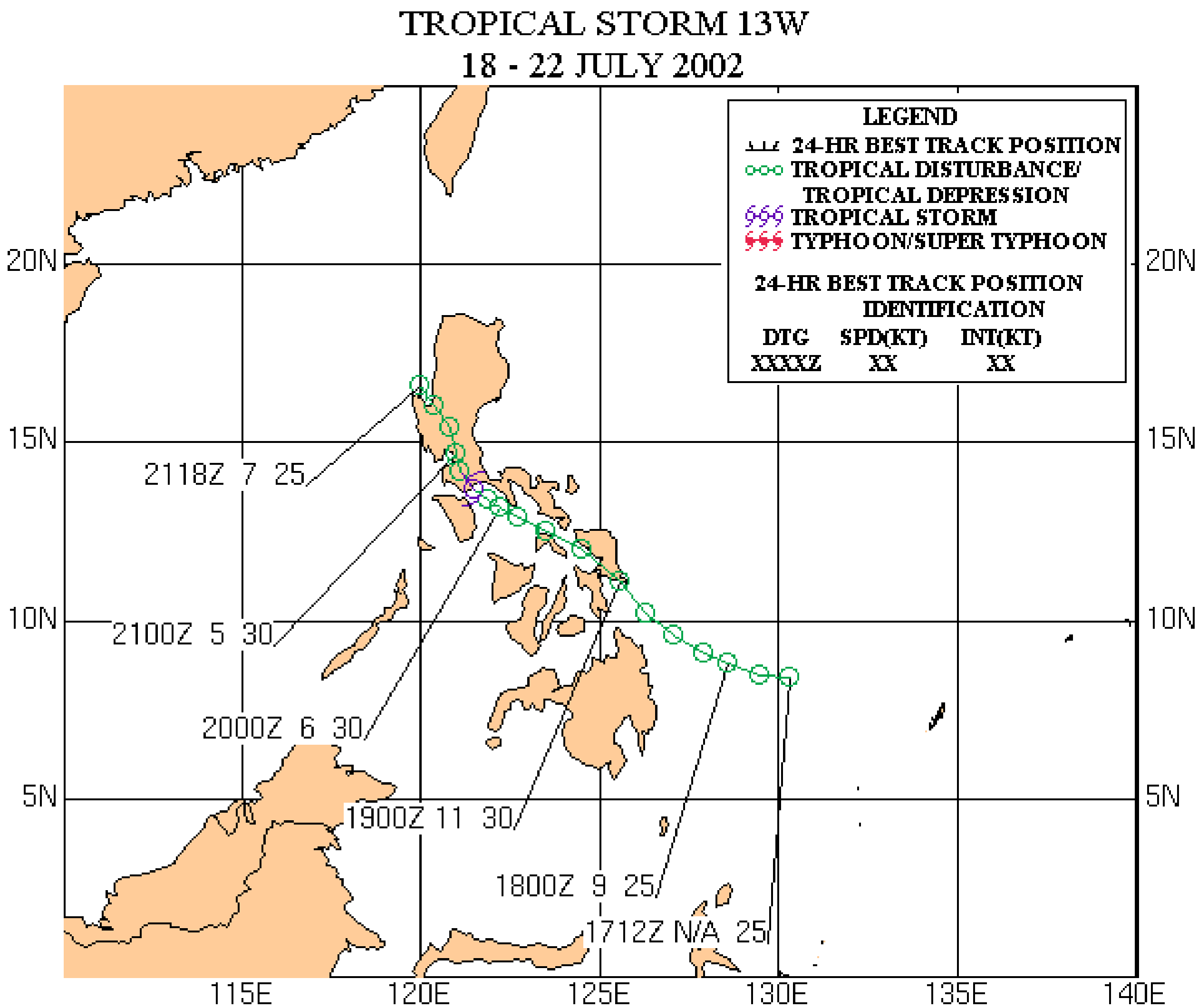


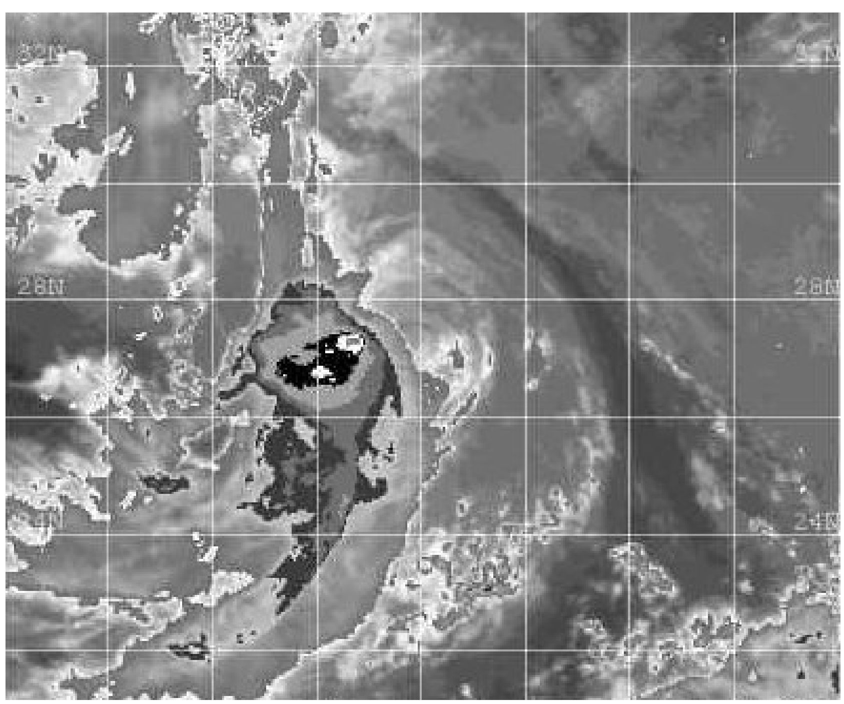

Figure 1-13W-1. 201207Z July 2002 multi-sensor satellite images of TS 13W, over Luzon, Philippines with an estimated intensity of 35 knots.


TROPICAL STORM 13W
18 - 22 JULY 2002
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 XX
2118Z 7 25
2100Z 5 30
2000Z 6 30
1900Z 11 30
1800Z 9 25
1712Z N/A 25
20N
15N
10N
5N
115E
120E
125E
130E
135E
140E

# Typhoon (TY) 14W (Fung-Wong)

Verification Statistics

First Poor : 0000Z 20 Jul 02
First Fair : 1900Z 18 Jul 02
First TCFA : 1030Z 20 Jul 02
First Warning : 1200Z 20 Jul 02
Last Warning : 0600Z 27 Jul 02
Max Intensity : 65 kts, gusts to 80 kts
Landfall : None
Total Warnings : 28
Remarks:
(1) TY 14W developed in the Bonin Islands, near 24N 141E, tracked westward and looped before moving northwest and dissipating between Kyushu and Cheju Islands.
(2) This cyclone attained a maximum intensity of 65 knots during the looping portion of its track, which appears to have been caused by interaction with STY 12W (Fengshen).
(3) Increasing vertical shear, cool sea surface temperatures, and dry air entrainment were noted in dissipation just south of Cheju Do island.
(4) No casualties or damage were reported.



TD 15W Kalmaegi

TS 16W Kammuri

TD 17W

TS 18W

STY19W Phanfone

TS 20W Vongfong

TY 21W Rusa

TY 22W Sinlaku

TS 23W Hagupit

TS 24W Mekkhala

STY25W Higos

TY 26W Bavi

TD 27W

TD 28W

TS 29W Maysak

TY 30W Haishen

STY31W Pongsona

HUR02C Ele

HUR03C Huko

TC 01A

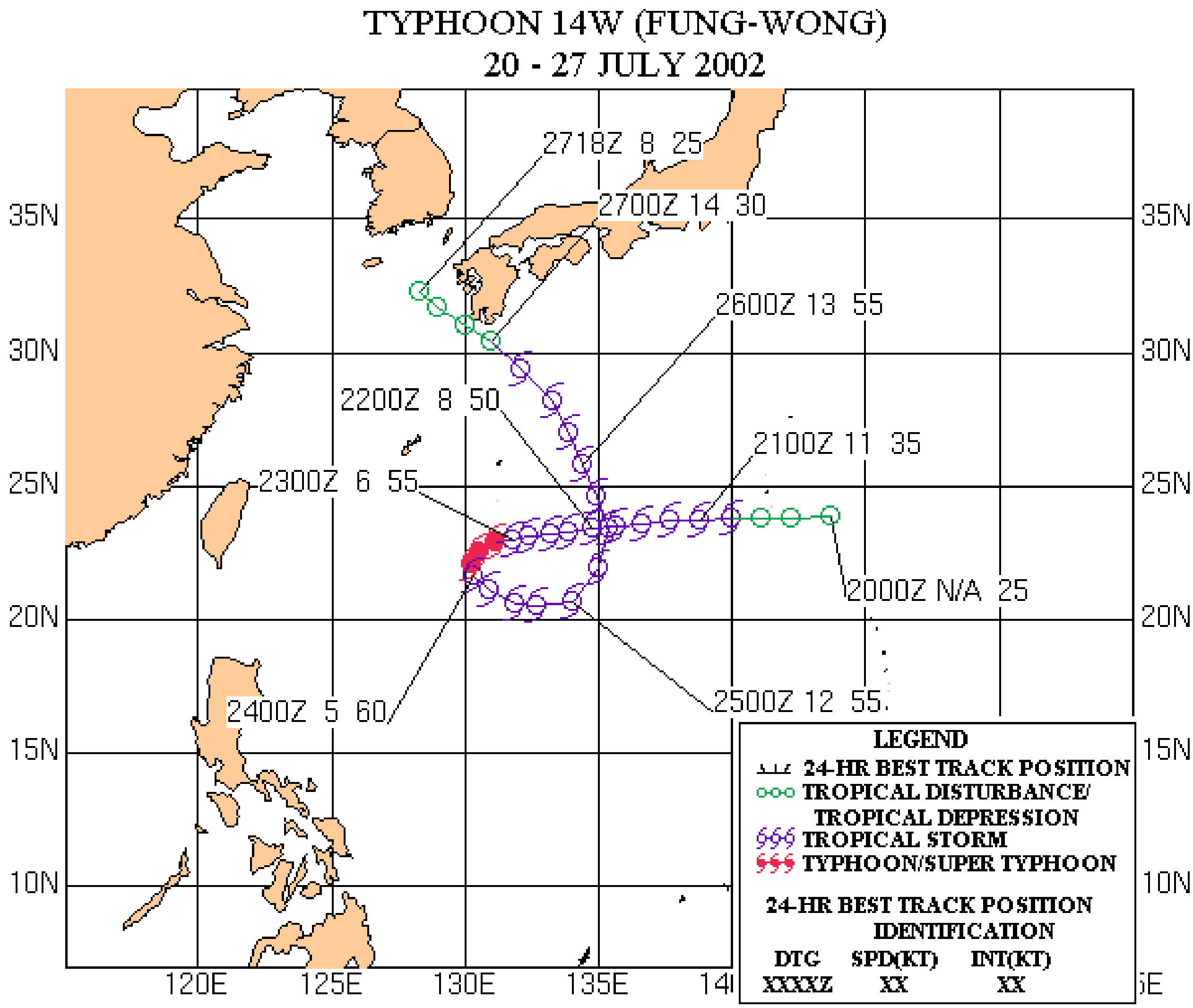
TC 02B

TC 03B

TC 04B

TC 05B


Figure 1-14W-1. 260731Z July 2002 DMSP enhanced infrared imagery of TY 14W (Fung-Wong), sheared system is located 302 nm east of Okinawa, Japan. with an estimated intensity of 50 knots.



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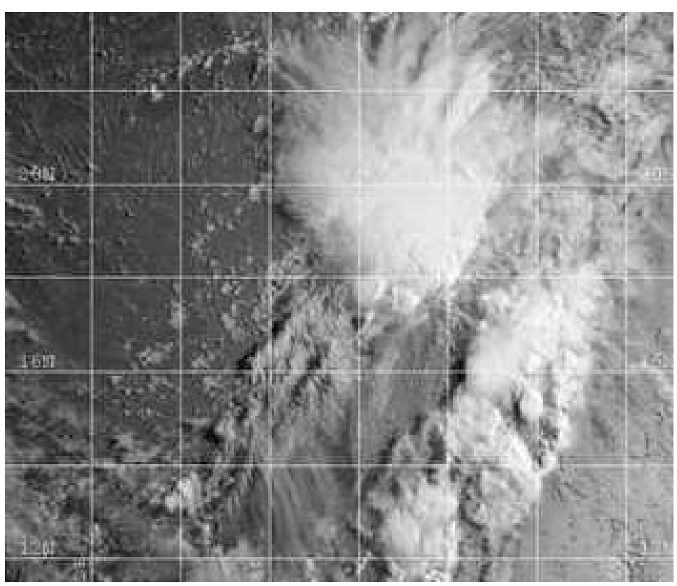
# Tropical Depression (TD) 15W (Kalmaegi)

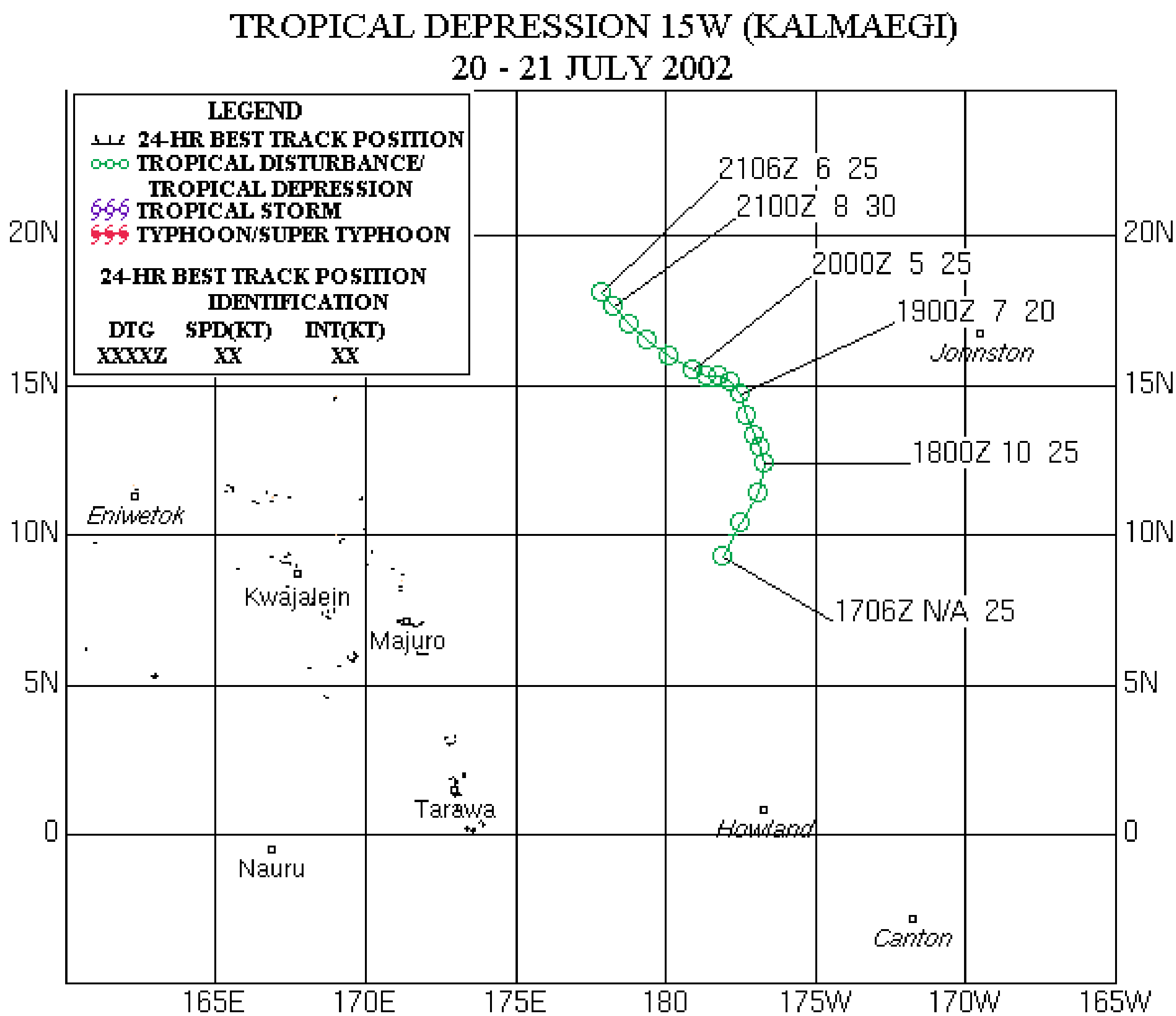
Verification Statistics

First Poor : 0000Z 18 Jul 02
First Fair : 2200Z 18 Jul 02
First TCFA : 0000Z 19 Jul 02
First Warning : 1800Z 20 Jul 02
Last Warning : 0600Z 21 Jul 02
Max Intensity : 30 kts, gusts to 40 kts
Landfall : None
Total Warnings : 03
Remarks:
(1) At 1800Z 20 July the first warning was issued on this cyclone with an intensity of 30 knots near 17 N 178 E, approximately 650 nm east of Kwajalein Atoll.
(2) TD 15W tracked northwest in response to mid-level steering flow associated with the subtropical ridge situated to the north of the system. A TUTT cell to the northwest of the cyclone provided outflow conditions for the system to develop. However, as TD 15W tracked northwestward development ceased due to restricted outflow and increased vertical wind shear associated with the TUTT. This abbreviated period of increased outflow and favorable vertical wind shear resulted in only minimal development and a very short life-span.
(3) Vertical wind shear and weak outflow caused the cyclone to dissipate 18 hours after the first warning.
(4) No casualties or damage were reported with this system.



TD 15W Kalmaegi
TS 16W Kammuri
TD 17W
TS 18W
STY19W Phanfone
TS 20W Vongfong
TY 21W Rusa
TY 22W Sinlaku
TS 23W Hagupit
TS 24W Mekkhala
STY25W Higos
TY 26W Bavi
TD 27W
TD 28W
TS 29W Maysak
TY 30W Haishen
STY31W Pongsona
HUR02C Ele
HUR03C Huko
TC 01A
TC 02B
TC 03B
TC 04B
TC 05B

Figure 1-15W-1. 201913Z July 2002 GMS-5 visible imagery of TS 15W (Kalmaegi), low level circulation center is located south of the deep convection and is located 720 nm east Wake Island with an estimated intensity of 25 knots.



# Tropical Storm (TS) 16W (Kammuri)

Verification Statistics

First Poor : 0030Z 02 Aug 02
First Fair : 0230Z 02 Aug 02
First TCFA : None
First Warning : 0600Z 02 Aug 02
Last Warning : 1200Z 05 Aug 02
Max Intensity : 50 kts, gusts to 65 kts
Landfall : 2200Z 04 Aug 02
Total Warnings : 14
Remarks:
(1) TS 16W developed in the South China Sea approximately 140 miles west of Luzon. At 0600Z 02 August the first warning was issued on this cyclone with an intensity of 30 knots, based on ship reports. TS 16W attained maximum intensity of 50 knots at 1800Z 04 August.
(2) TS 16W tracked initially to the northwest under the steering influence of the mid level ridge over eastern China. A developing baroclinic low with associated trough weakened this ridge and pulled the system poleward. The system continued moving north until making landfall just east of Shanwei, China. The cyclone's maximum intensity of 50 knots was attained just prior to landfall.
(3) Moderate vertical wind shear and interaction land resulted in dissipation over eastern China.
(4) No casualties were reported. Only minor property damage from heavy rain was reported.

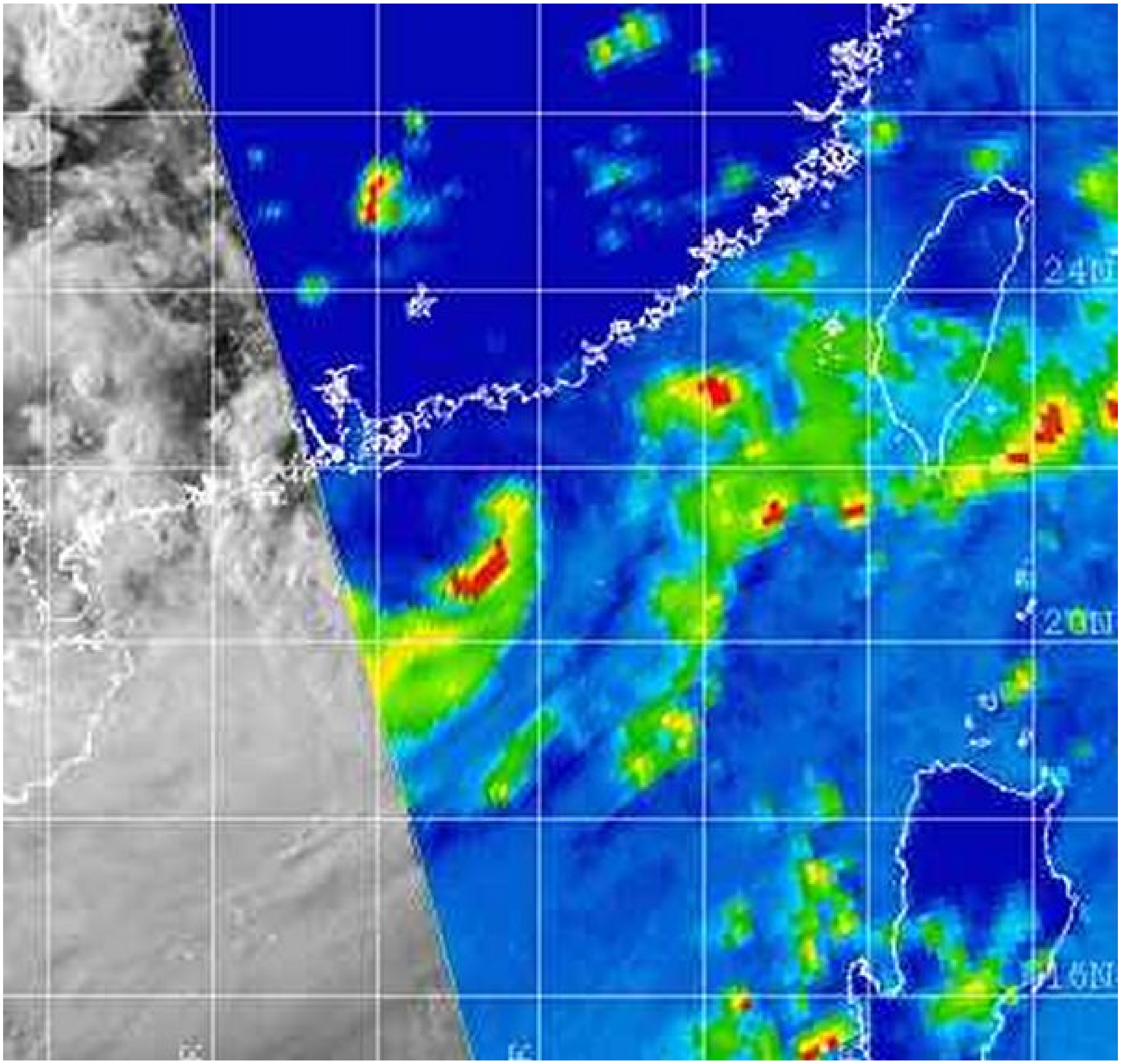
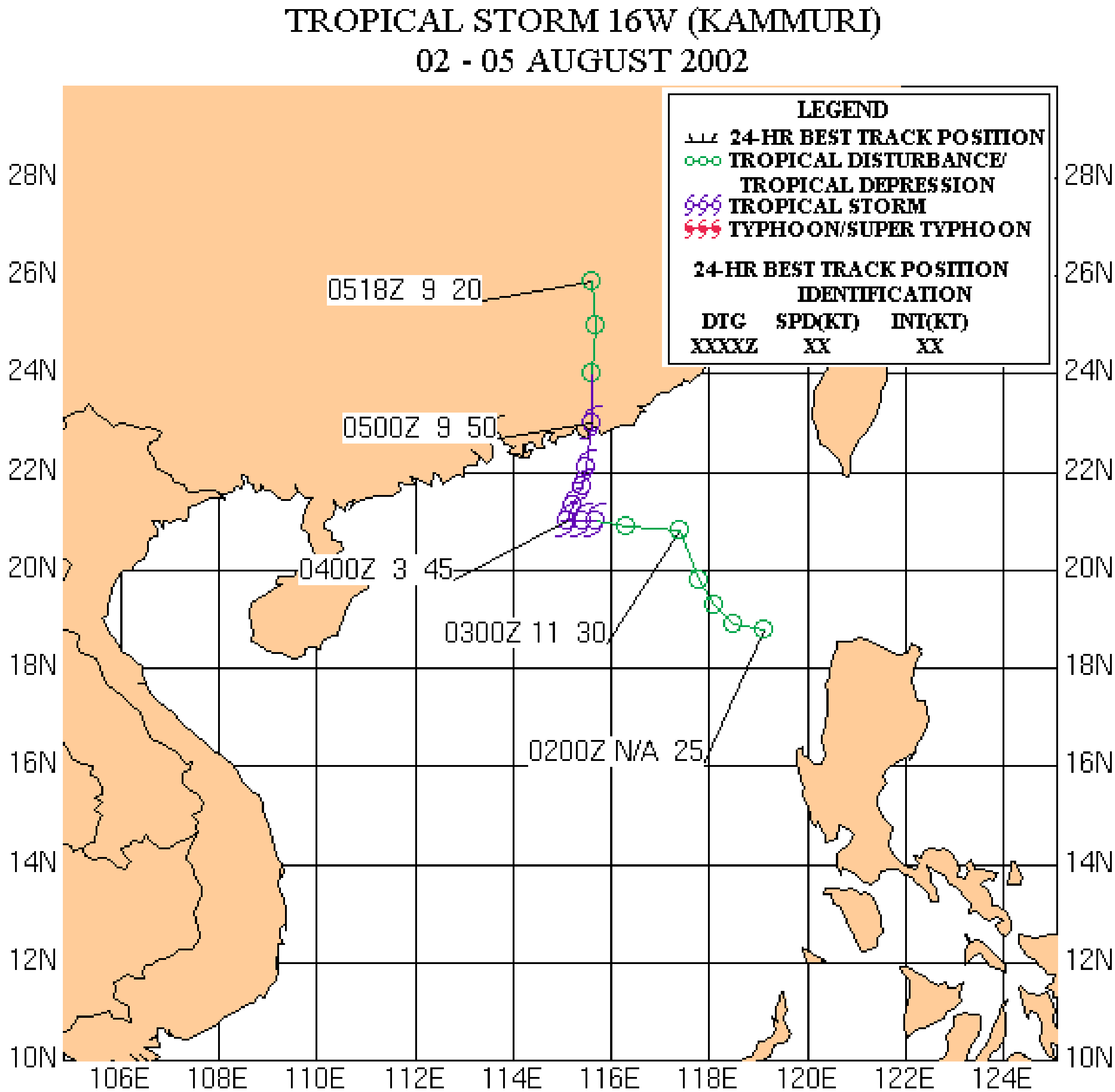



Figure 1-16W-1. 041000Z August 2002 SSM/I imagery of TS 16W (Kammuri), just before landfall 152nm southeast of Hong Kong with an estimated intensity of 45kts.


TROPICAL STORM 16W (KAMMURI)
02 - 05 AUGUST 2002
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 XX
0518Z 9 20
0500Z 9 50
0400Z 3 45
0300Z 11 30
0200Z N/A 25
28N
26N
24N
22N
20N
18N
16N
14N
12N
10N
106E 108E 110E 112E 114E 116E 118E 120E 122E 124E

# Tropical Depression (TD) 17W

Verification Statistics

First Poor : 0600Z 04 Aug 02
First Fair : 1830Z 03 Aug 02
First TCFA : 0300Z 05 Aug 02
First Warning : 0600Z 05 Aug 02
Last Warning : 1200Z 05 Aug 02
Max Intensity : 25 kts, Gusts To 35 kts
Landfall : None
Total Warnings : 02
Remarks:
(1) TD 17W was classified as a small or midget cyclone that was first detected immediately south of the Ise Peninsula, Honshu. At 0600Z 05 August, the first warning was issued on this cyclone, located near 34N 150E, with an intensity of 25 knots.
(2) Steering flow associated with a mid-level ridge to the southeast of the cyclone caused this system to move eastward.
(3) Moderate vertical shear, weak outflow, and cooler sea surface temperatures prevented development and eventually caused the cyclone to dissipate east of Japan.
(4) No casualties or damage were reported.

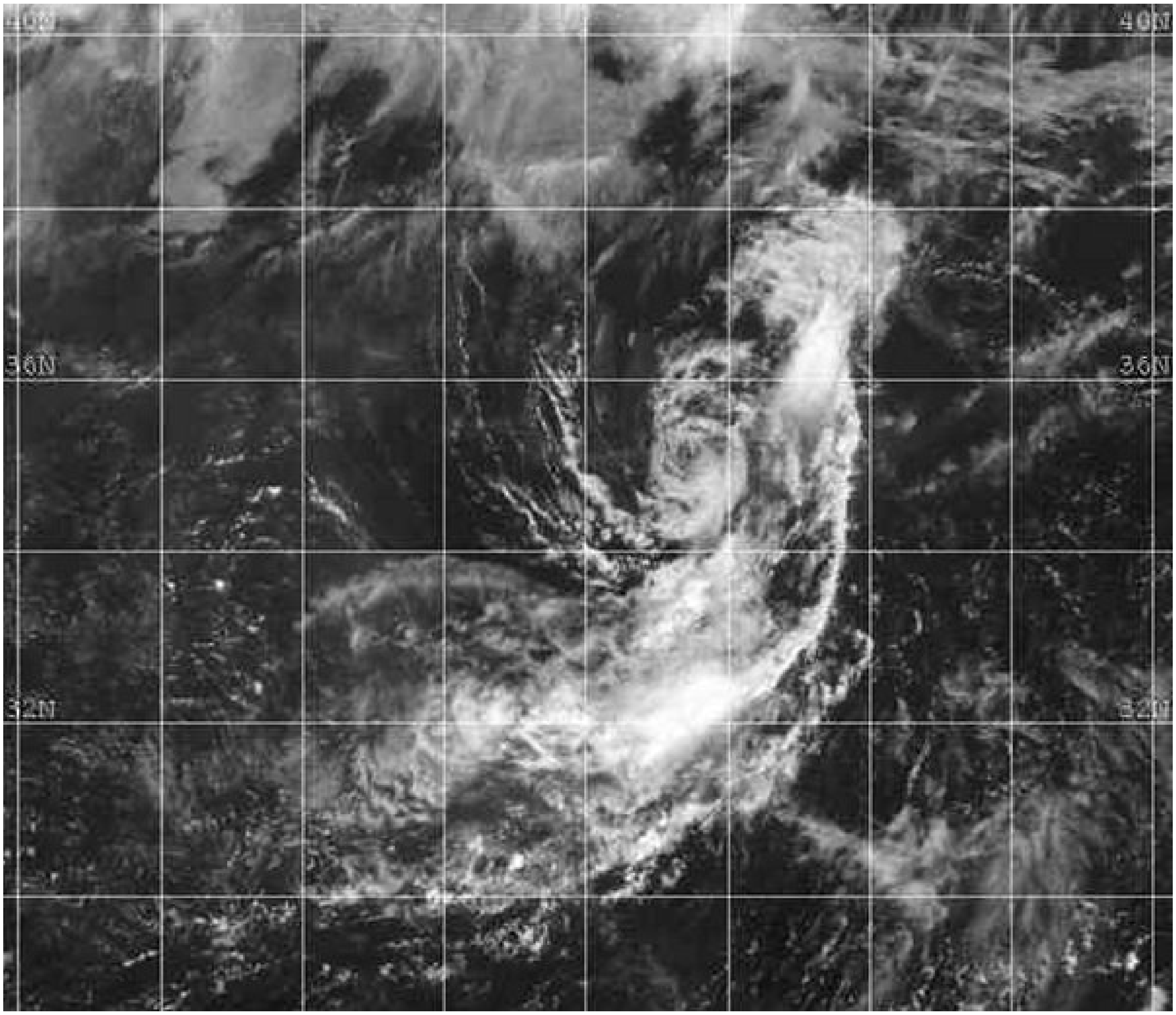
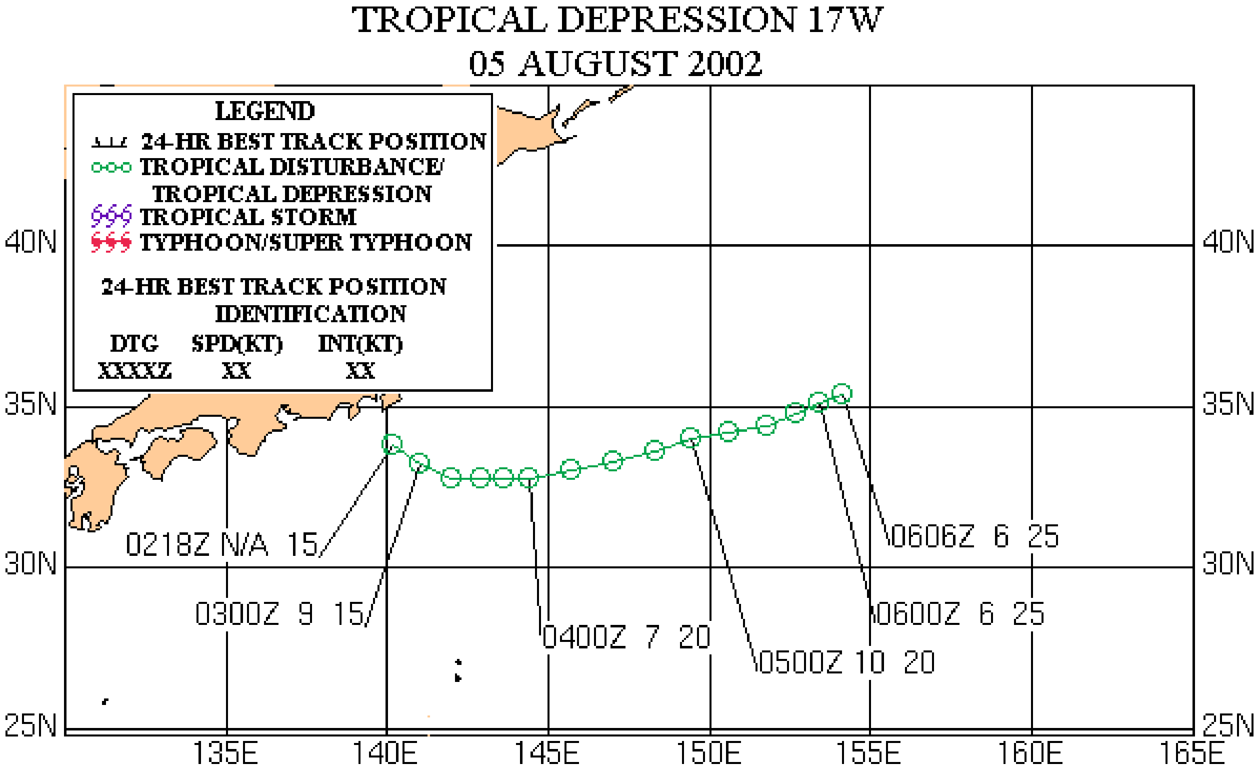



Figure 1-17W-1. 050131Z August 2002 GMS-5 visible image of TD 17W (Noname), located 485nm east of mainland Japan, with an estimated intensity of 20 knots.


TROPICAL DEPRESSION 17W
05 AUGUST 2002
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 XX
40N
35N
30N
25N
135E
140E
145E
150E
155E
160E
165E
0218Z N/A 15
0300Z 9 15
0400Z 7 20
0500Z 10 20
0600Z 6 25
0606Z 6 25

# Tropical Storm (TS) 18W

Verification Statistics

First Poor : 0600Z 09 Aug 02
First Fair : 2130Z 08 Aug 02
First TCFA : 1430Z 10 Aug 02
First Warning : 1800Z 10 Aug 02
Last Warning : 1200Z 13 Aug 02
Max Intensity : 35 kts, gusts to 45 kts
Landfall : 0800Z 13 Aug 02
Total Warnings : 12
Remarks:
(1) TS 18W developed in the Philippine Sea northwest of Palau, tracked northwestward for two days and then turned westward and moved over southern Luzon before weakening over land, approximately 15 nm south of Manila. TS 18W attained maximum intensity of 35 knots at 1200Z on 12 August.
(2) TS 18W initially tracked northwestward in a weak steering environment between equatorial westerly winds to the south and easterly winds to the north, then began tracking westward in response to a low-level subtropical ridge north of the cyclone. At approximately 0800Z on 13 August, TS 18W made landfall near Infanta, Luzon.
(3) Vertical wind shear and interaction with land caused the cyclone to dissipate over Luzon.
(4) No casualties were reported. Reports indicated property damage from heavy rains.

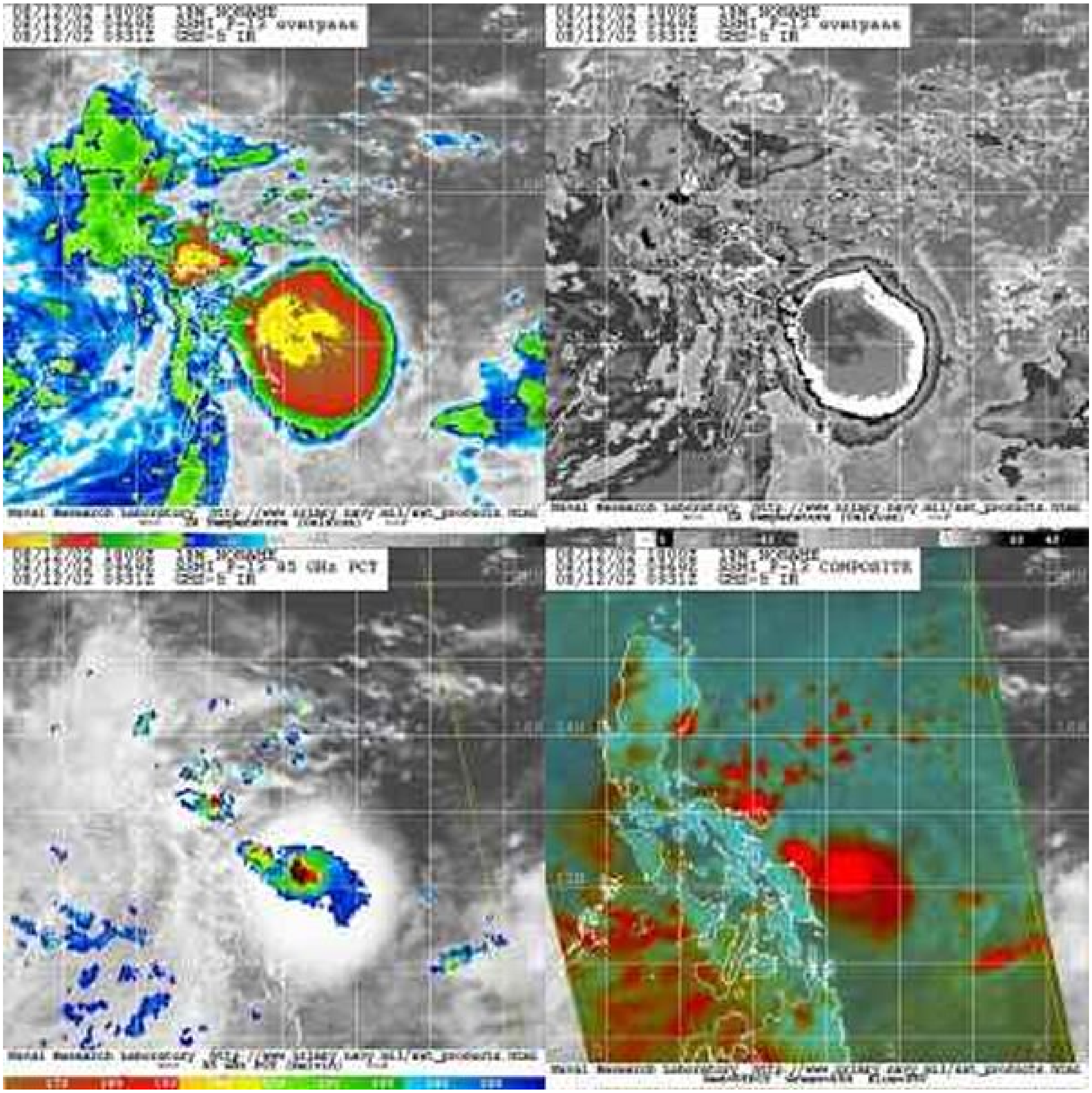
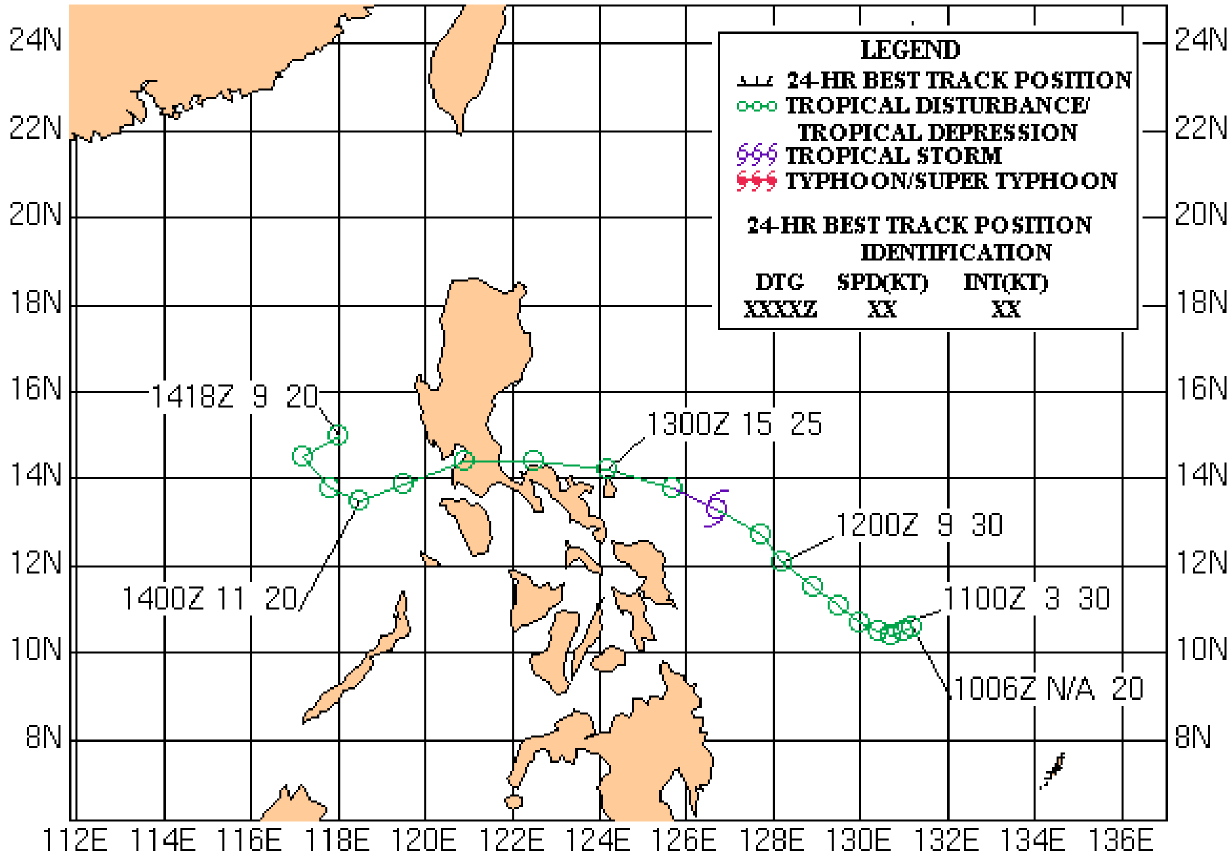
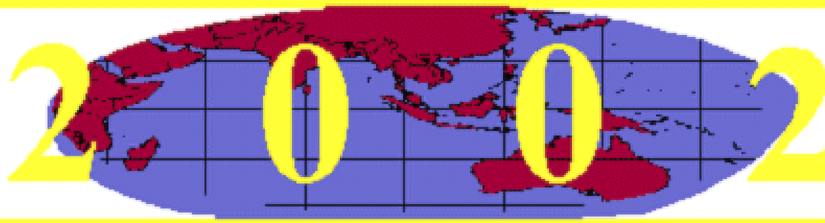


Figure 1-18W-1. 120949Z August 2002 multi-sensor satellite images of TS 18W, located 240nm east of the Philippines, with a maximum intensity of 35 knots.

## TROPICAL STORM 18W
## 10 - 13 AUGUST 2002









# Super Typhoon (STY) 19W (Phanfone)

Verification Statistics

First Poor : 2030Z 06 Aug 02
First Fair : 0600Z 09 Aug 02
First TCFA : 0700Z 10 Aug 02
First Warning : 0000Z 11 Aug 02
Last Warning : 0600Z 20 Aug 02
Max Intensity : 135 kts, gusts to 165 kts
Landfall : None
Total Warnings : 38
Remarks:
(1) STY 19W developed just west of Ujelang Island within the monsoon trough then attained a maximum intensity of 135 knots at 1800Z on 15 August 2002 north of the Mariana Islands.
(2) STY 19W initially tracked westward in the monsoon trough, then tracked northwestward toward Honshu at around 1200Z on 12 August. The cyclone remained on a northwestward track for about six days. On 18 August, an upper level low moving eastward from Japan caused the cyclone to slow, then track northeastward and begin to transition into an extratropical cyclone. STY 19W passed approximately 160 nm south of Tokyo on 19 August 2002 during this northeastward movement.
(3) Moderate vertical wind shear and interaction with the baroclinic zone as the cyclone transitioned into an extratropical cyclone caused STY 19W to dissipate.
(4) As STY 19W traveled south of Honshu, the cyclone produced more than 9 inches of rain and generated winds up to 87 knots. According to the BBC News, four people were reported missing off the coast of Kanagawa Prefecture in rough seas.

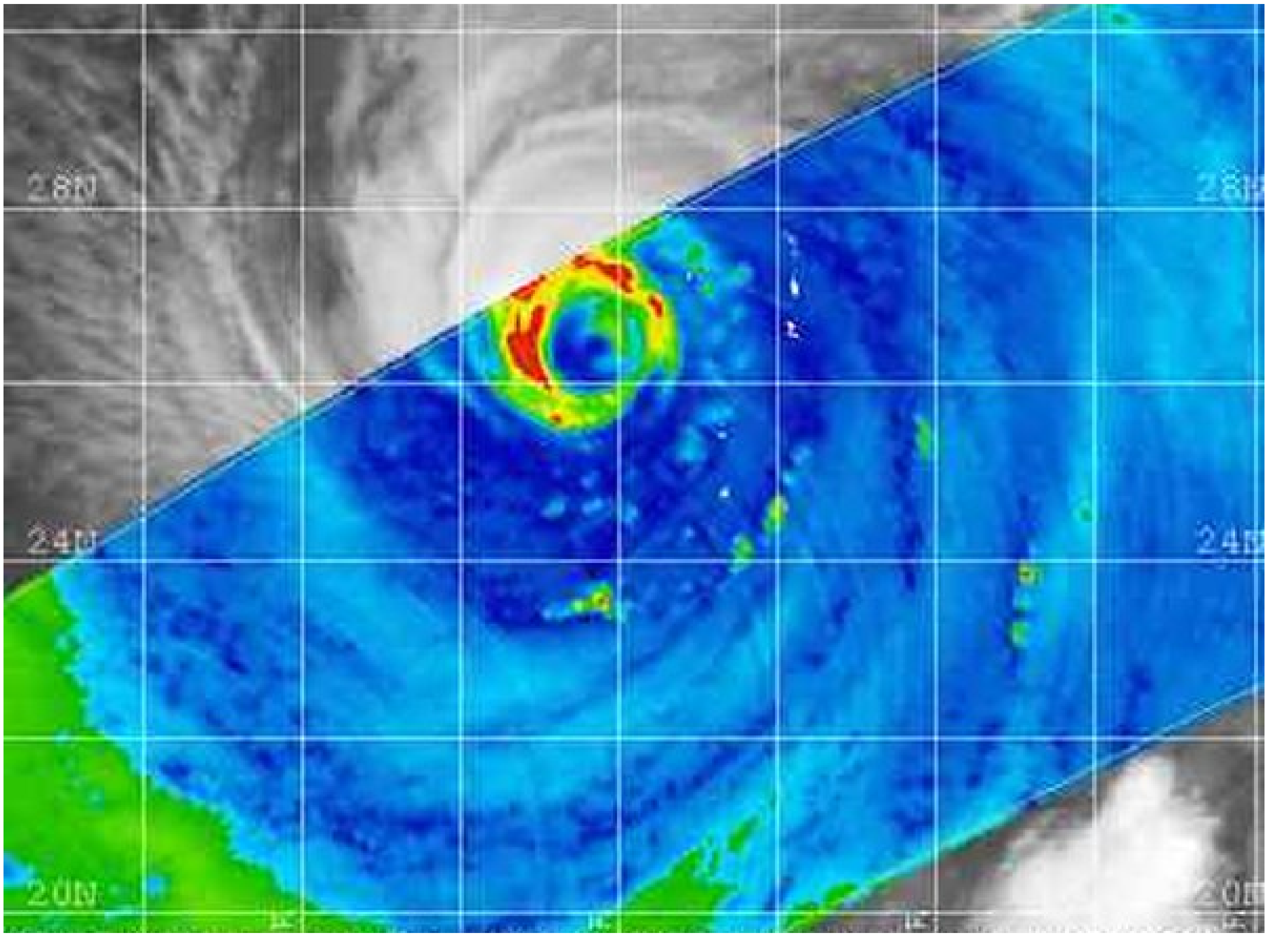
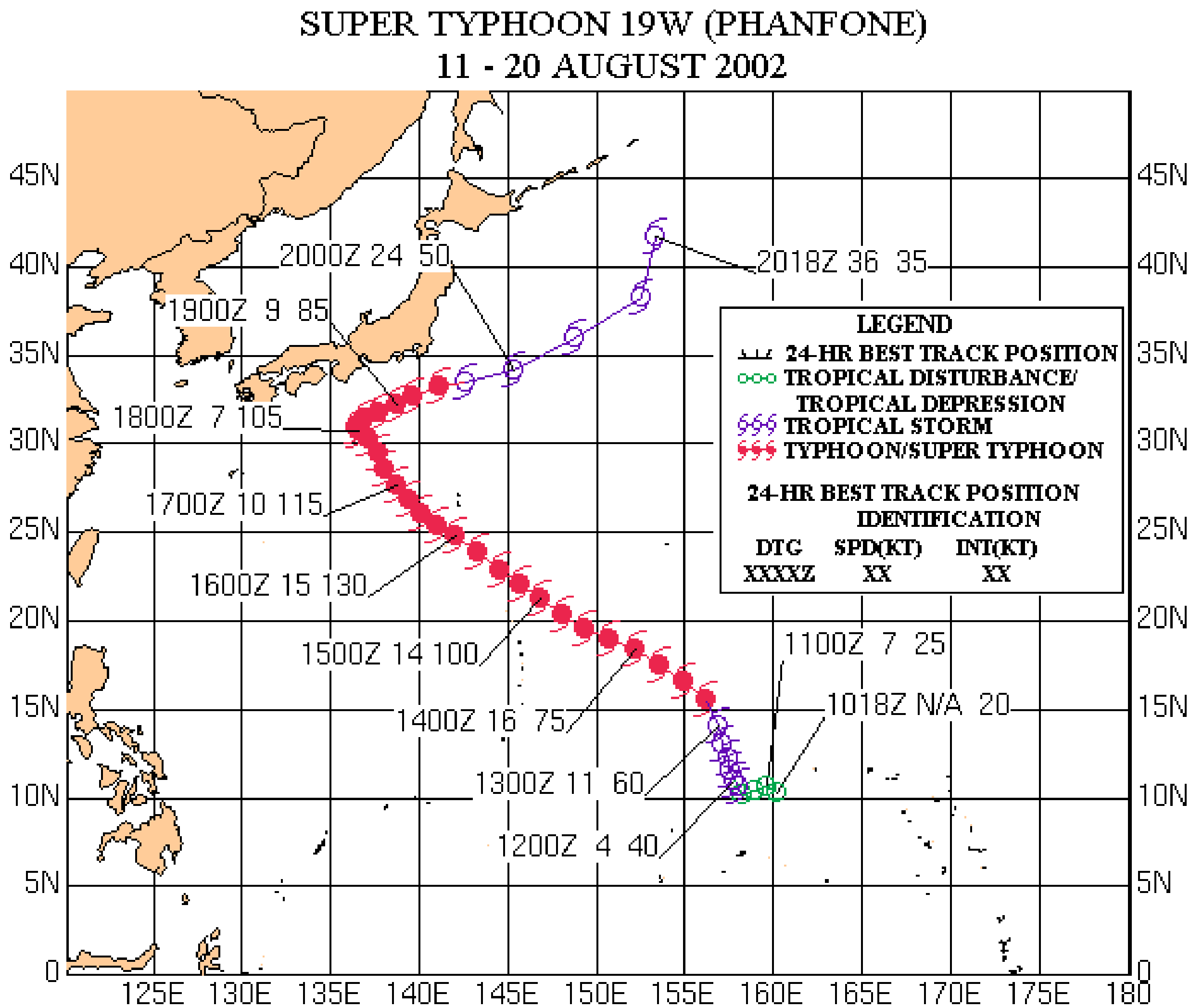



Figure 1-19W-1. 161455Z August 2002 85 GHz TRMM image of STY 19W (Phanfone), located 125 nm northwest of Iwo Jima, with a peak intensity of 130 knots.


SUPER TYPHOON 19W (PHANFONE)
11 - 20 AUGUST 2002
45N
40N
35N
30N
25N
20N
15N
10N
5N
0
125E 130E 135E 140E 145E 150E 155E 160E 165E 170E 175E 180
2000Z 24 50
2018Z 36 35
1900Z 9 85
1800Z 7 105
1700Z 10 115
1600Z 15 130
1500Z 14 100
1400Z 16 75
1300Z 11 60
1200Z 4 40
1100Z 7 25
1018Z N/A 20
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 XX

# Tropical Storm (TS) 20W (Vongfong)

Verification Statistics

First Poor : None
First Fair : 1530Z 13 Aug 02
First TCFA : 0900Z 15 Aug 02
First Warning : 1200Z 15 Aug 02
Last Warning : 0000Z 20 Aug 02
Max Intensity : 55 kts, gusts to 70 kts
Landfall : 2100Z 19 Aug 02
Total Warnings : 19
Remarks:
(1) TS 20W developed in the central South China Sea with the first warning issued at 1200Z 15 August. The system then moved generally northward and attained maximum intensity of 55 knots at 0600Z 19 August just before making landfall near Maoming, China.
(2) At 0000Z 17 August, a surge in the southwest monsoon resulted in convergence and increasing convection in the southwest quadrant. The surge event coincided with improved organization and a shift in track more poleward. A low-level ridge that built across the straits of Taiwan toward China provided additional steering flow as TS 20W tracked north until making landfall at 2100Z 19 August, after which it rapidly dissipated.
(3) No casualties were reported for this cyclone, though minor property damage from heavy precipitation was noted.

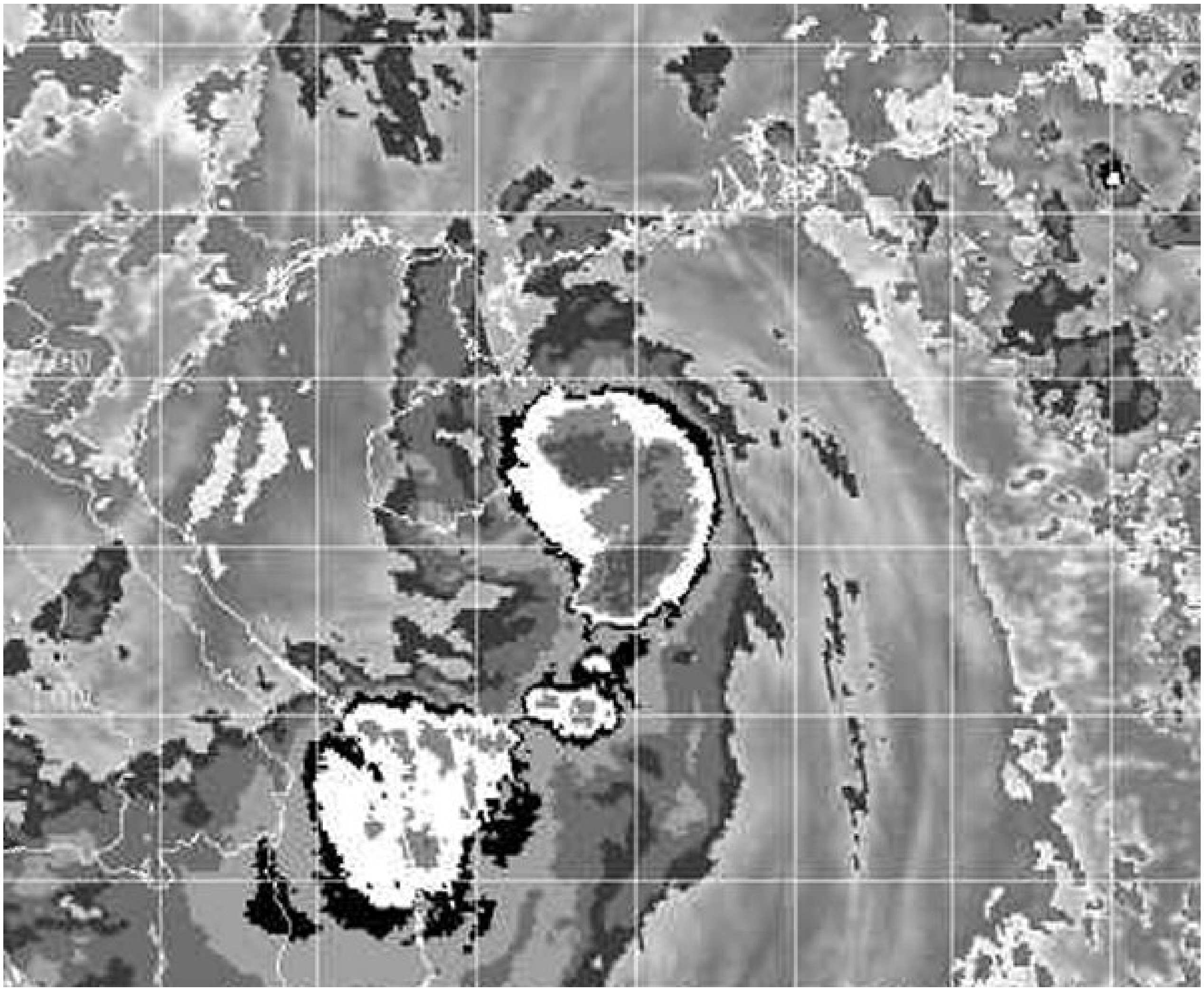
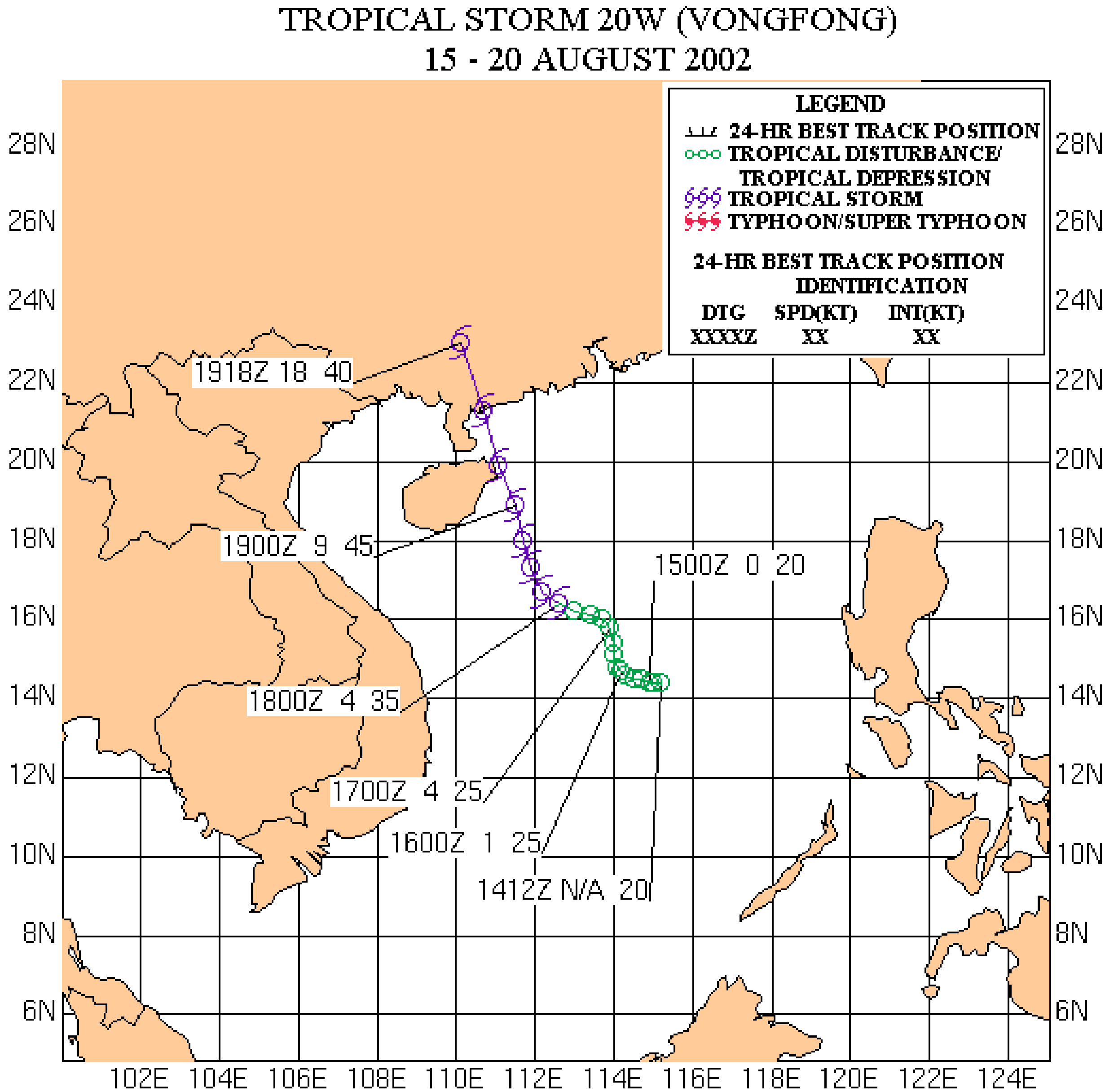


Figure 1-20W-1. 190141Z August 2002 DMSP enhanced infrared imagery TY 20W (Vongfong), located 50nm east of Hainan island, with a peak intensity of 50 knots.


TROPICAL STORM 20W (VONGFONG)
15 - 20 AUGUST 2002
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 XX
1918Z 18 40
1900Z 9 45
1800Z 4 35
1700Z 4 25
1600Z 1 25
1500Z 0 20
1412Z N/A 20
28N
26N
24N
22N
20N
18N
16N
14N
12N
10N
8N
6N
102E 104E 106E 108E 110E 112E 114E 116E 118E 120E 122E 124E

# Typhoon (TY) 21W (Rusa)

Verification Statistics

First Poor : 0230Z 22 Aug 02
First Fair : 0600Z 22 Aug 02
First TCFA : 0930Z 22 Aug 02
First Warning : 1200Z 22 Aug 02
Last Warning : 0600Z 01 Sep 02
Max Intensity : 115 kts, gusts to 140 kts
Landfall : 0630Z 31 Aug 02
Total Warnings : 40
Remarks:
(1) TY 21W developed southwest of Wake Island at the eastern periphery of the monsoon trough. The cyclone tracked northwest toward Okinawa for approximately 8 days before turning toward the Korean Peninsula and subsequently made landfall at approximately 0630Z 31 August near the city of Goheung, South Korea, with maximum sustained winds of 65 knots, gusting to 80 knots.
(2) TY 21W reached a peak intensity of 115 knots on 26 August 2002 near the Bonin Islands and maintained this intensity for 24 hours before beginning a slow weakening trend until landfall in South Korea.
(3) Press reports indicated 113 fatalities and 71 missing in South Korea. TY 21W was the most powerful typhoon to hit South Korea since 1959. A total of 88,625 people in all were evacuated. The province of Gangwon was hit the hardest, where an estimated 36 inches of rain fell in less than 48 hours, flooding nearly 36,000 homes. The Korean Defense ministry reported floodwaters submerged 16 jet fighters and 622 military buildings and facilities at Kangnung airbase. According to Reuters, TY 21W caused 7.2 trillion won (nearly $6 billion U.S.) of damage in South Korea.

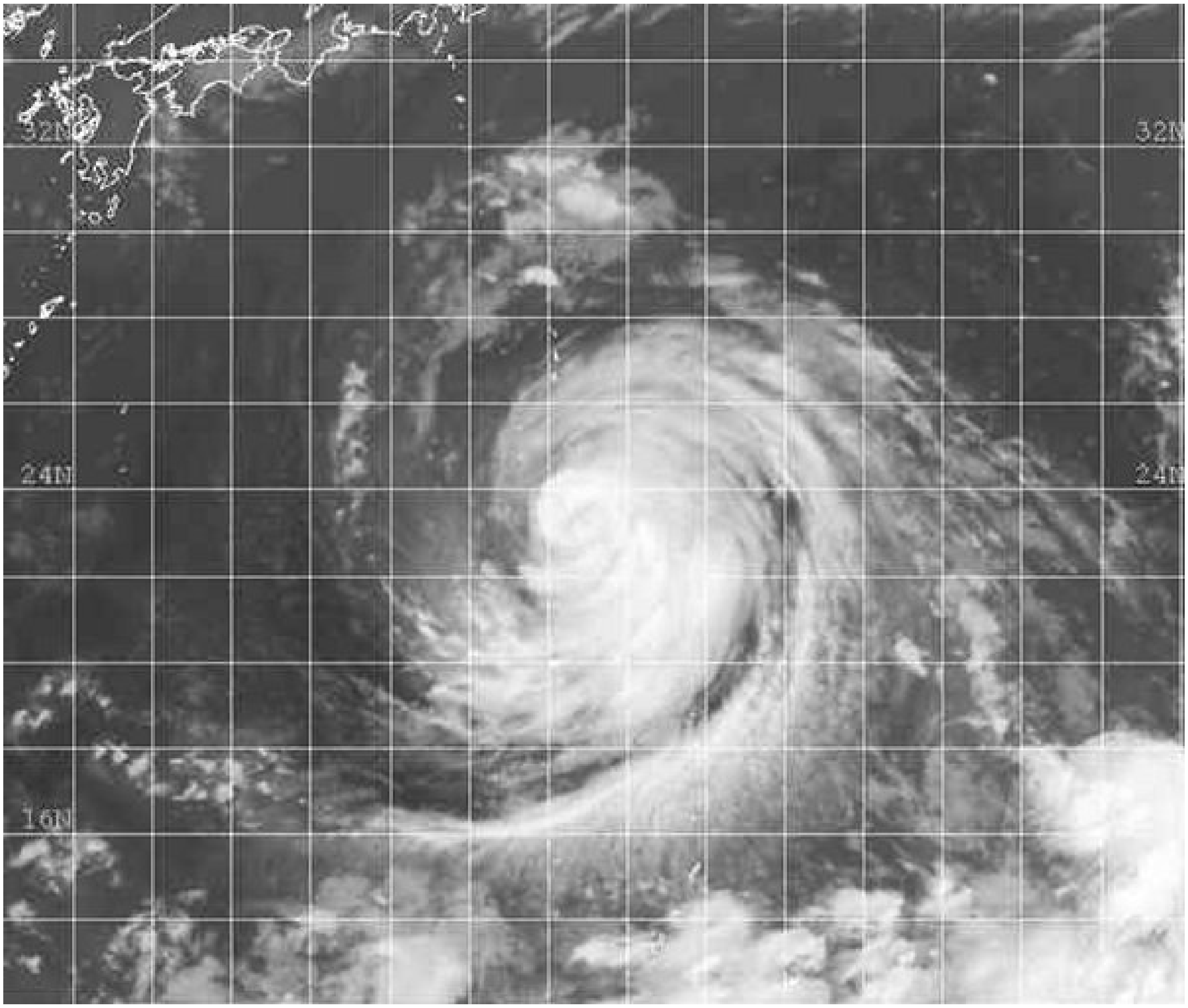
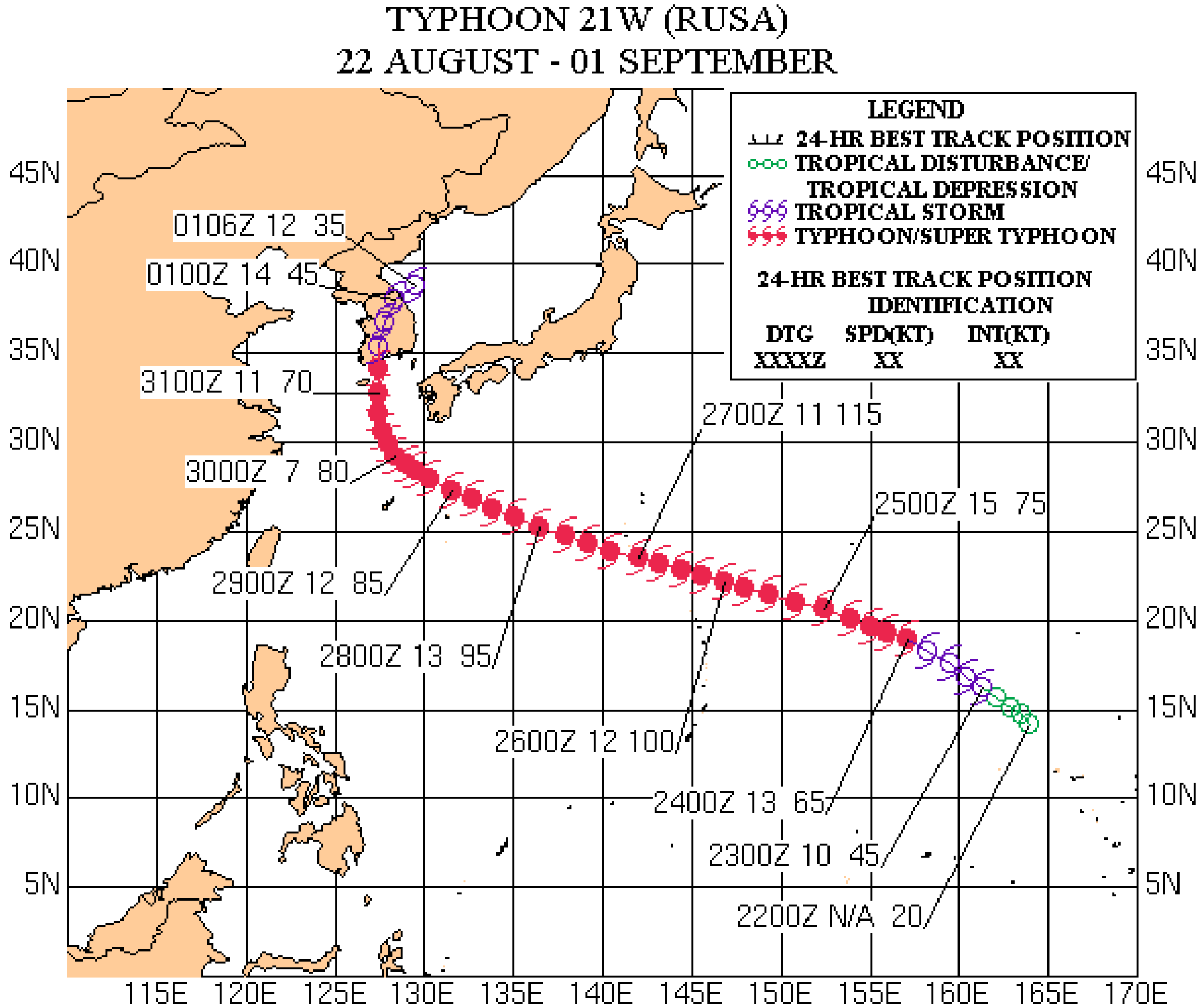



Figure 1-21W-1. 261836Z August 2002 GMS-5 infrared imagery TY 21W (Rusa), located 860nm east of Naha, Japan, with a peak intensity of 115 knots.


TYPHOON 21W (RUSA)
22 AUGUST - 01 SEPTEMBER
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 XX
0106Z 12 35
0100Z 14 45
3100Z 11 70
3000Z 7 80
2900Z 12 85
2800Z 13 95
2700Z 11 115
2600Z 12 100
2500Z 15 75
2400Z 13 65
2300Z 10 45
2200Z N/A 20
45N
40N
35N
30N
25N
20N
15N
10N
5N
115E 120E 125E 130E 135E 140E 145E 150E 155E 160E 165E 170E

# Typhoon (TY) 22W (Sinlaku)

Verification Statistics

First Poor : None
First Fair : 2100Z 26 Aug 02
First TCFA : 1000Z 28 Aug 02
First Warning : 1800Z 28 Aug 02
Last Warning : 0000Z 08 Sep 02
Max Intensity : 110 kts, gusts to 135 kts
Landfall : 1200Z 07 Sep 02
Total Warnings : 42
Remarks:
(1) TY 22W developed east of the Mariana Islands then tracked generally westward. The cyclone attained a maximum intensity of 110 knots as it passed north of the Mariana Islands on 31 August.
(2) TY 22W tracked to the west under the influence of the subtropical ridge east of Japan. TY 22W experienced several intensity fluctuations as it is tracked westward toward China that were attributed to changes in outflow and vertical wind shear conditions. TY 22W passed over southern Okinawa with maximum sustained winds estimated at 95 kts. Satellite fix bulletins reported a 60 nm eye feature as the system passed over Okinawa. Two days later, the cyclone had weakened to 70 kts as it passed to the north of Taiwan.
(3) Increasing vertical wind shear associated with an upper level ridge situated over China weakened TY 22W before making landfall. TY 22W rapidly dissipated over land in the Fujian Province, China.
(4) TY 22W caused significant damage on Okinawa and Taiwan. Reports indicated that Kadena airbase suffered total damages of 2.7 million dollars for base facilities and $942,000 for military family housing. Press reports indicate 200 households were left without water and 170 without power on Taiwan. Press also reported two dead from TY 22W in Taiwan.

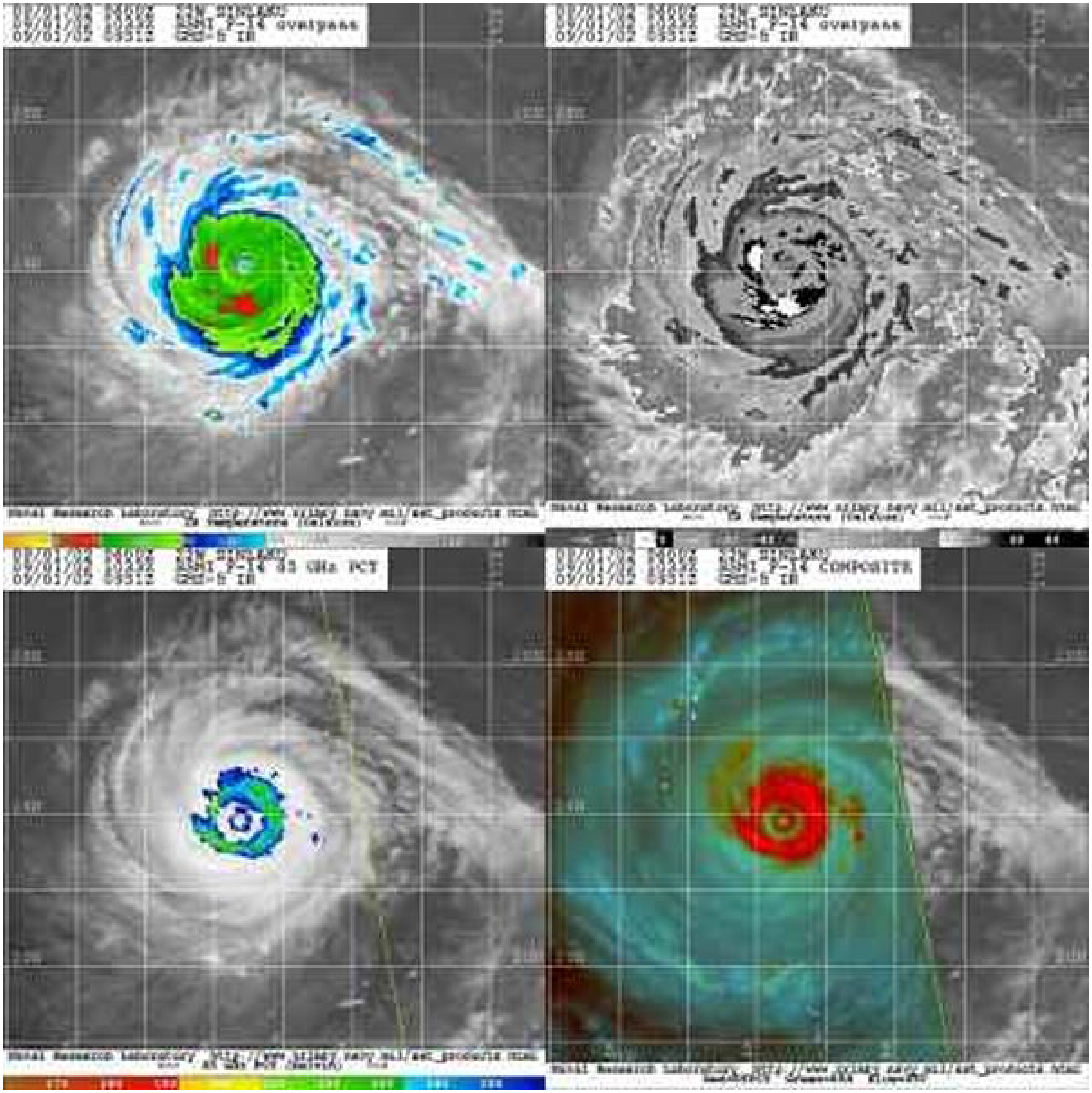


Figure 1-22W-1. 011033Z September 2002 multi-sensor satellite image of TY 22W (Sinlaku), 174 nm east of Iwo Jima, with a peak intensity of 115 knots.

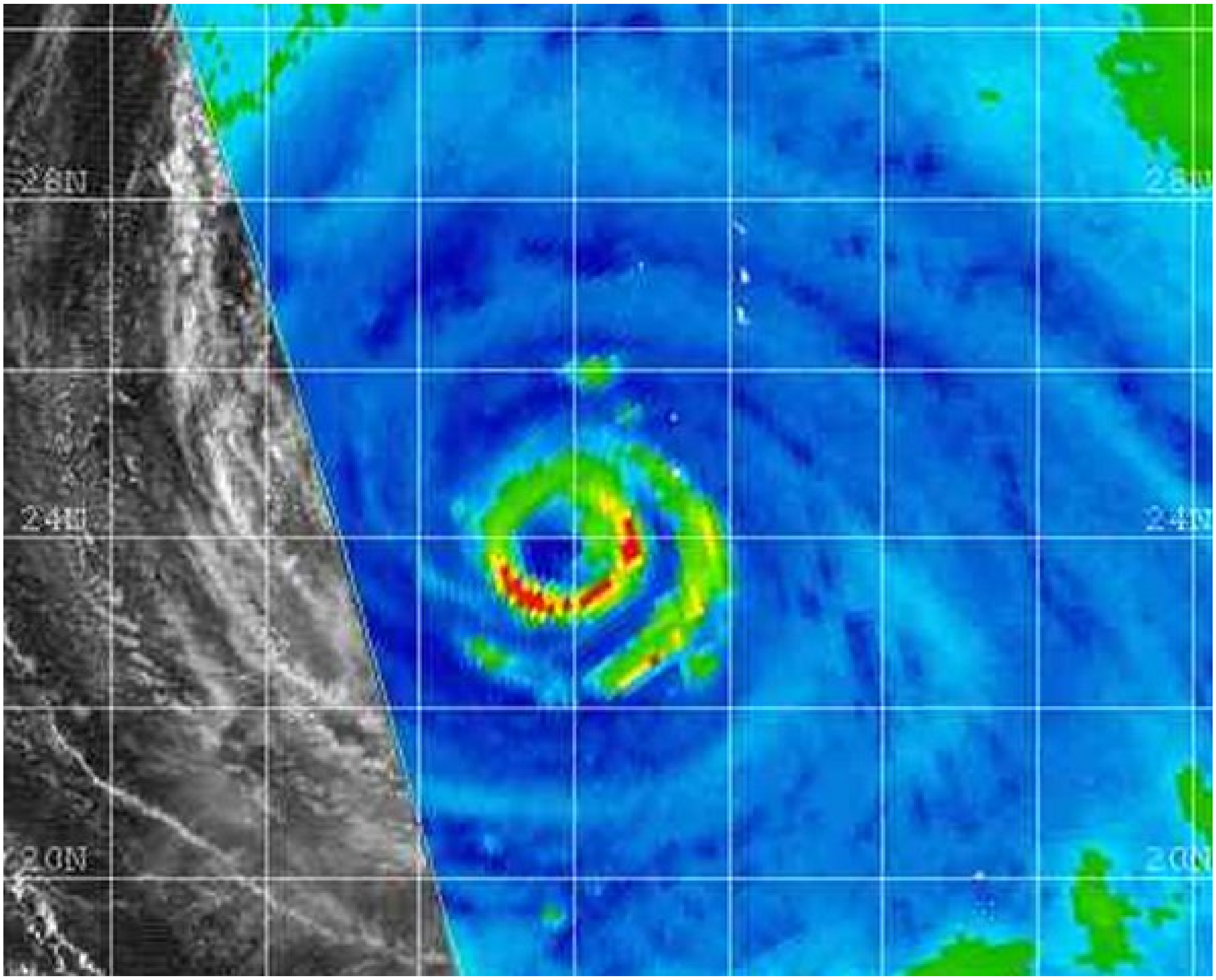
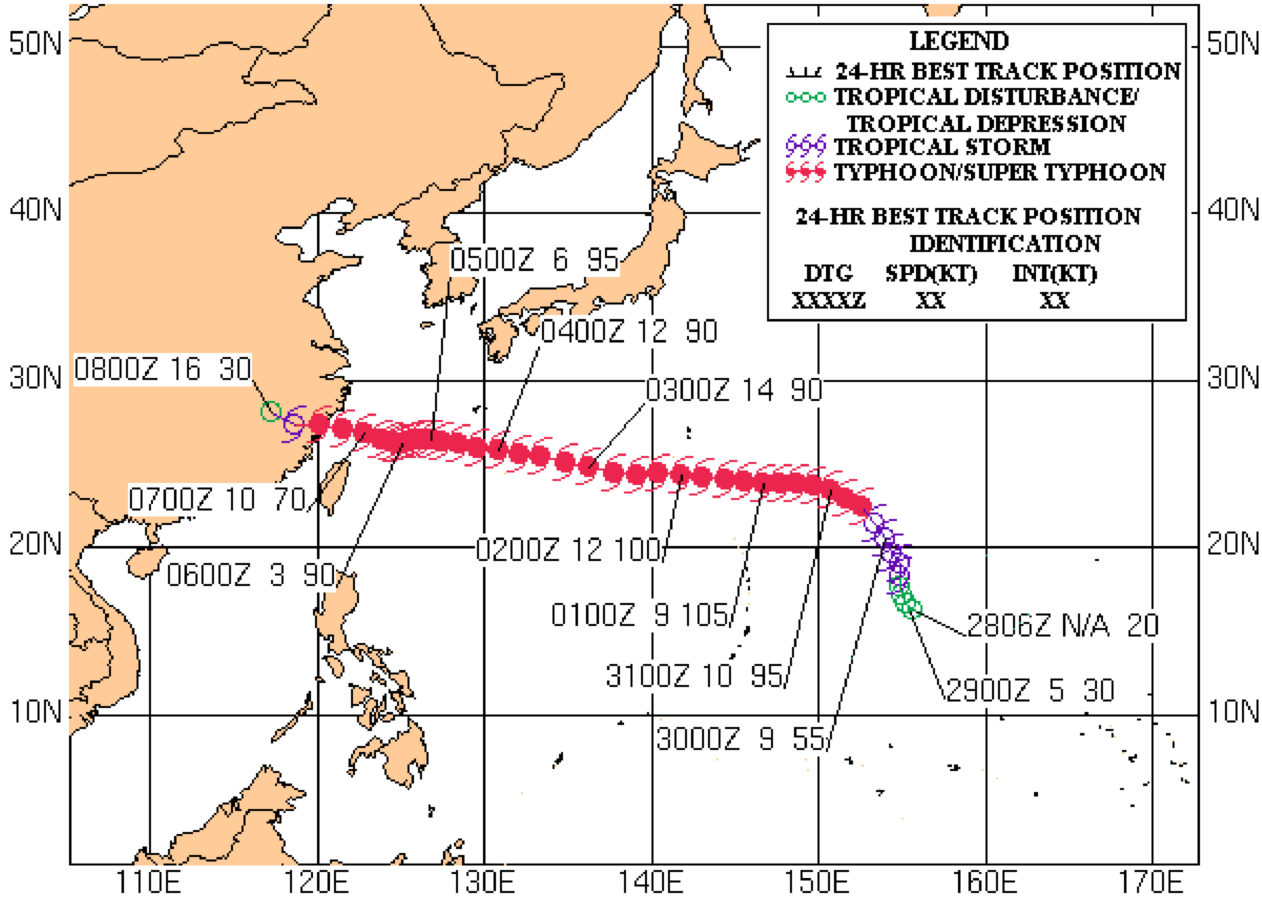



Figure 1-22W-2. 020824Z September 2002 SSM/I imagery of TY 22W (Sinlaku), 120 nm west of Iwo Jima, with a maximum intensity of 95 knots.

# TYPHOON 22W (SINLAKU)
## 28 AUGUST-08 SEPTEMBER 2002



# Tropical Storm (TS) 23W (Hagupit)

Verification Statistics

First Poor : 0600Z 08 Sep 02
First Fair : 1400Z 09 Sep 02
First TCFA : 1930Z 09 Sep 02
First Warning : 0000Z 10 Sep 02
Last Warning : 0600Z 12 Sep 02
Max Intensity : 45 kts, gusts to 55 kts
Landfall : 1930Z 11 Sep 02
Total Warnings : 10
Remarks:
(1) TS 23W formed near 19 N 119 E, approximately 320 nm east-southeast of Hong Kong, attained maximum intensity of 45 knots at 1200Z 11 September before making landfall about 110 miles west of Hong Kong and rapidly dissipating.
(2) TS 23W was steered west-northwestward by a low to mid level ridge located over central China.
(3) Reports in the press indicated that authorities in China shut down various government offices, the stock exchange, banks and other institutions. Reports further indicated 32 people were hurt, with 5 people being admitted to hospitals. Press reports also indicated 25 crewmembers from 2 fishing vessels were rescued by helicopters, and 41 inbound and outbound flights at Hong Kong’s Chek Lap Kok airport were cancelled due to this cyclone.

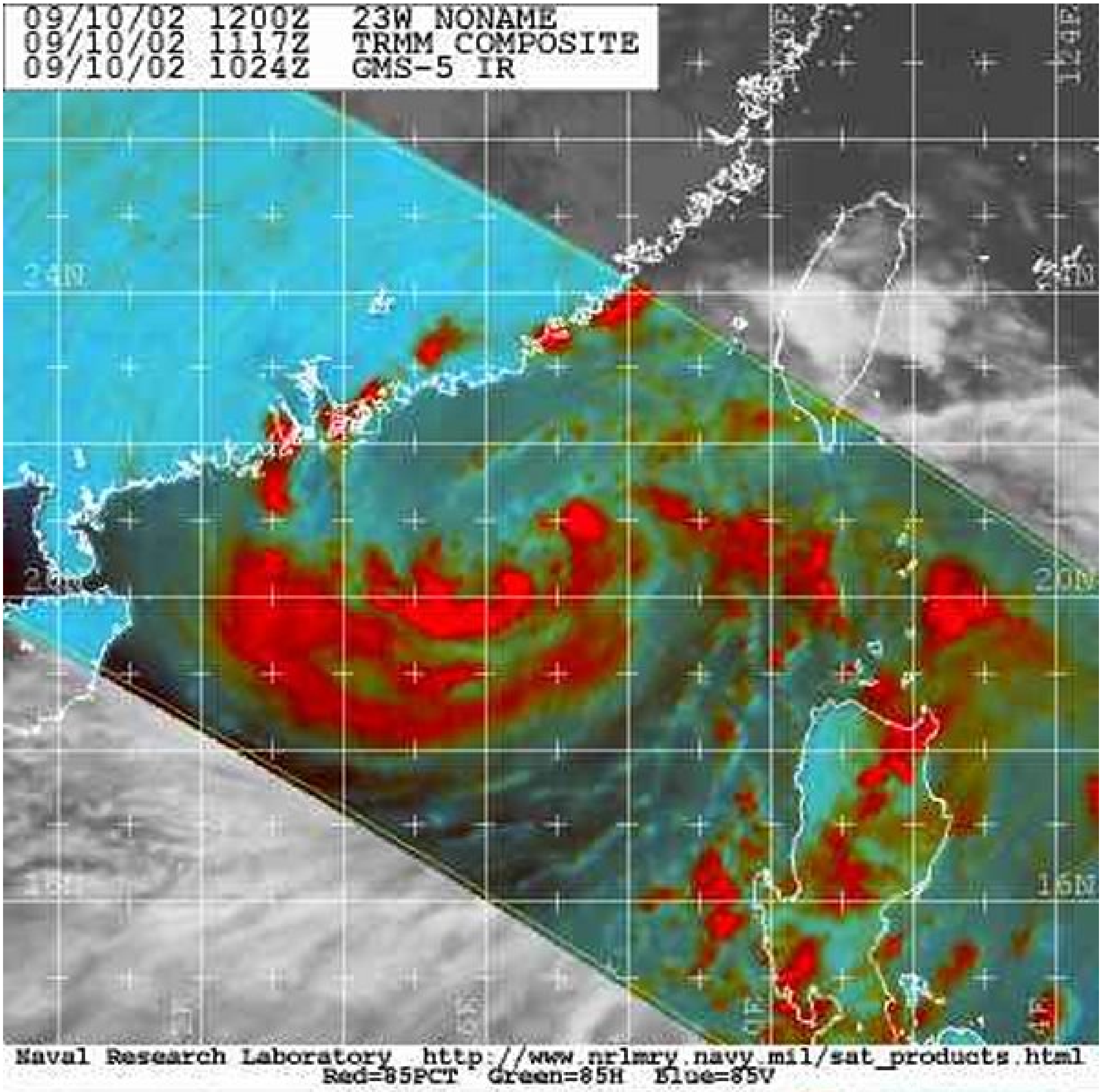
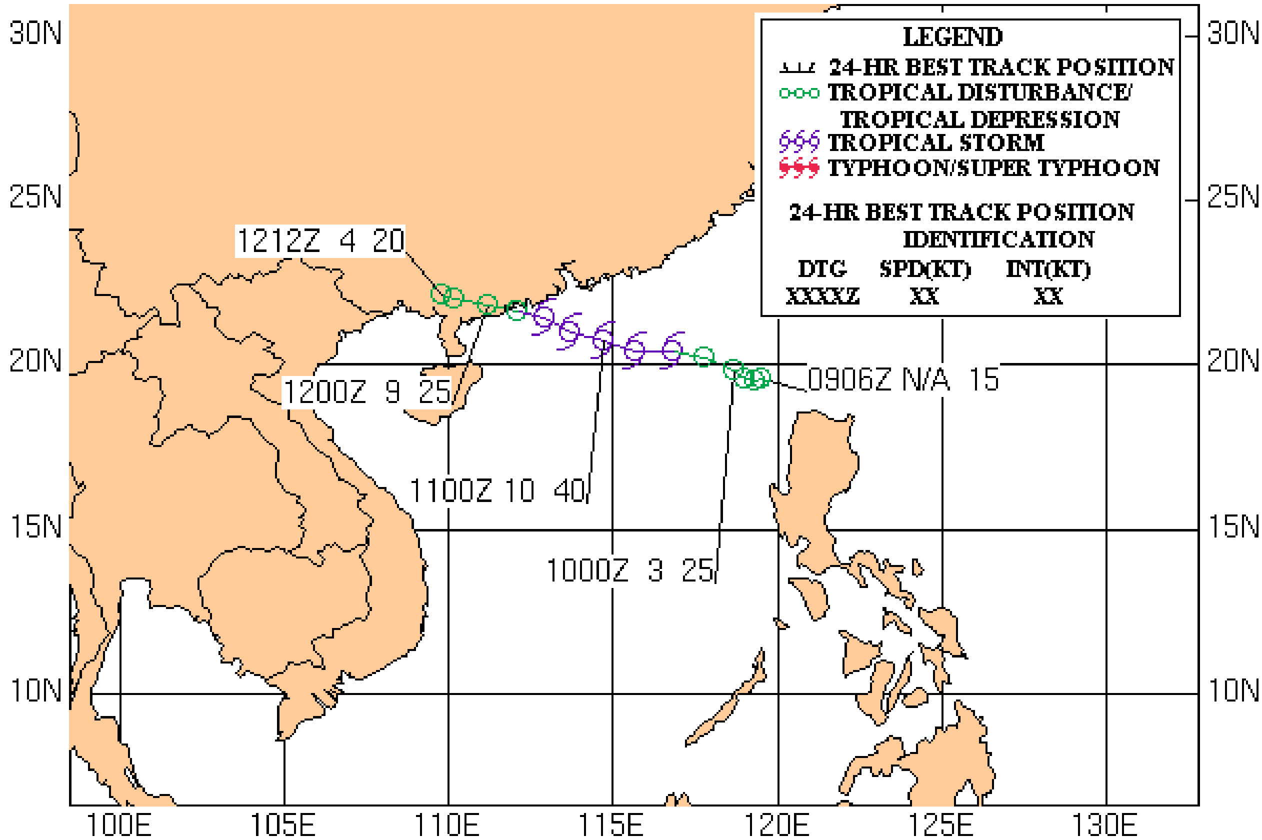



Figure 1-23W-1. 101117Z September 2002 color 85 TRMM composite image of TY 23W (Hagupit), 100 nm southeast of Hong Kong, with a peak intensity of 30 knots.

# TROPICAL STORM 23W (HAGUPIT)
## 10-12 SEPTEMBER 2002



# Tropical Storm (TS) 24W (Mekkhala)

Verification Statistics

First Poor : 0600Z 21 Sep 02
First Fair : 0600Z 22 Sep 02
First TCFA : 0900Z 22 Sep 02
First Warning : 1200Z 23 Sep 02
Last Warning : 0600Z 27 Sep 02
Max Intensity : 55 kts, gusts to 70 kts
Landfall : 1800Z 25 Sep 02
Total Warnings : 16
Remarks:
(1) TS 24W developed in the South China Sea and tracked northwestward toward Hainan Island. The cyclone attained a maximum intensity of 55 knots just prior to passing over Hainan Island at 1200Z on 25 September.
(2) A low to mid-level ridge near Luzon provided the poleward steering influence to TS 24W. After passing over Hainan Island, TS 24W moved into the Gulf of Tonkin and began to weaken in response to increased vertical wind shear. TS 24W dissipated along the coast near Gang City, China
(3) Final dissipation occurred as a result of the vertical wind shear, poor outflow conditions and land interference.
(4) Press provided no reports of storm damage.

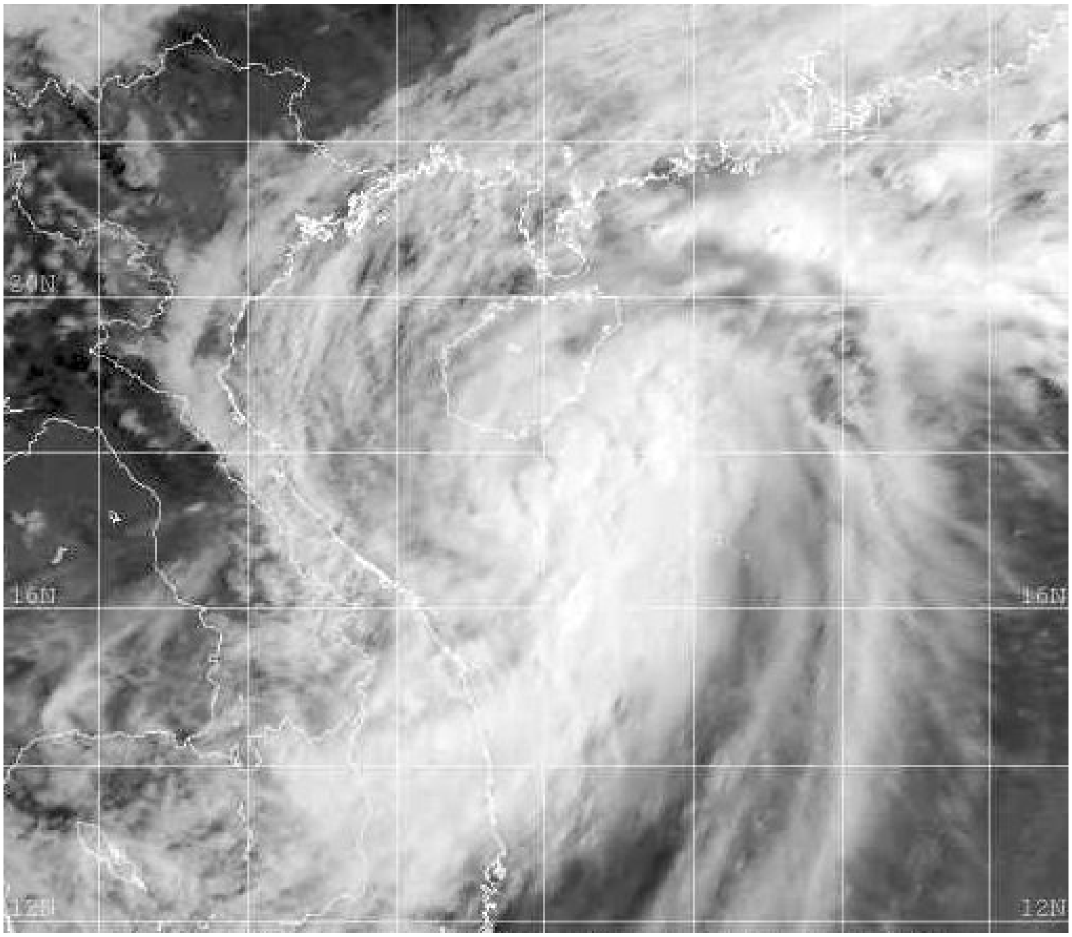



Figure 1-24W-1. 250130Z September 2002 MET-5 visible image of TS 24W (Mekkhala), located 30 nm south of Hainan island, with an estimated intensity of 55 knots.

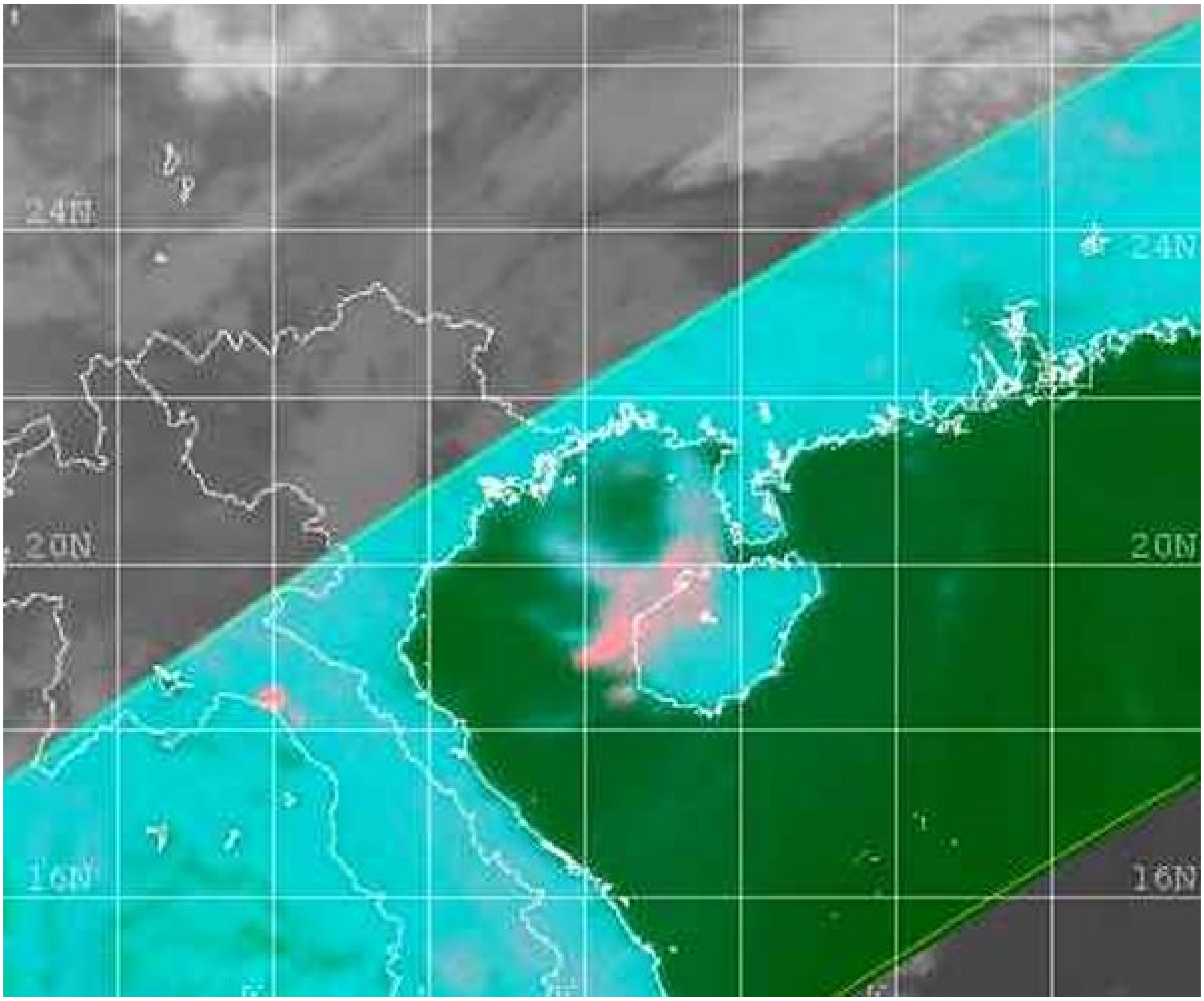
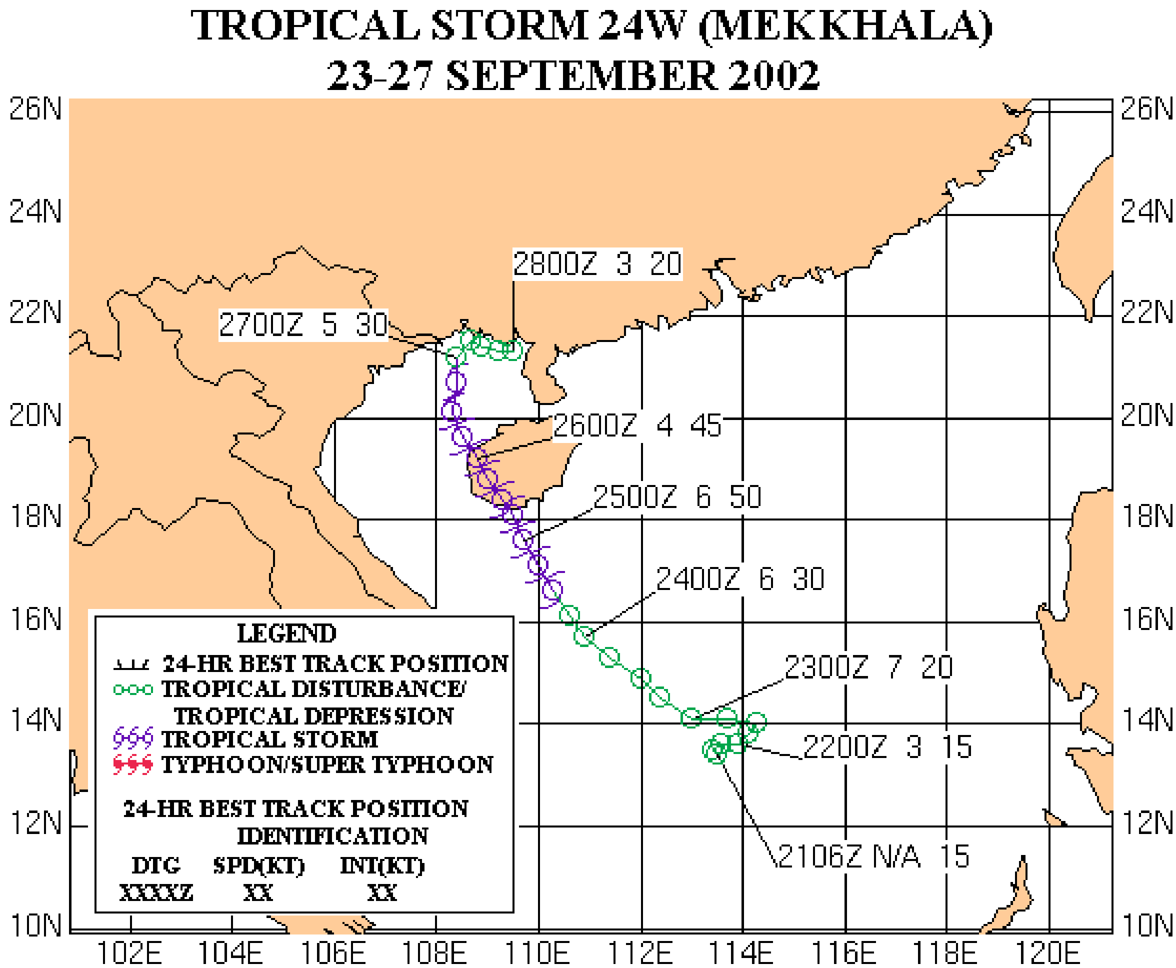



Figure 1-24W-2. 261929Z September 2002 37 GHz TRMM image of TS 24W (Mekkhala), revealing an exposed low level circulation, located 55 nm northwest of Hainan island, with an estimated intensity of 35 knots.


TROPICAL STORM 24W (MEKKHALA)
23-27 SEPTEMBER 2002
26N
24N
22N
20N
18N
16N
14N
12N
10N
102E
104E
106E
108E
110E
112E
114E
116E
118E
120E
2800Z 3 20
2700Z 5 30
2600Z 4 45
2500Z 6 50
2400Z 6 30
2300Z 7 20
2200Z 3 15
2106Z N/A 15
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
XX

# Super Typhoon (STY) 25W (Higos)

Verification Statistics

First Poor : 0600Z 25 Sep 02
First Fair : 2230Z 25 Sep 02
First TCFA : 0630Z 26 Sep 02
First Warning : 0600Z 26 Sep 02
Last Warning : 0600Z 02 Oct 02
Max Intensity : 135 kts, gusts to 165 kts
Landfall : 1100Z 01 Oct 02
Total Warnings : 25
Remarks:
(1) STY 25W developed approximately 500 nm east the Mariana Islands on 26 September and attained maximum intensity of 135 knots at 1200Z 29 September, coincident with a northward turn into a weakness in the subtropical ridge.
(2) The system tracked rapidly west-northwestward after developing, steered by the subtropical ridge feature centered east of Japan. A longwave trough propagating eastward from the Yellow Sea influenced the steering pattern and resulted in a sharp poleward turn and aided in intensification. After recurvature, STY 25W continued northward toward Tokyo, Japan, and began to slowly weaken due to increasing vertical wind shear. Synoptic and radar fixes indicated that the cyclone made landfall at (approximately) 1100Z 01 October, near Yokosuka, Japan, with max sustained winds reported at 51 knots.
(3) STY 25W continued to track northward over Honshu toward Hokkaido for 18 hours, weakening slightly and undergoing extratropical transition. The system completed extratropical transition at 0600Z 02 October.
(4) STY 25W caused 4 deaths and injured 55 people in Tokyo as a result of heavy rains and high winds. As the system tracked northward over Hokkaido, it weakened to a tropical depression, but still caused 5 deaths and left thousands without power. STY 25W was the third strongest typhoon to strike Tokyo since World War II.
(5) Post-analysis of the cyclone and effects to the NAVPACMETOCCEN Yokosuka authored by Mr. Steven Ahn of NAVPACMETOCCEN Yokosuka is included in Chapter 6 of this report.

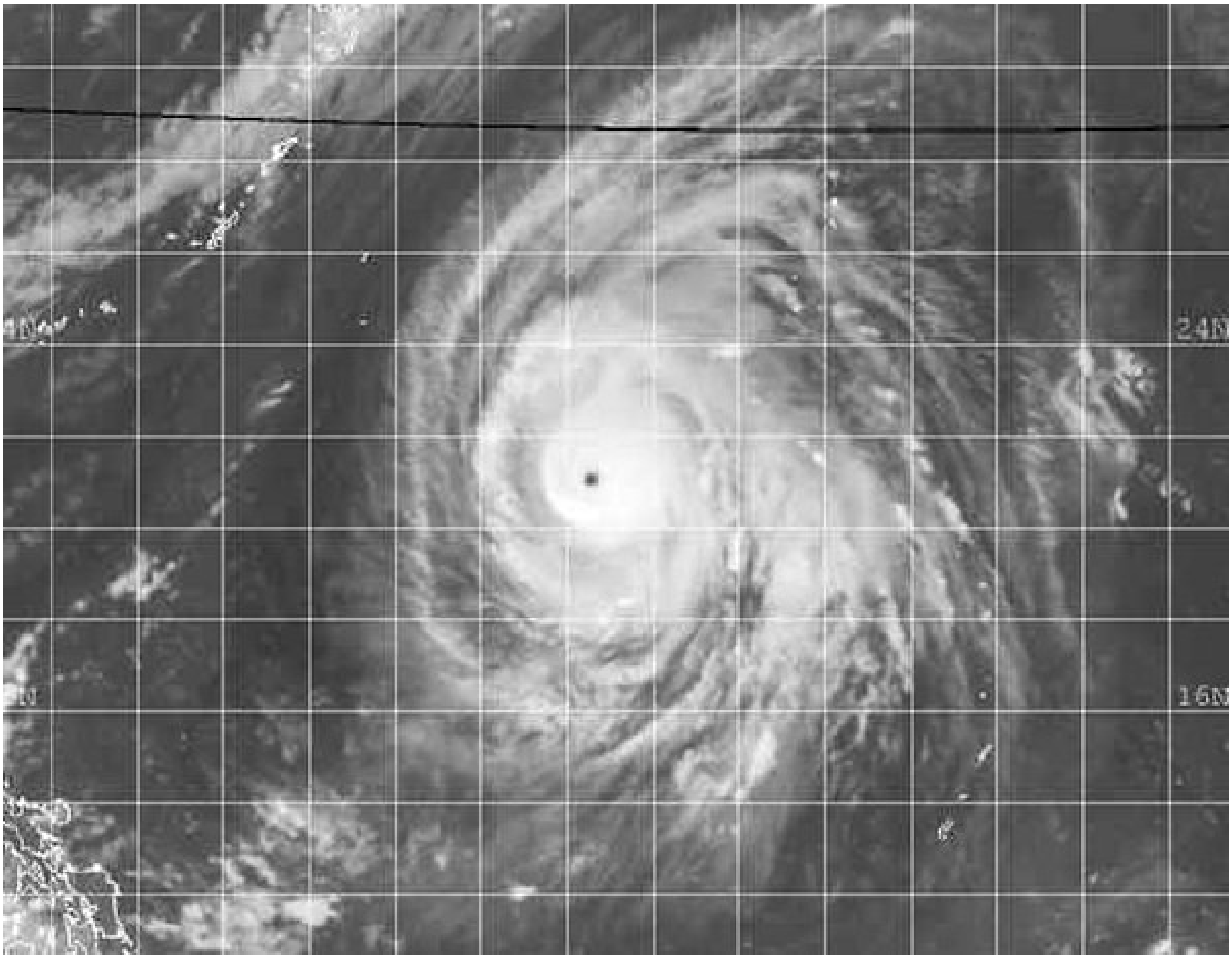



Figure 1-25W-1. 291231Z September 2002 GMS-5 infrared imagery of STY 25W (Higos), located 340 nm southwest of Iwo Jima, with a maximum intensity of 135 knots.

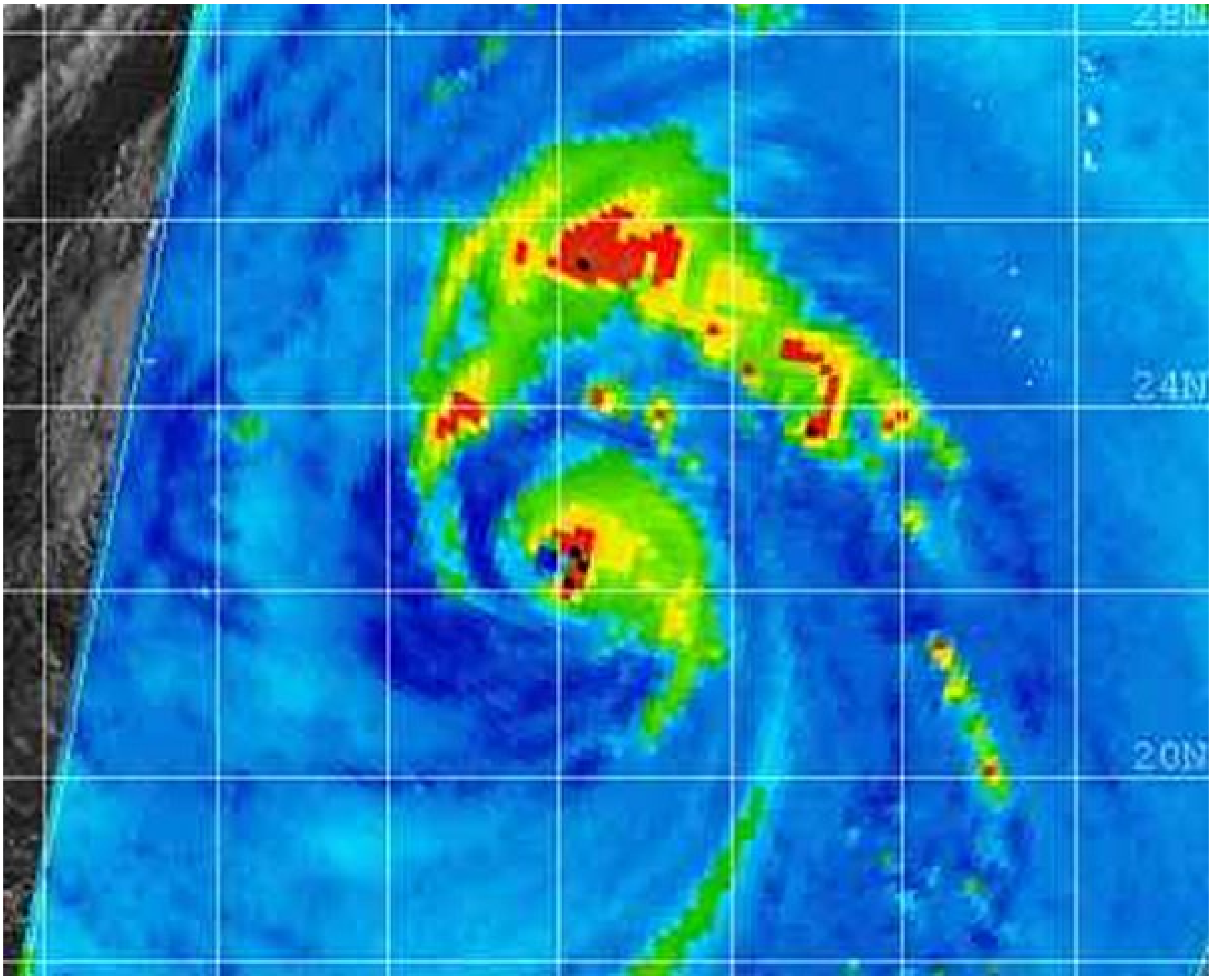
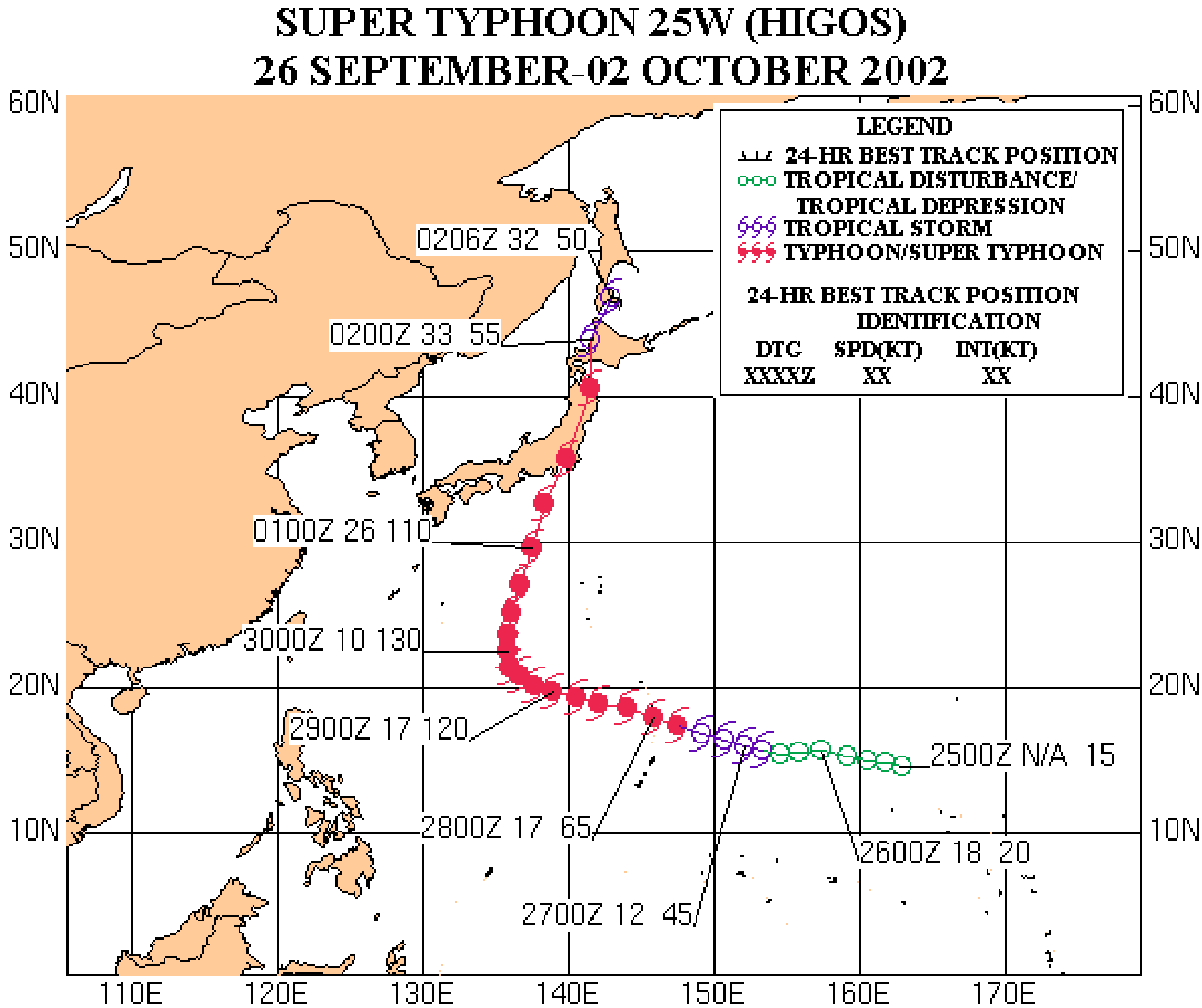



Figure 1-25W-2. 292316Z September 2002 85 GHz SSM/I imagery of STY 25W (Higos), located 348 nm southwest of Iwo Jima, with an estimated intensity of 130 knots.


SUPER TYPHOON 25W (HIGOS)
26 SEPTEMBER-02 OCTOBER 2002
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 XX
0206Z 32 50
0200Z 33 55
0100Z 26 110
3000Z 10 130
2900Z 17 120
2800Z 17 65
2700Z 12 45
2600Z 18 20
2500Z N/A 15
60N
50N
40N
30N
20N
10N
110E
120E
130E
140E
150E
160E
170E

Print Friendly (PDF)



# Typhoon (TY) 26W (Bavi)

Verification Statistics

First Poor : 0600Z 05 Oct 02
First Fair : 0600Z 07 Oct 02
First TCFA : 2000Z 07 Oct 02
First Warning : 0600Z 09 Oct 02
Last Warning : 0600Z 14 Oct 02
Max Intensity : 70 kts, gusts to 85 kts
Landfall : None
Total Warnings : 21
Remarks:
(1) TY 26W developed in the western Marshall Islands, then tracked westward toward Guam for three days before turning north. TY 26W attained maximum intensity of 70 knots at 1800Z 12 October east of the Bonin Islands..
(2) TY 26W initially moved to the west under the influence of a mid to low-level ridge. A passing mid-lat trough weakened this ridge feature, and TY 26W moved poleward into this weakness. After turning poleward, the system continued on a northward track for approximately three days before interacting with the mid-latitude westerlies while still east of Japan. In these last moments, TY 26W accelerated to the northeast.
(3) TY 26W underwent extratropical transition and weakened as it interacted with the baroclinic zone.
(4) There were no casualties reported.

TD 15W Kalmaegi
TS 16W Kammuri
TD 17W
TS 18W
STY19W Phanfone
TS 20W Vongfong
TY 21W Rusa
TY 22W Sinlaku
TS 23W Hagupit
TS 24W Mekkhala
STY25W Higos
TY 26W Bavi
TD 27W
TD 28W
TS 29W Maysak
TY 30W Haishen
STY31W Pongsona
HUR02C Ele
HUR03C Huko
TC 01A
TC 02B
TC 03B
TC 04B
TC 05B

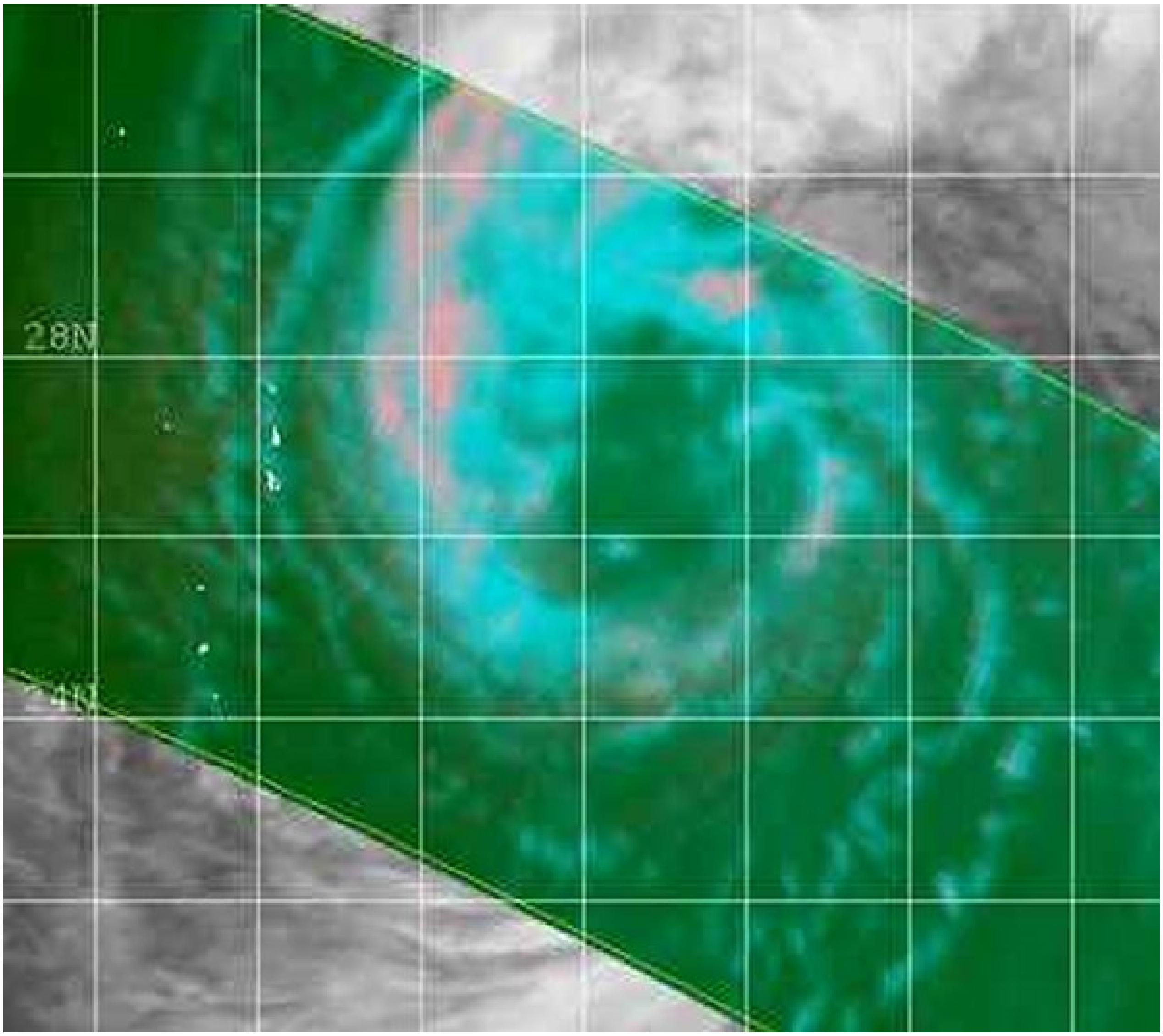
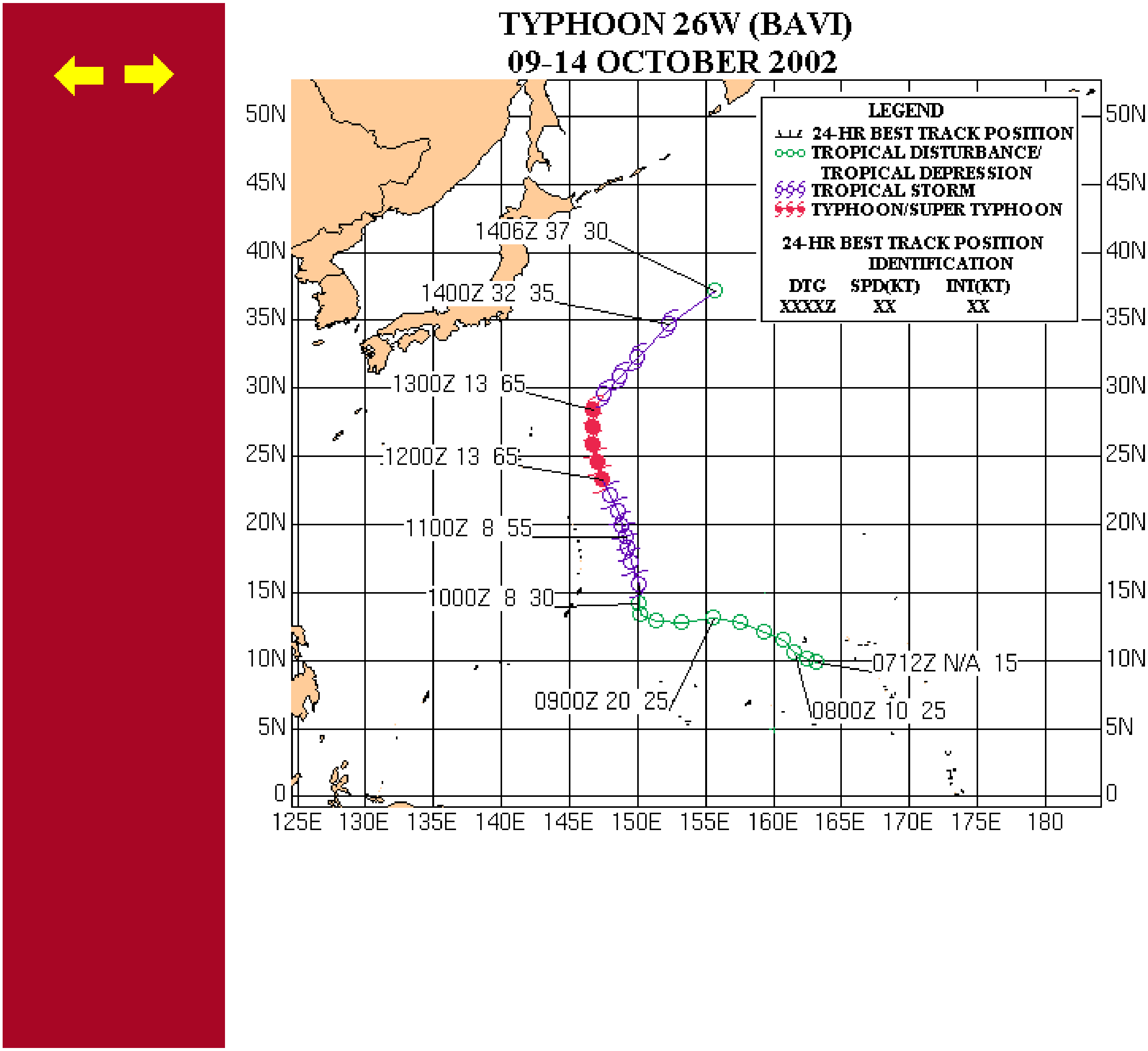



Figure 1-26W-1. 121611Z October 2002 37 GHz TRMM image of TY 26W (Bavi), revealing a large exposed low level circulation, located 313 nm east of Iwo Jima, with an estimated intensity of 70 knots.


TYPHOON 26W (BAVI)
09-14 OCTOBER 2002
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 XX
1406Z 37 30
1400Z 32 35
1300Z 13 65
1200Z 13 65
1100Z 8 55
1000Z 8 30
0900Z 20 25
0800Z 10 25
0712Z N/A 15
50N
45N
40N
35N
30N
25N
20N
15N
10N
5N
0
125E 130E 135E 140E 145E 150E 155E 160E 165E 170E 175E 180

# Tropical Depression (TD) 27W

Verification Statistics

First Poor : 0100Z 16 Oct 02
First Fair : 0600Z 16 Oct 02
First TCFA : 1200Z 16 Oct 02
First Warning : 0000Z 17 Oct 02
Last Warning : 0600Z 19 Oct 02
Max Intensity : 30 kts, gusts to 40 kts
Landfall : None
Total Warnings : 10
Remarks:
(1) TD 27W formed approximately 660 nm east-northeast of Saipan, tracked west-northwestward, then attained maximum intensity of 30 knots at 0000Z 18 October before dissipating in the Northern Mariana Islands.
(2) TD 27W moved westward under the steering influence of the subtropical ridge north of the system.
(3) Moderate vertical shear, weak outflow and dry air entrainment caused the cyclone to dissipate.
(4) No casualties were reported with this system.

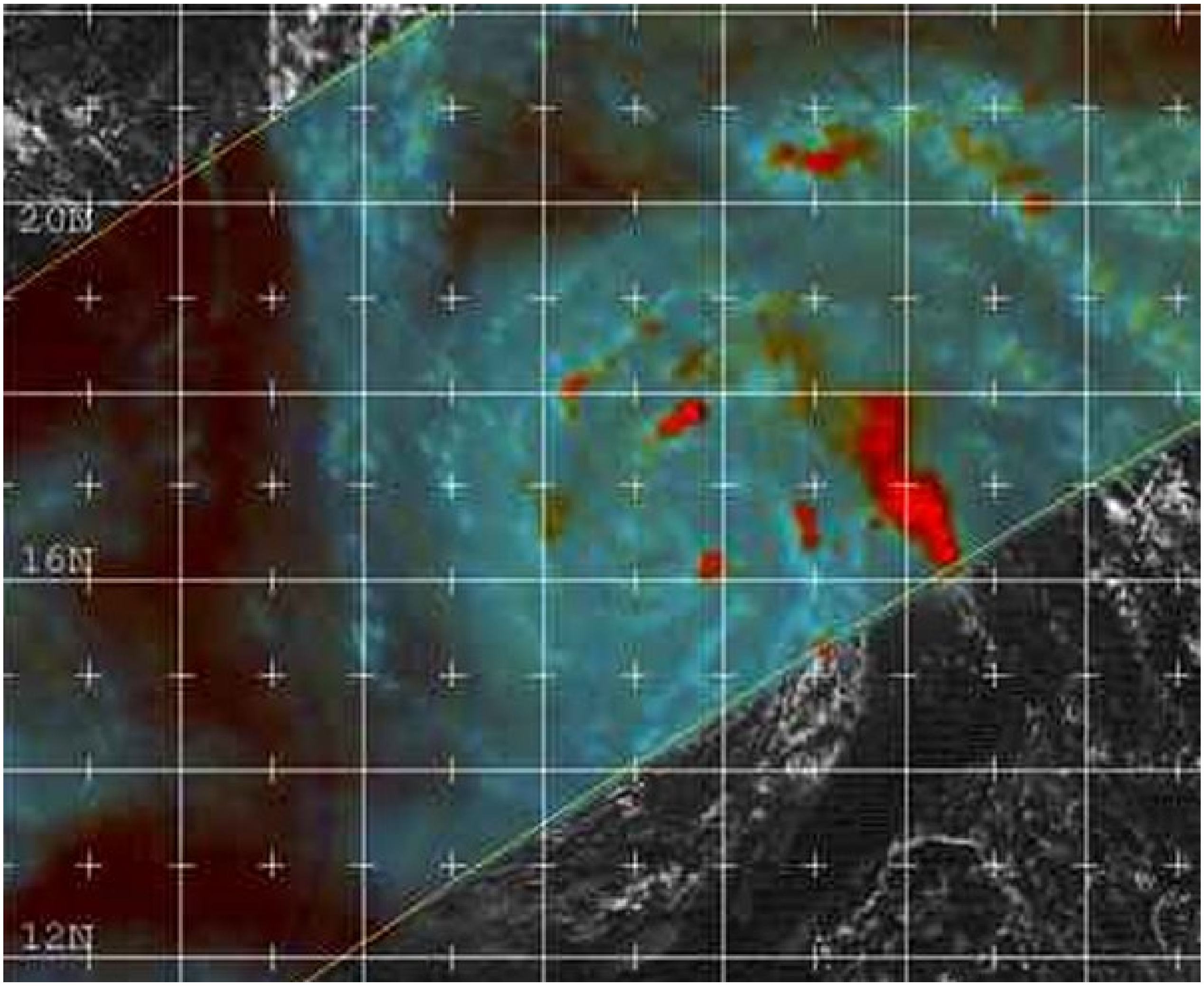
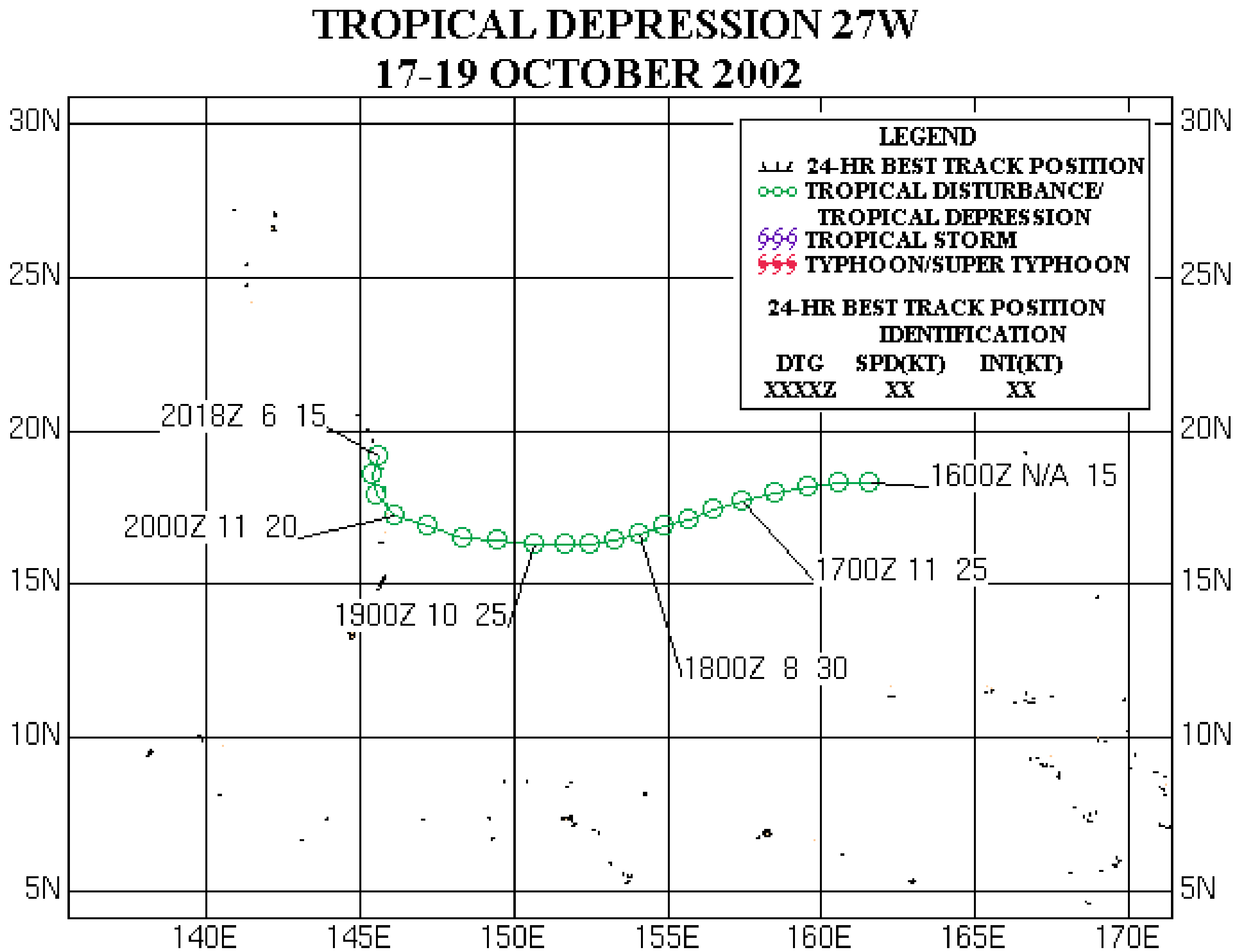



Figure 1-27W-1. 180544Z October 2002 85 GHz TRMM image of TD 27W (No Name), revealing an exposed low level circulation, located 447 nm east of Saipan, with an estimated intensity of 30 knots.


TROPICAL DEPRESSION 27W
17-19 OCTOBER 2002
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 XX
2018Z 6 15
2000Z 11 20
1900Z 10 25
1800Z 8 30
1700Z 11 25
1600Z N/A 15
30N
25N
20N
15N
10N
5N
140E
145E
150E
155E
160E
165E
170E

# Tropical Depression (TD) 28W

Verification Statistics

First Poor : 1300Z 17 Oct 02
First Fair : 1500Z 17 Oct 02
First TCFA : 1900Z 17 Oct 02
First Warning : 0000Z 18 Oct 02
Last Warning : 0600Z 19 Oct 02
Max Intensity : 30 kts, gusts to 40 kts
Landfall : None
Total Warnings : 06
Remarks:
(1) At 0000Z 18 October the first warning was issued with an intensity of 30 knots. Post analysis indicates that TD 28W probably formed near 13 N 177 E approximately 18 hours before the first warning was issued. The system only marginally developed and quickly dissipated after attaining an estimated maximum intensity of 30 knots at 0600Z 18 October.
(2) TD 28W tracked poleward toward a weakness in the subtropical ridge during its short life-span.
(3) Moderate vertical wind shear caused the cyclone to dissipate.
(4) There were no casualties reported.

TD 15W Kalmaegi
TS 16W Kammuri
TD 17W
TS 18W
STY19W Phanfone
TS 20W Vongfong
TY 21W Rusa
TY 22W Sinlaku
TS 23W Hagupit
TS 24W Mekkhala
STY25W Higos
TY 26W Bavi
TD 27W
TD 28W
TS 29W Maysak
TY 30W Haishen
STY31W Pongsona
HUR02C Ele
HUR03C Huko
TC 01A
TC 02B
TC 03B
TC 04B
TC 05B

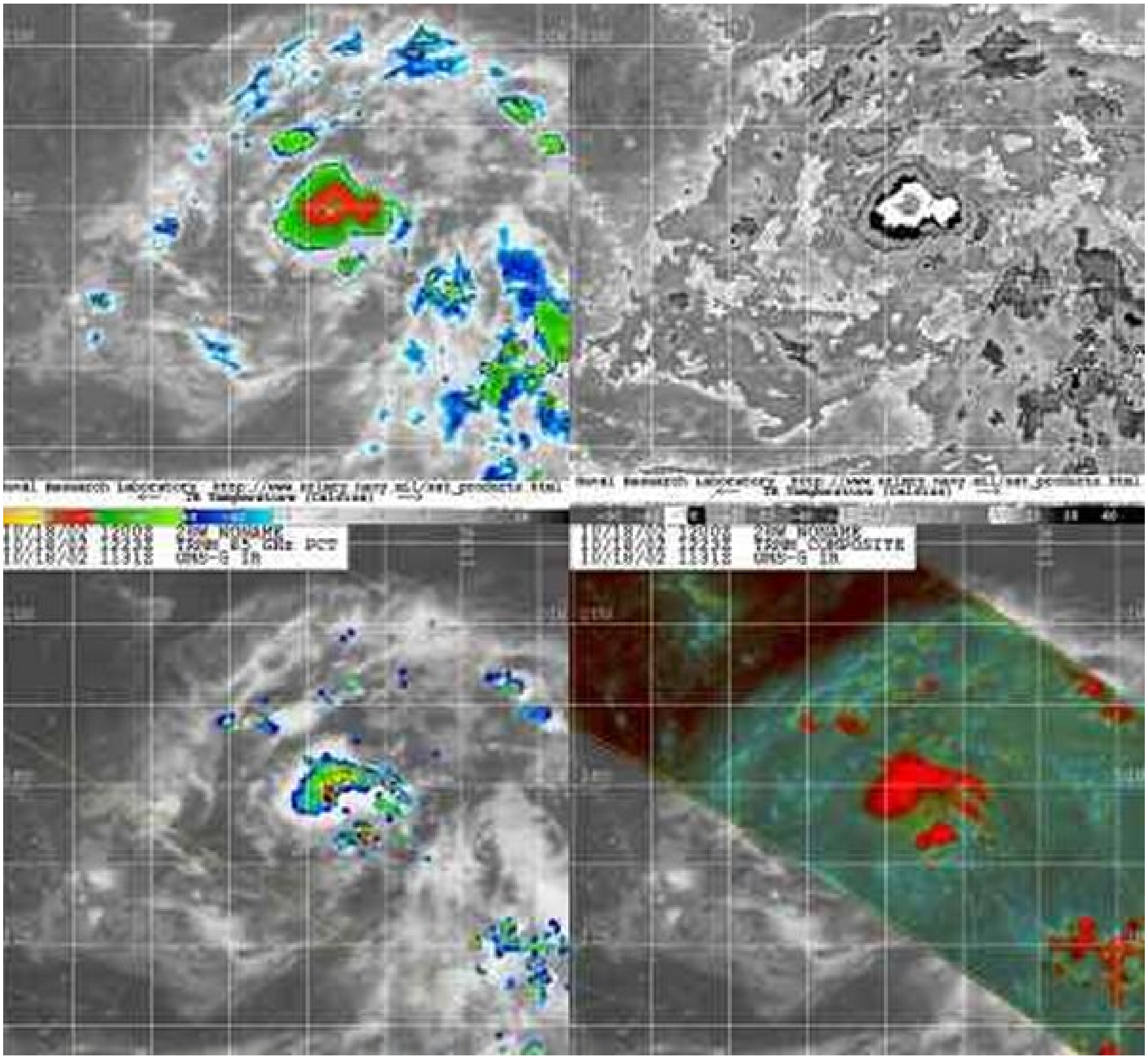
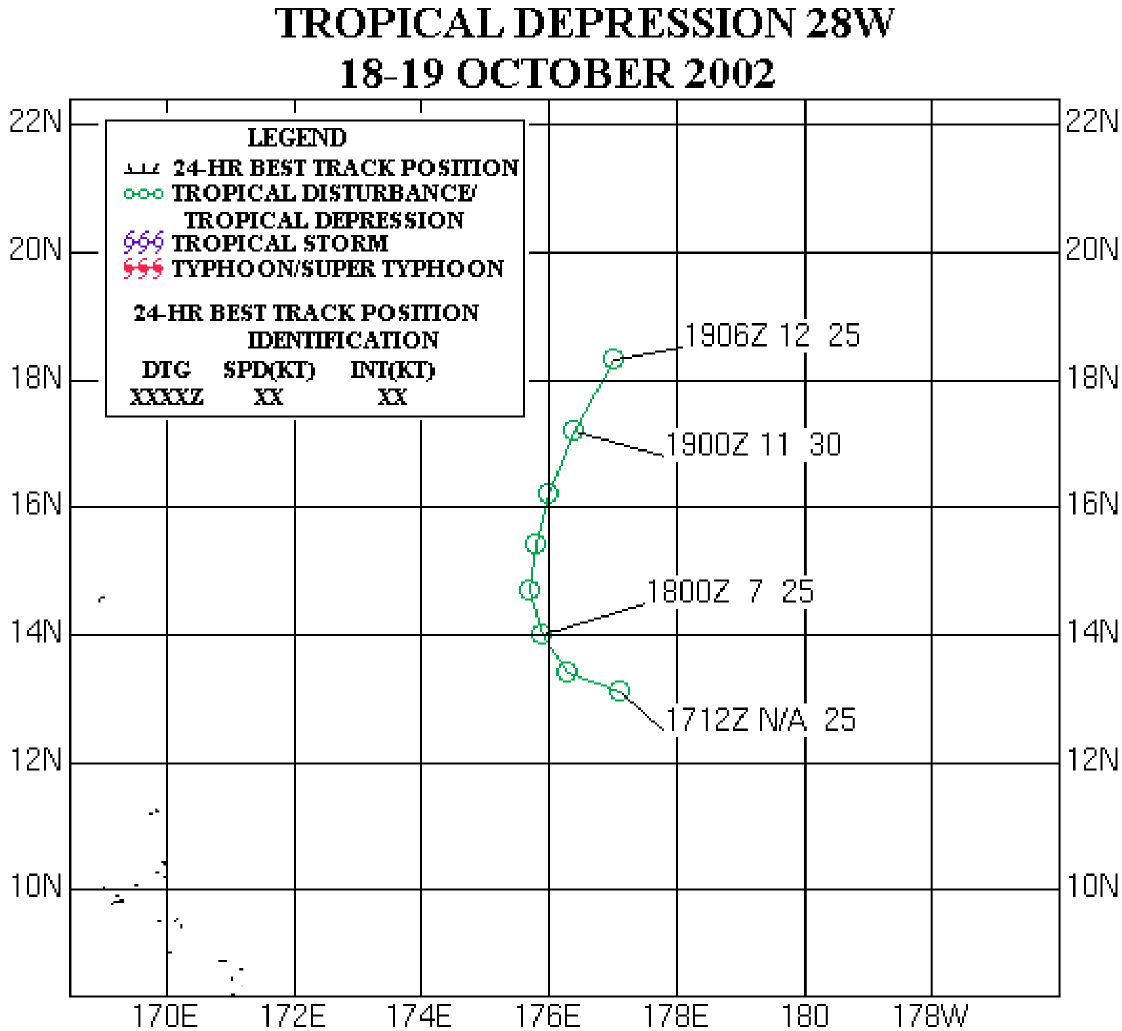


Figure 1-28W-1. 181223Z October 2002 multi-sensor satellite images of TD 28W (No Name), located 560 nm southeast of Wake Island, with an estimated intensity of 30 knots.


TROPICAL DEPRESSION 28W
18-19 OCTOBER 2002
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 XX
1906Z 12 25
1900Z 11 30
1800Z 7 25
1712Z N/A 25
22N
20N
18N
16N
14N
12N
10N
170E
172E
174E
176E
178E
180
178W

# Tropical Storm (TS) 29W (Maysak)

Verification Statistics

First Poor : 0600Z 25 Oct 02
First Fair : 0030Z 26 Oct 02
First TCFA : 0900Z 26 Oct 02
First Warning : 1800Z 26 Oct 02
Last Warning : 1200Z 29 Oct 02
Max Intensity : 60 kts, gusts to 75 kts
Landfall : None
Total Warnings : 12
Remarks:
(1) TS 29W developed south of Wake Island, tracked north-northwestward for 24 hours before turning north, then northeastward. TS 29W attained maximum intensity of 60 knots at 0600Z 28 October.
(2) TS 29W initially tracked north-northwestward under the influence of a low to mid-level ridge east of the cyclone. A passing mid-latitude trough weakened the ridge, causing TS 29W to track poleward into the weakness and then northeastward.
(3) TS 29W underwent extratropical transition and weakened as it interacted with the baroclinic zone.
(4) No casualties were reported.

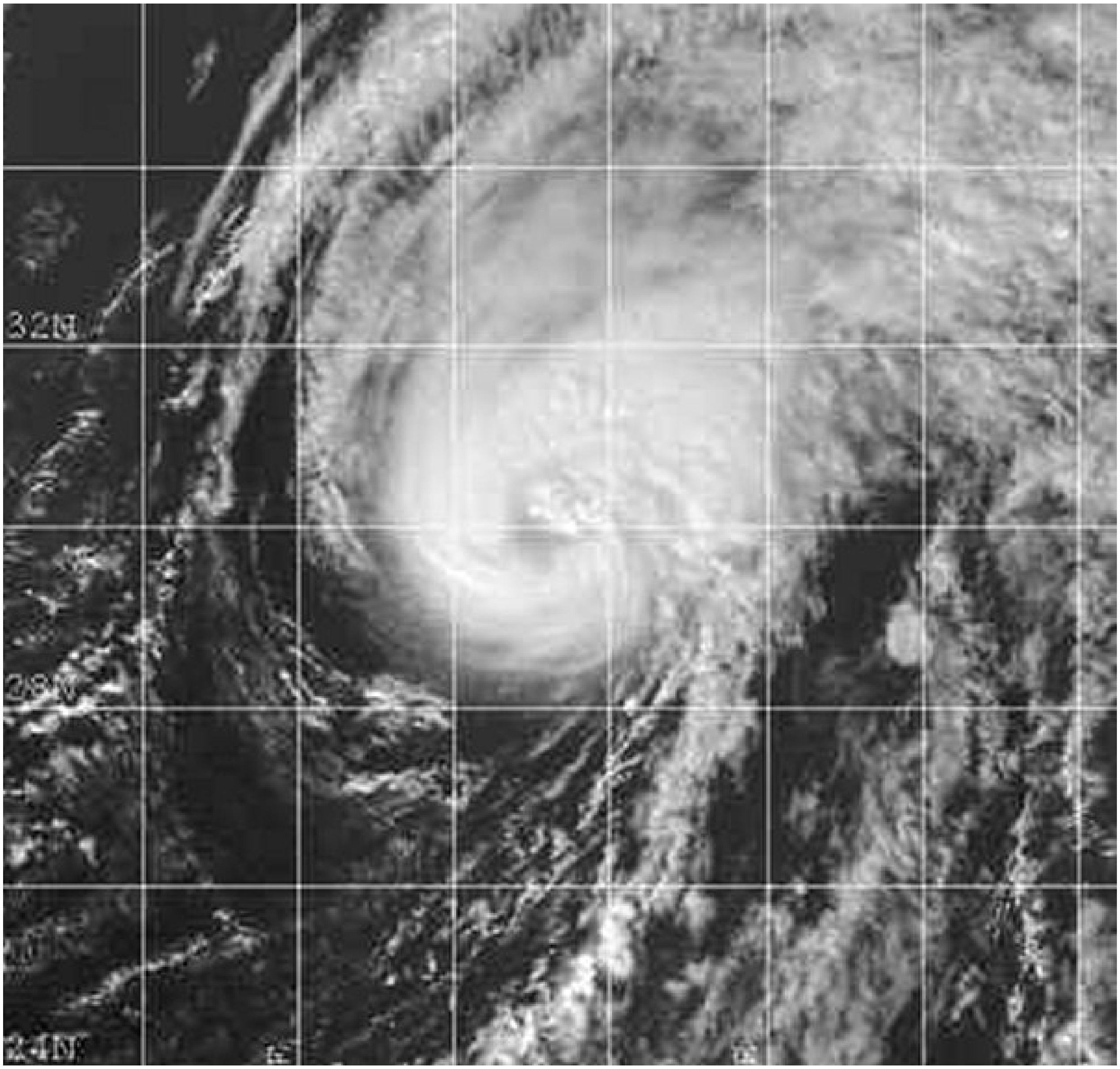
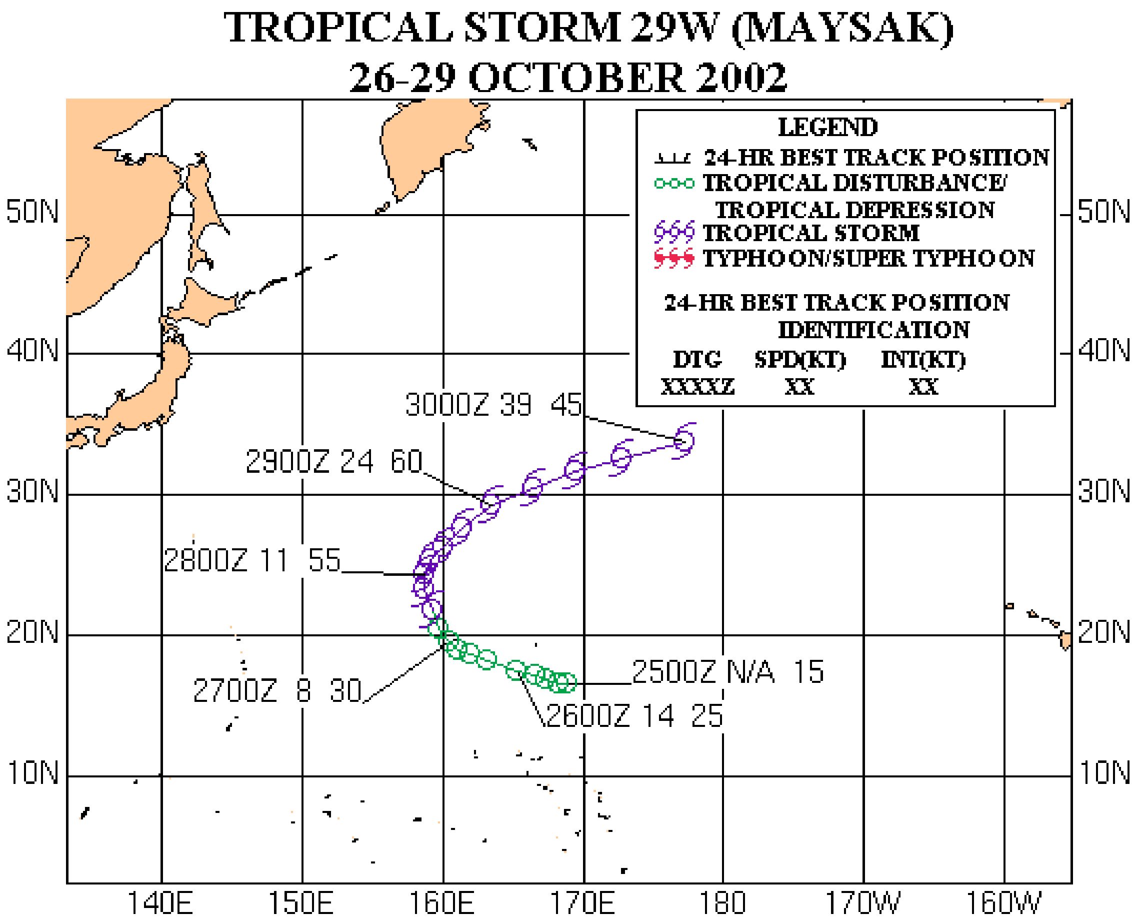



Figure 1-29W-1. 290331Z October 2002 GMS-5 visible imagery of TS 29W (Maysak), located approximately 600 nm northwest of Wake Island, with an estimated intensity of 50 knots.


TROPICAL STORM 29W (MAYSAK)
26-29 OCTOBER 2002
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 XX
3000Z 39 45
2900Z 24 60
2800Z 11 55
2700Z 8 30
2500Z N/A 15
2600Z 14 25
50N
40N
30N
20N
10N
140E
150E
160E
170E
180
170W
160W

# Typhoon (TY) 30W (Haishen)

Verification Statistics

First Poor : 0030Z 19 Nov 02
First Fair : None
First TCFA : 0200Z 20 Nov 02
First Warning : 0600Z 20 Nov 02
Last Warning : 1800Z 24 Nov 02
Max Intensity : 95 kts, gusts to 115 kts
Landfall : None
Total Warnings : 19
Remarks:
(1) TY 30W developed just north of the Caroline Islands, tracked west-northwestward initially before turning poleward and attaining maximum intensity of 95 knots at 1800Z 23 November.
(2) TY 30W tracked to the west-northwest for 36 hours under the influence of the low to mid-level subtropical ridge situated to the east of Guam. A passing mid-latitude trough caused the cyclone to turn north, then track northeastward, passing west of Iwo Jima..
(3) TY 30W underwent extratropical transition and weakened in the baroclinic zone.
(4) No casualties were reported.

**TD 15W Kalmaegi**

**TS 16W Kammuri**

**TD 17W**

**TS 18W**

**STY19W Phanfone**

**TS 20W Vongfong**

**TY 21W Rusa**

**TY 22W Sinlaku**

**TS 23W Hagupit**

**TS 24W Mekkhala**

**STY25W Higos**

**TY 26W Bavi**

**TD 27W**

**TD 28W**

**TS 29W Maysak**

**TY 30W Haishen**

**STY31W Pongsona**

**HUR02C Ele**

**HUR03C Huko**

**TC 01A**

**TC 02B**

**TC 03B**

**TC 04B**

**TC 05B**

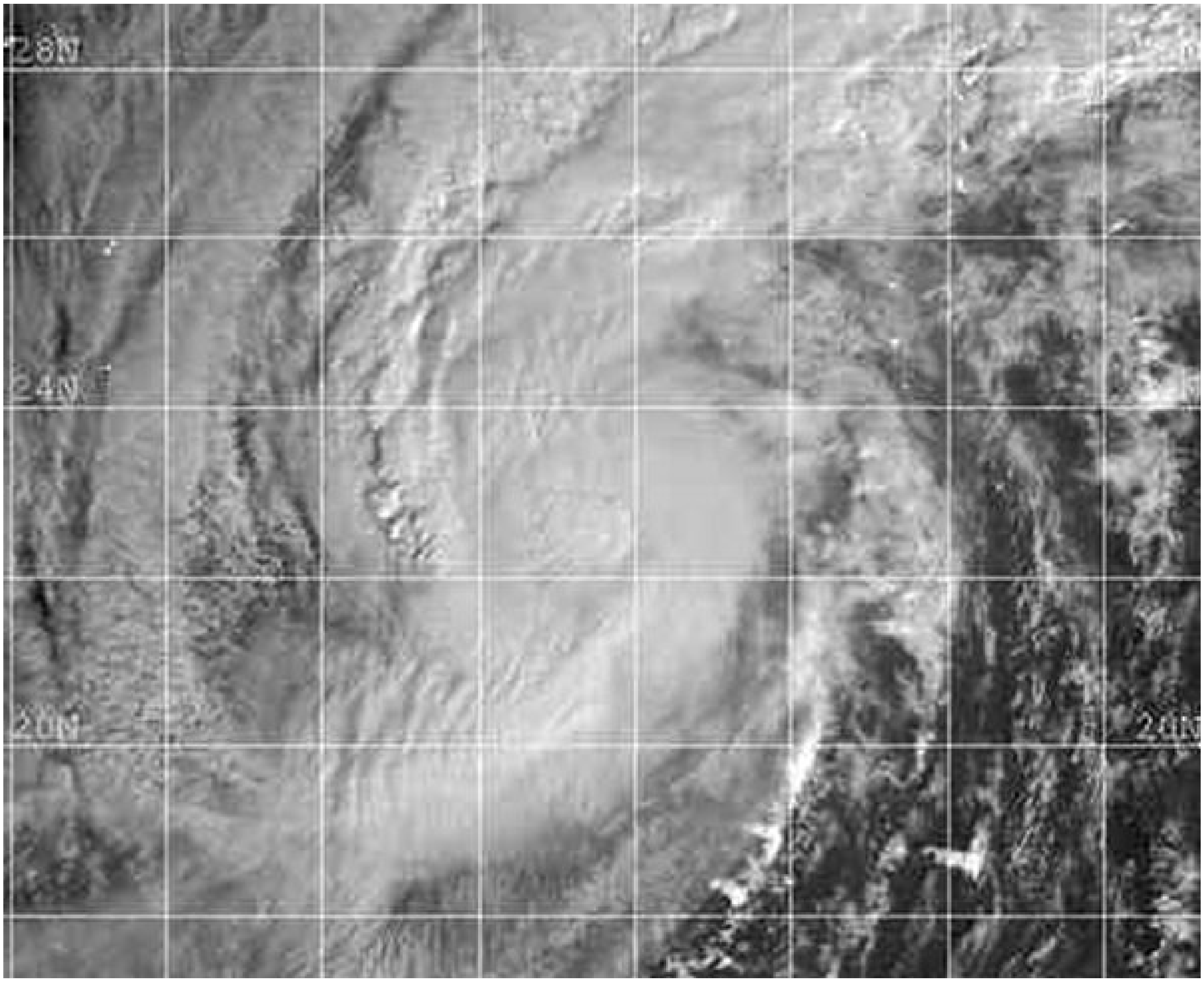
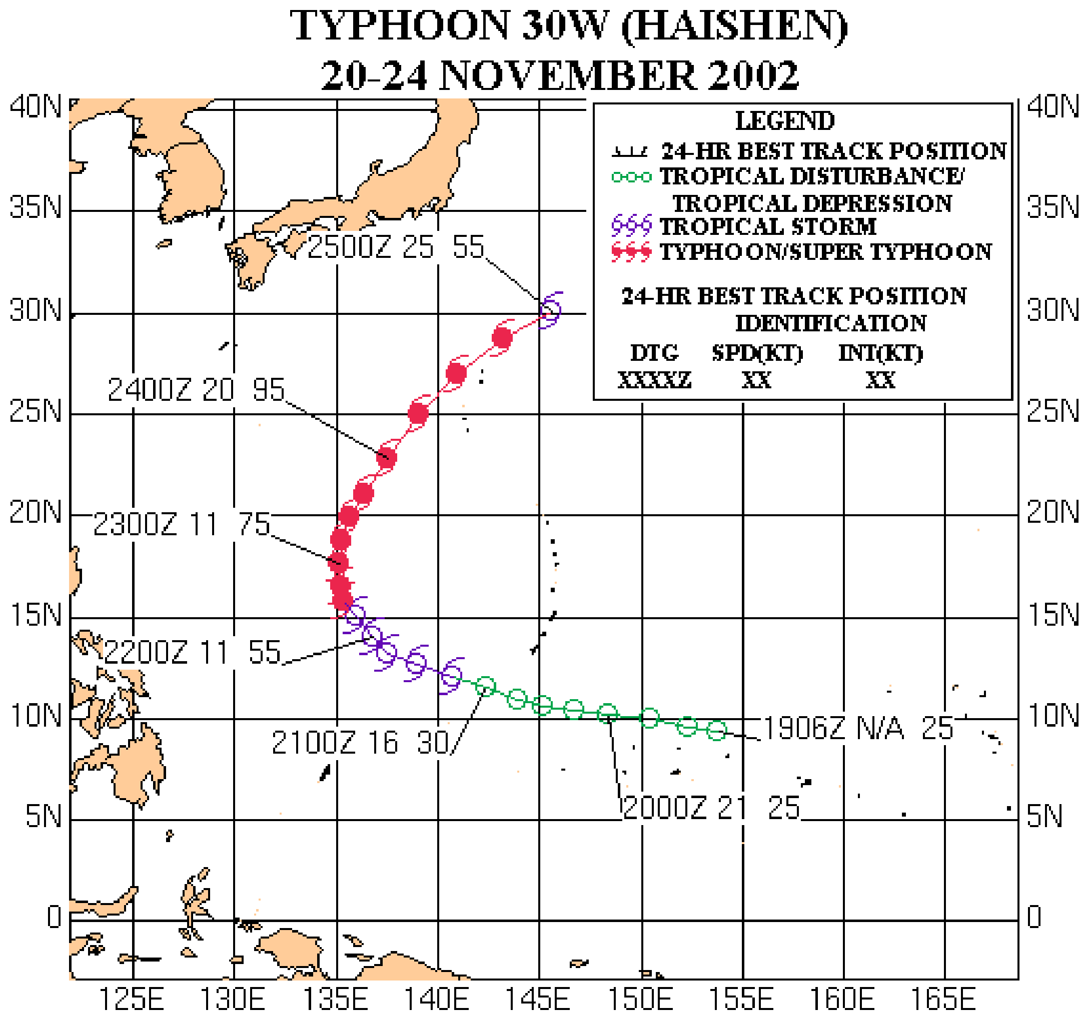



Figure 1-30W-1. 232351Z November 2002 GMS-5 visible satellite imagery of TY 30W (Haishen) approximately 230 nm southwest of Iwo Jima with an estimated intensity of 95 knots.


TYPHOON 30W (HAISHEN)
20-24 NOVEMBER 2002
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 XX
2500Z 25 55
2400Z 20 95
2300Z 11 75
2200Z 11 55
2100Z 16 30
2000Z 21 25
1906Z N/A 25
40N
35N
30N
25N
20N
15N
10N
5N
0
125E 130E 135E 140E 145E 150E 155E 160E 165E

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# Super Typhoon (STY) 31W (Pongsona)

Verification Statistics

First Poor : None
First Fair : 0900Z 01 Dec 02
First TCFA : 1100Z 02 Dec 02
First Warning : 1800Z 02 Dec 02
Last Warning : 0000Z 11 Dec 02
Max Intensity : 130 kts, gusts to 160 kts
Landfall : 0500Z 08 Dec 02
Total Warnings : 34
Remarks:
(1) Super Typhoon 31W (Pongsona) was first detected as a tropical disturbance in the Marshall Islands southwest of Kwajelein Atoll on 30 November. This cyclone then began moving west-northwestward while developing and passed close to the north of both Ponape and Chuuk. Subsequently, the cyclone passed very close to Guam, with eye passage recorded on both Guam and Rota (30 miles north of Guam).
(2) At 0000Z 03 December the first warning was issued with an intensity of 35 knots at 09 N 163 E. STY 31W tracked to the west for 48 hours under the influence of the low to mid level subtropical ridge located north of the system. STY 31W then recurved to the northeast as a mid-latitude trough weakened the ridge.
(3) STY 31W weakened as it encountered strong vertical shear associated with a mid-latitude boundary to the northwest of the system and transitioned to an extra tropical storm.
(4) STY 31W did significant damage to Guam. Three people were killed and over 200 injured, and 2,000 people were left homeless. Three Exxon Mobil Corp fuel storage tanks were set on fire. Guam’s power, sewage and water systems were also severely damaged.
(5) Two government reports were produced detailing the forecast and warning procedures as well as the damage incurred from this cyclone: (1) a Department of Commerce Service Assessment; and (2) a U.S. Air Force report.

TD 15W Kalmaegi
TS 16W Kammuri
TD 17W
TS 18W
STY19W Phanfone
TS 20W Vongfong
TY 21W Rusa
TY 22W Sinlaku
TS 23W Hagupit
TS 24W Mekkhala
STY25W Higos
TY 26W Bavi
TD 27W
TD 28W
TS 29W Maysak
TY 30W Haishen
STY31W Pongsona
HUR02C Ele
HUR03C Huko
TC 01A
TC 02B
TC 03B
TC 04B
TC 05B

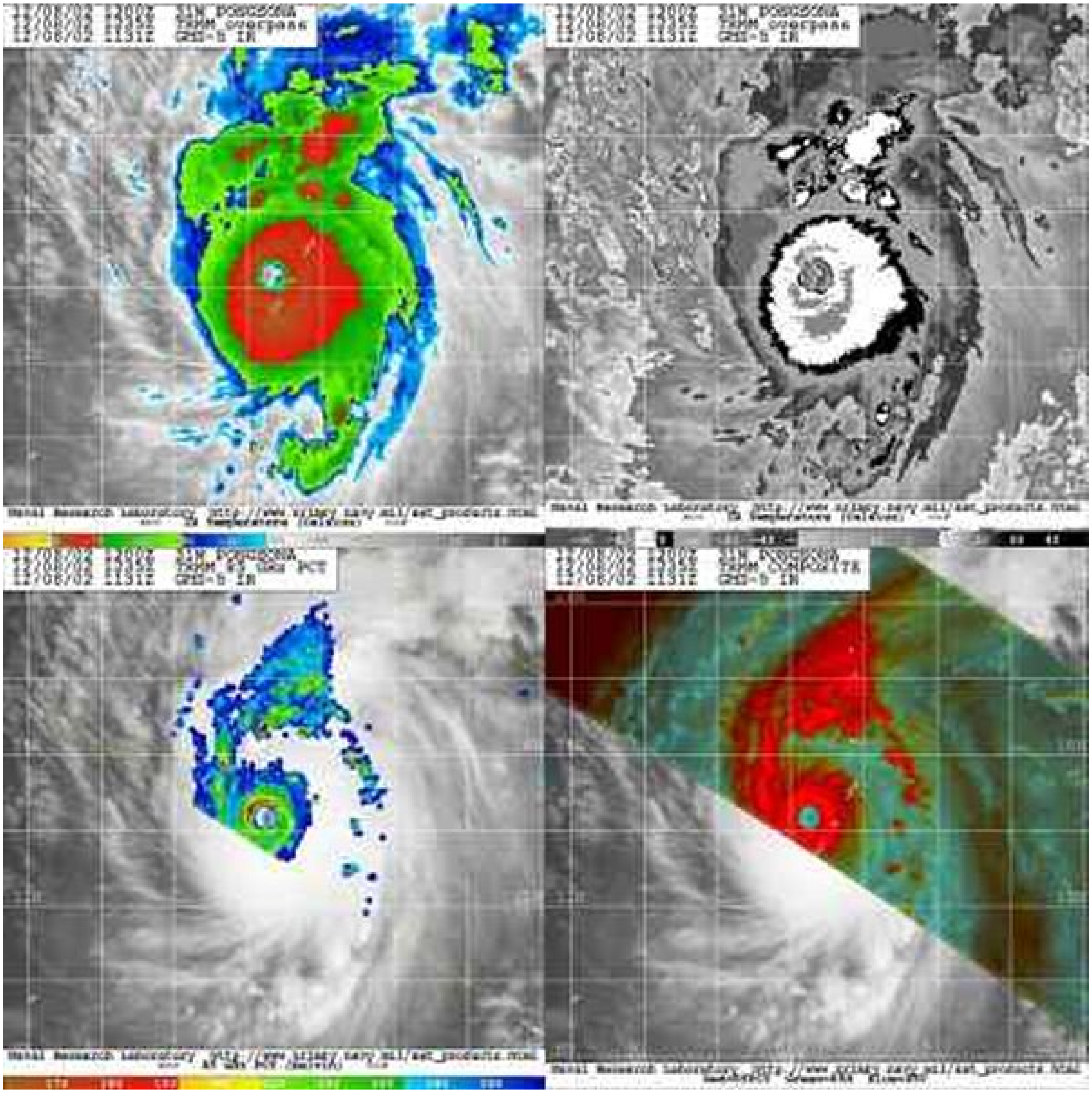


Figure 1-31W-1. 081235Z December 2002 multi-sensor satellite images of TY 31W (Pongsona) 75 nm north of Guam with an estimated peak intensity of 130 knots.

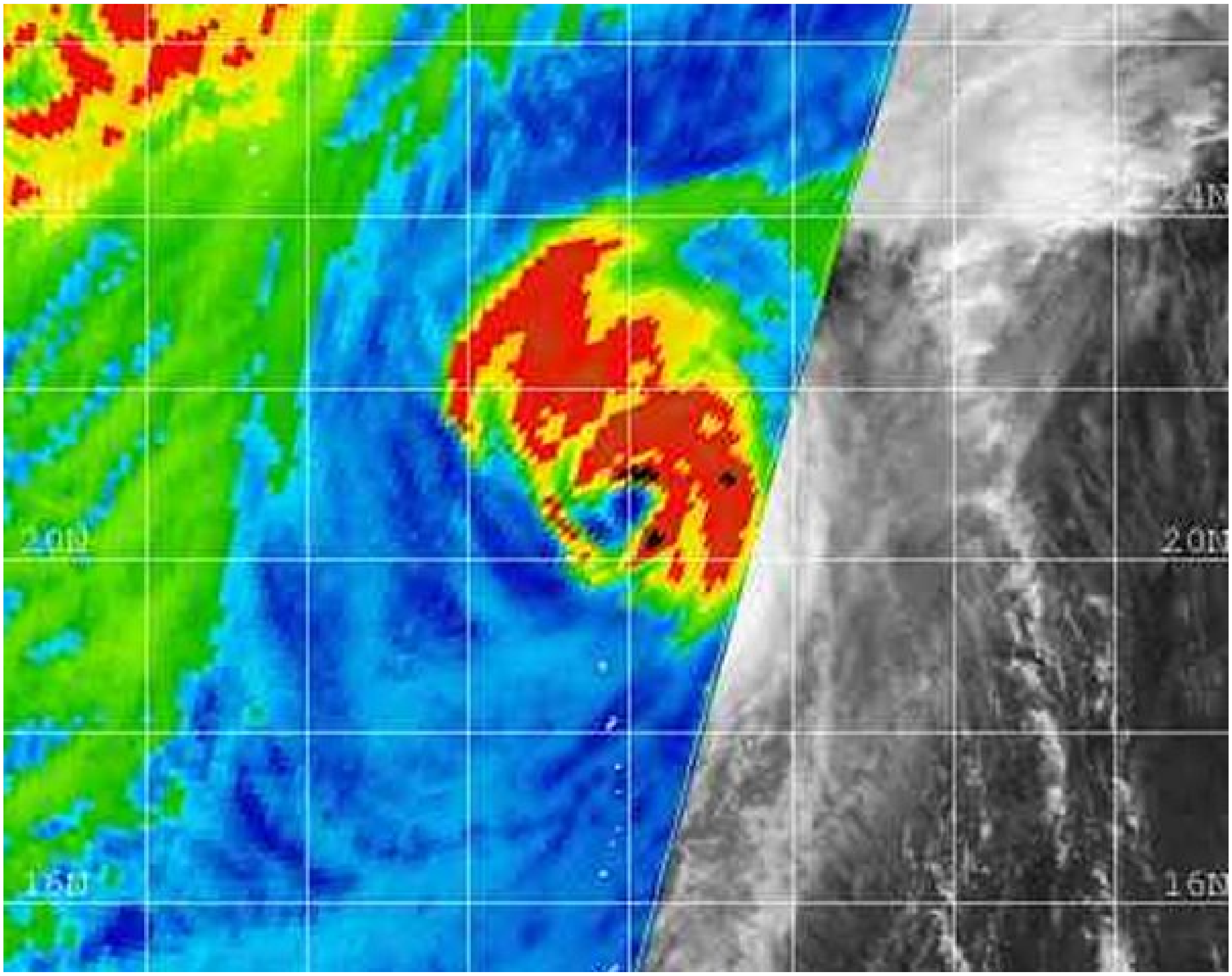
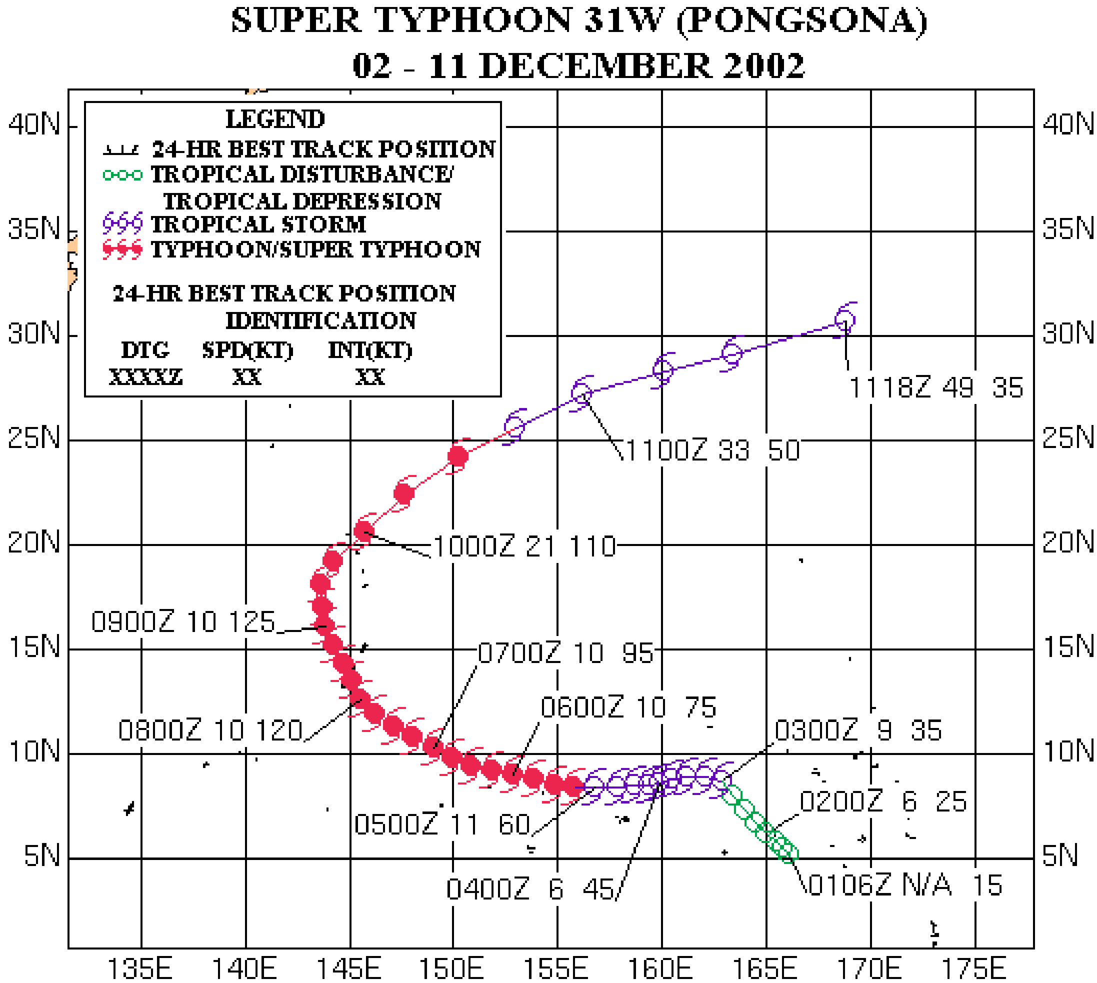



Figure 1-31W-2. 100019Z December 2002 SSM/I imagery of TY 31W (Pongsona), The system has begun weakening in the southwest quadrant, located 365 nm southeast of Iwo Jima with an estimated intensity of 110 knots.



SUPER TYPHOON 31W (PONGSONA)
02 - 11 DECEMBER 2002
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 XX
1118Z 49 35
1100Z 33 50
1000Z 21 110
0900Z 10 125
0700Z 10 95
0600Z 10 75
0800Z 10 120
0300Z 9 35
0200Z 6 25
0500Z 11 60
0400Z 6 45
0106Z N/A 15
40N
35N
30N
25N
20N
15N
10N
5N
135E
140E
145E
150E
155E
160E
165E
170E
175E

# Hurricane (HUR) 02C (Ele)

Verification Statistics

First Poor : None
First Fair : 0900Z 25 Aug 02
First TCFA : 0230Z 26 Aug 02
First Warning : 0600Z 26 Aug 02
Last Warning : 1200Z 10 Sep 02
Max Intensity : 115 kts, gusts to 140 kts
Landfall : None
Total Warnings : 45*
Remarks:

(1) TY 02C formed in the Central Pacific basin near 10 N 163 W, approximately 530 nm southeast of Johnston Island. The first warnings were issued by RSMC Central Pacific Hurricane Center in Honolulu, HI. At approximately 0000Z 30 September, Hurricance 02C crossed the dateline and was renamed TY 02C. The storm intensity was estimated at 100 knots. TY 02C continued to develop as it tracked west-northwest toward a developing weakness in the subtropical ridge. TY 02C reached a maximum intensity of 115 knots as it tracked into a col area of the upper tropospheric subtropical ridge. This cyclone dissipated over water in an unfavorable environment characterized by cool sea surface temperature and strong westerly vertical wind shear.

(2) TY 02C might be notable for missing the first opportunity to recurve as a shortwave trough passed close by in early September. The track of 02C reveals this influence in its track to the north-northeast before turning back to the northwest for four more days. A building mid-tropospheric ridge feature behind the shortwave trough steered TY 02C back to the northwest for several more days.

(3) TY 02C slowly weakened as it tracked over increasingly cooler sea surface temperatures north of 25 N. TY 02C did not accelerate as it interacted with the mid-latitude westerlies, but rather continued to dissipate as vertical wind shear de-coupled deep convection.

(4) Press reported no casualties or property damage.

* JTWC issued 45 warnings on this system after crossing the dateline. A total of 62 warnings were issued for this system.

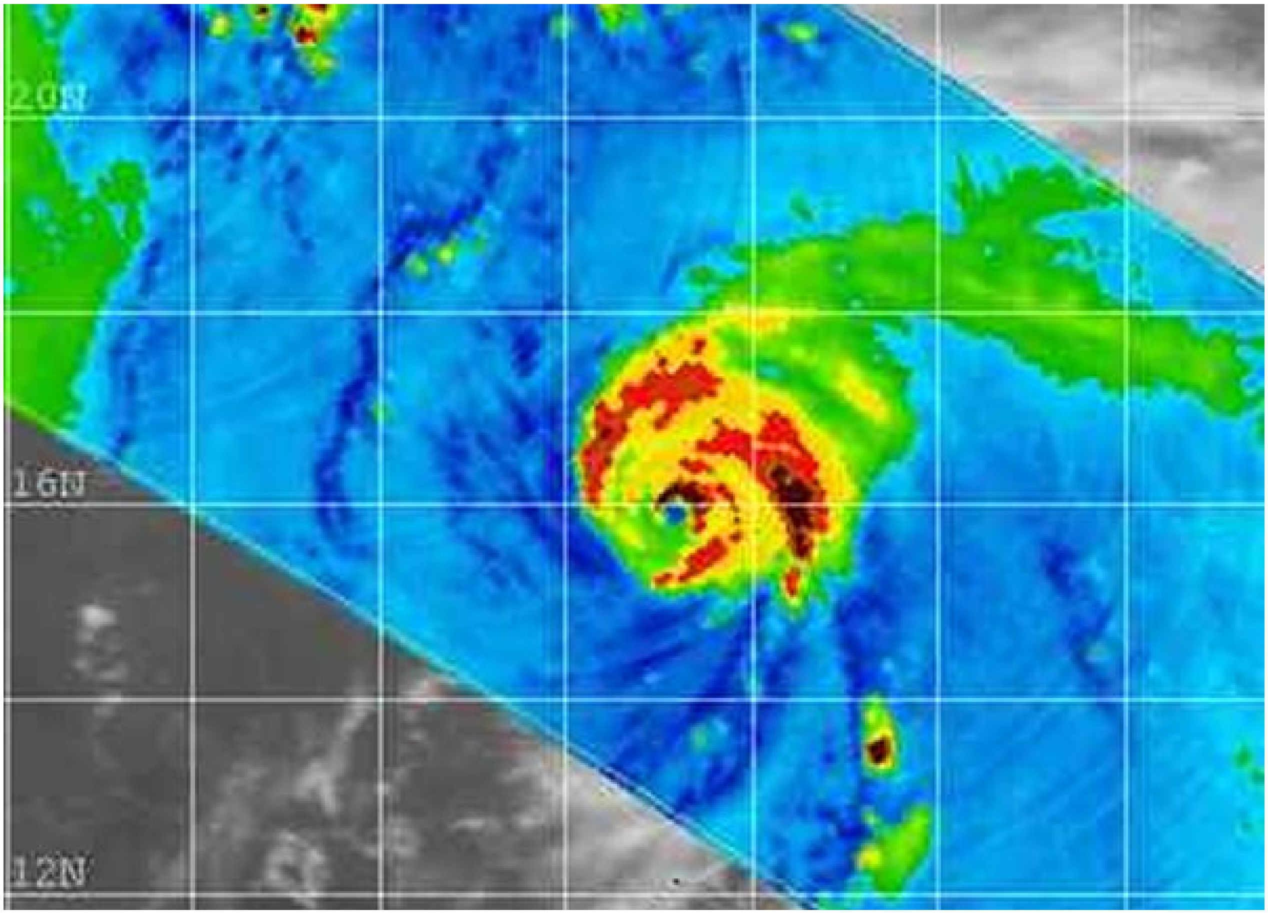



Figure 1-02C-1. 311237Z August 2002 85 GHz TRMM image of TY 02C (Ele), revealing a small eye, located 615 nm east of Wake Island, with a peak intensity of 115 knots.

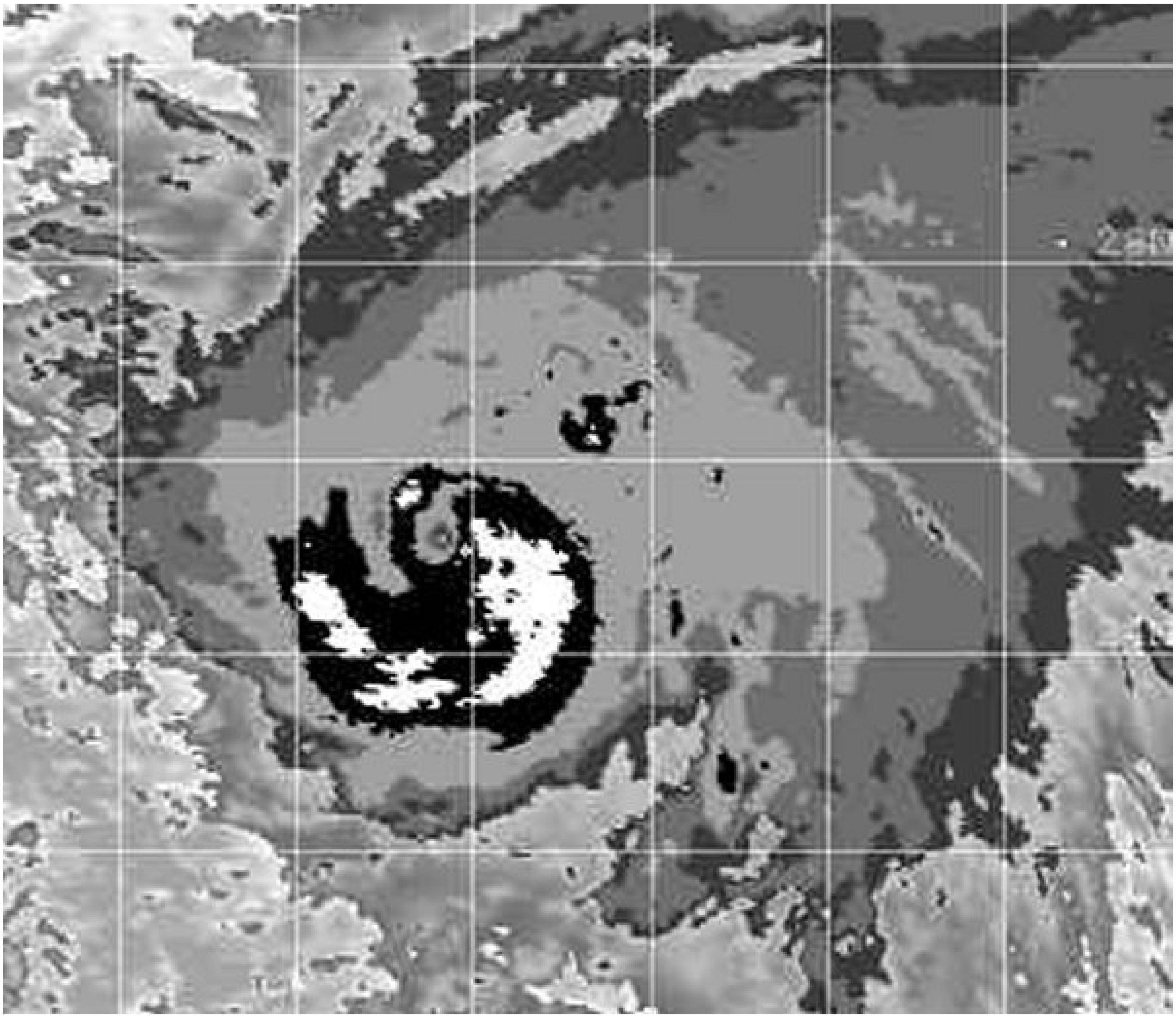
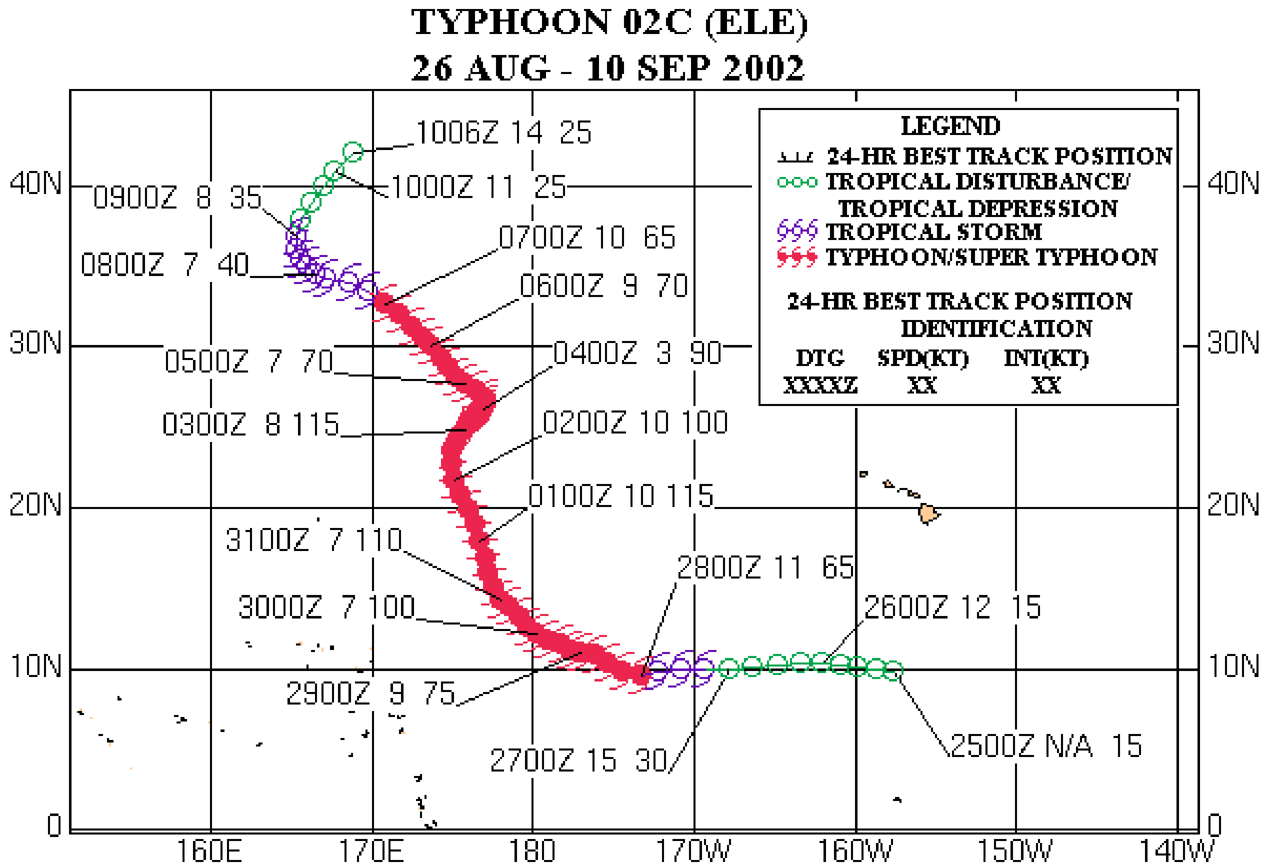


Figure 1-02C-2. 030454Z September 2002 DMSP enhanced infrared imagery of TY 02C (Ele), revealing a small eye, located 740 nm east of Wake Island, with an estimated intensity of 110 knots.


TYPHOON 02C (ELE)
26 AUG - 10 SEP 2002
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 XX
1006Z 14 25
1000Z 11 25
0900Z 8 35
0800Z 7 40
0700Z 10 65
0600Z 9 70
0500Z 7 70
0400Z 3 90
0300Z 8 115
0200Z 10 100
0100Z 10 115
3100Z 7 110
3000Z 7 100
2900Z 9 75
2800Z 11 65
2700Z 15 30
2600Z 12 15
2500Z N/A 15
40N
30N
20N
10N
0
160E
170E
180
170W
160W
150W
140W

# Hurricane (HUR) 03C (Huko)

Verification Statistics

First Poor : 0900Z 21 Oct 02
First Fair : 0800Z 24 Oct 02
First TCFA : 1500Z 24 Oct 02
First Warning : 1800Z 24 Oct 02
Last Warning : 0600Z 07 Nov 02
Max Intensity : 75 kts, gusts to 90 kts
Landfall : None
Total Warnings : 16*
Remarks:
(1) TY 03C formed near 09 N 154 W, approximately 700 nm south-southeast of Honolulu, HI. TY 03C developed slowly in a region with marginal development potential due to vertical wind shear. Initially warned on by RSMC Central Pacific Hurricane Center in Honolulu, HI. Hurricane 03C crossed the dateline at 0600Z 03 November and was passed to the Joint Typhoon Warning Center.
(2) TY 03C tracked slowly westward as it passed south of the Hawaiian Islands and closer to the International Dateline in a weak steering environment. After crossing the dateline TY 03C accelerated to 26 knots in the steering flow equatorward of a strong mid-tropospheric ridge ahead of a developing mid-latitude trough. Eventually, TY 03C would move into a weakness created by the same mid-latitude system and recurve to the northeast near 163 E.
(3) Although sea surface temperatures and inflow factors were favorable, upper level conditions appear to have limited intensification to minimal typhoon intensity.
(4) TY 03C weakened to tropical storm intensity in response to increasing vertical wind shear before completing extratropical transition.
* JTWC issued 16 warnings on this system after crossing the dateline. A total of 55 warnings were issued for this system.

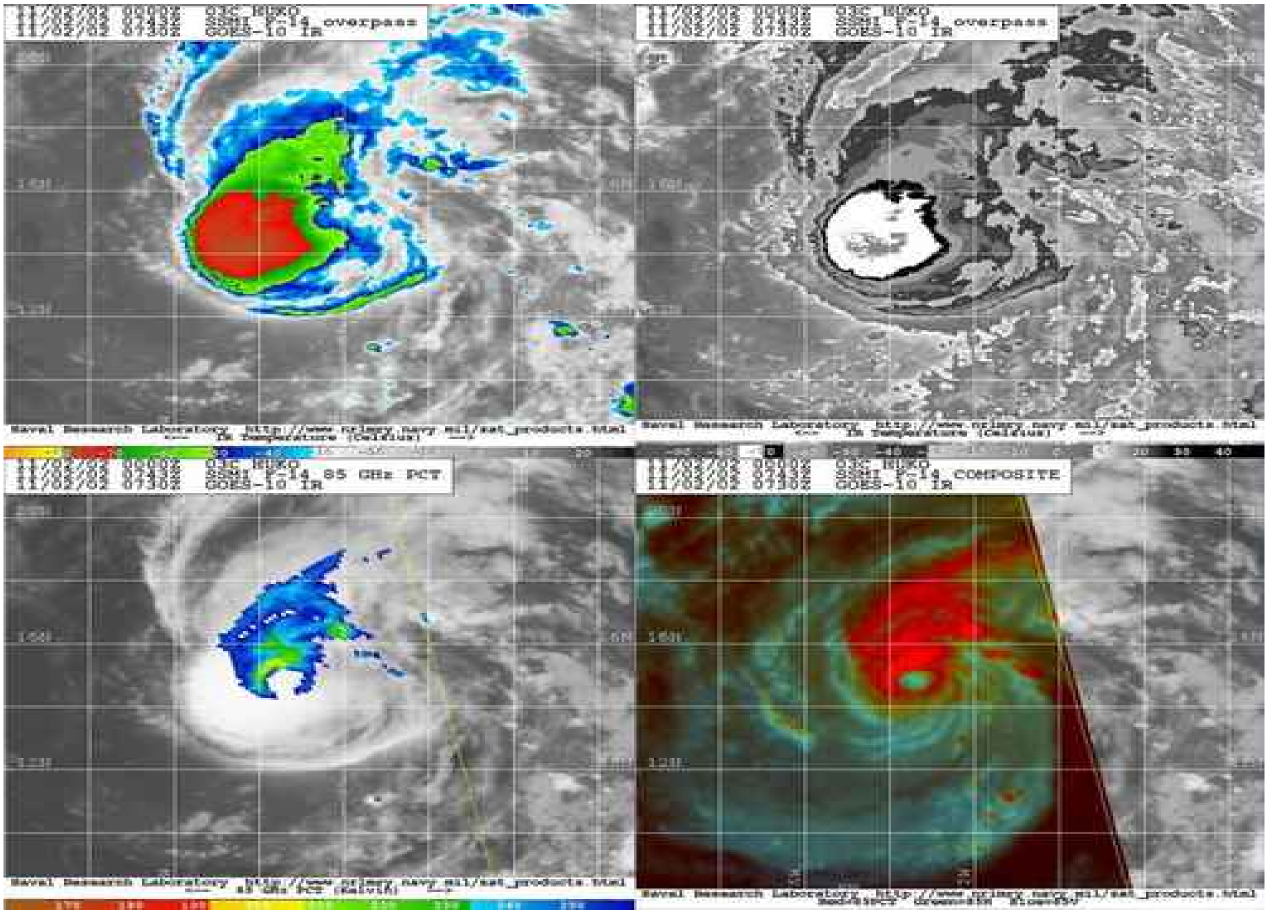
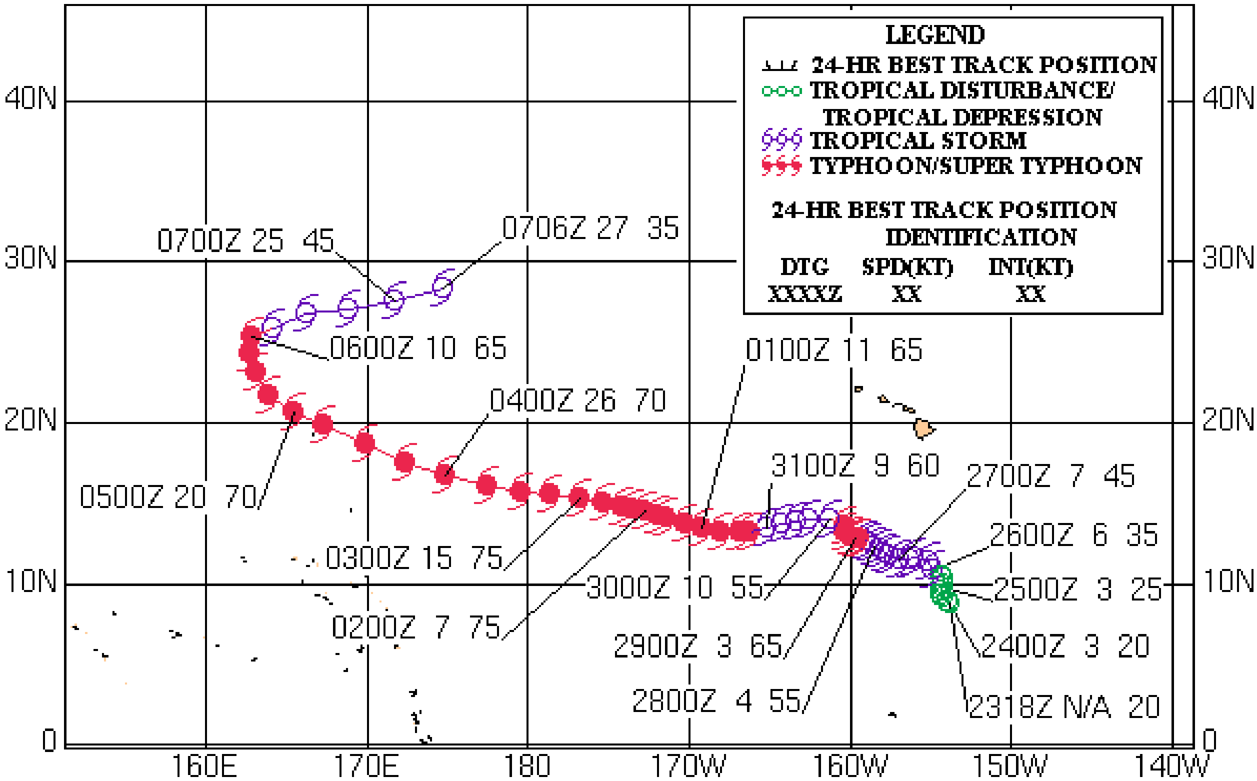


Figure 1-03C-1. 020743Z November 2002 multi-sensor satellite images of HU 03C (Huko), located 270 nm southwest of Johnston Atoll and in still in CPHC's area of forecast responsibility, with an estimated intensity of 35 knots.

# TYPHOON 03C (HUKO)
## 24 OCT - 07 NOV 2002



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# Tropical Cyclone (TC) 01A

Verification Statistics

First Poor : 1800Z 03 May 02
First Fair : 1800Z 05 May 02
First TCFA : 2300Z 05 May 02
First Warning : 1800Z 06 May 02
Last Warning : 1200Z 10 May 02
Max Intensity : 45 kts, Gusts To 55 kts
Landfall : 1000Z 10 May 02
Total Warnings : 15

STY10W Halong
TS 11W Nakri
STY12W Fengshen
TS 13W
TY 14W Fung-Wong
TD 15W Kalmaegi
TS 16W Kammuri
TD 17W
TS 18W
STY19W Phanfone
TS 20W Vongfong
TY 21W Rusa
TY 22W Sinlaku
TS 23W Hagupit
TS 24W Mekkhala
STY25W Higos
TY 26W Bavi
TD 27W
TD 28W
TS 29W Maysak
TY 30W Haishen
STY31W Pongsona
HUR02C Ele
HUR03C Huko
TC 01A
TC 02B
TC 03B
TC 04B

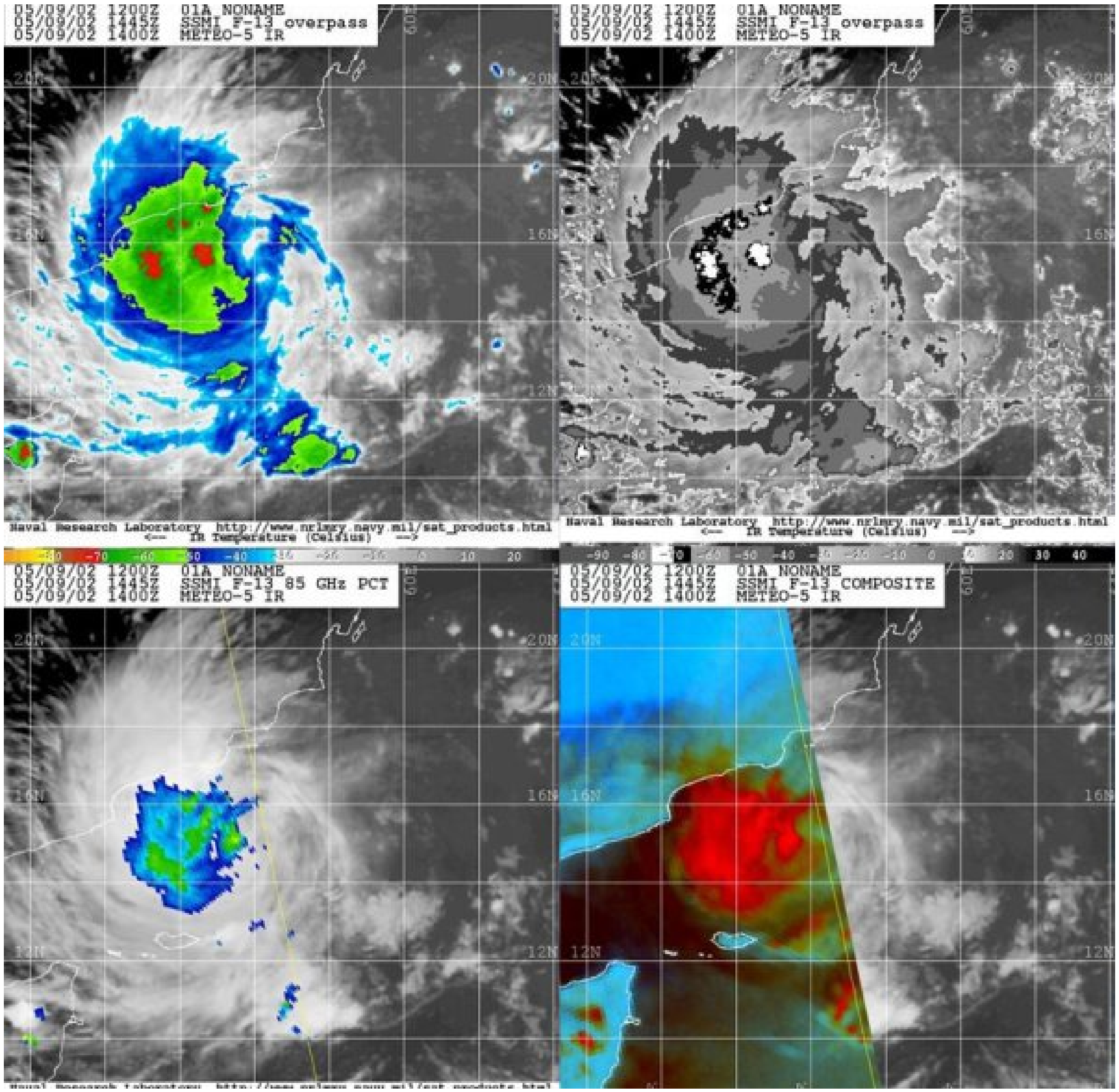
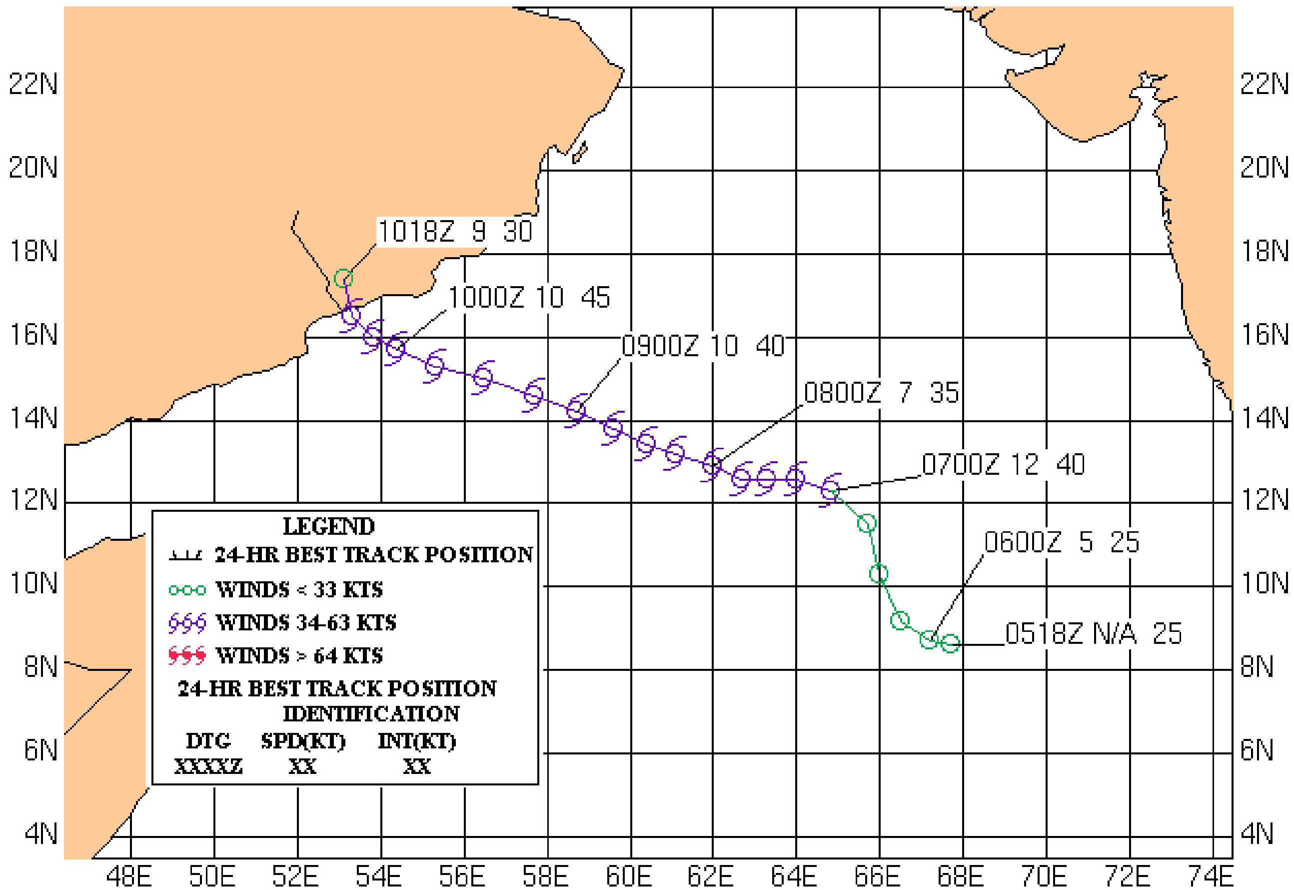



Figure 1-01A-1. 091445Z May 2002 multi-sensor satellite images of TC 01A, located 336 nm northeast of Cape Guardafui in the Arabian Sea, at its maximum intensity of 45 knots.

TC 05B

# TROPICAL CYCLONE 01A
## 06-10 MAY 2002



# Tropical Cyclone (TC) 02B

Verification Statistics

First Poor : 1800Z 07 May 02
First Fair : None
First TCFA : 1030Z 09 May 02
First Warning : 1200Z 10 May 02
Last Warning : 0600Z 12 May 02
Max Intensity : 45 kts, Gusts To 55 kts
Landfall : 2200Z 11 May 02
Total Warnings : 8

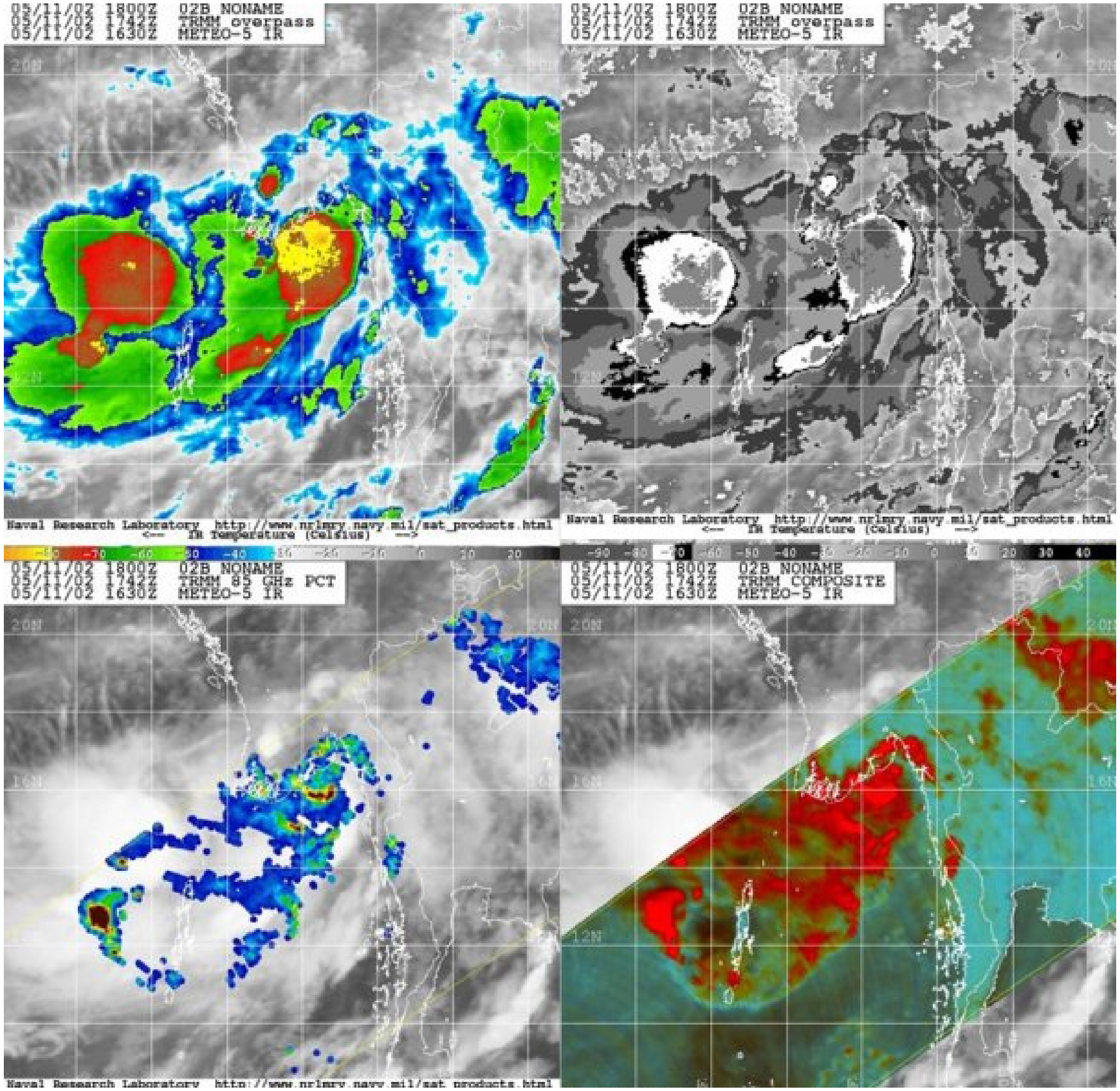
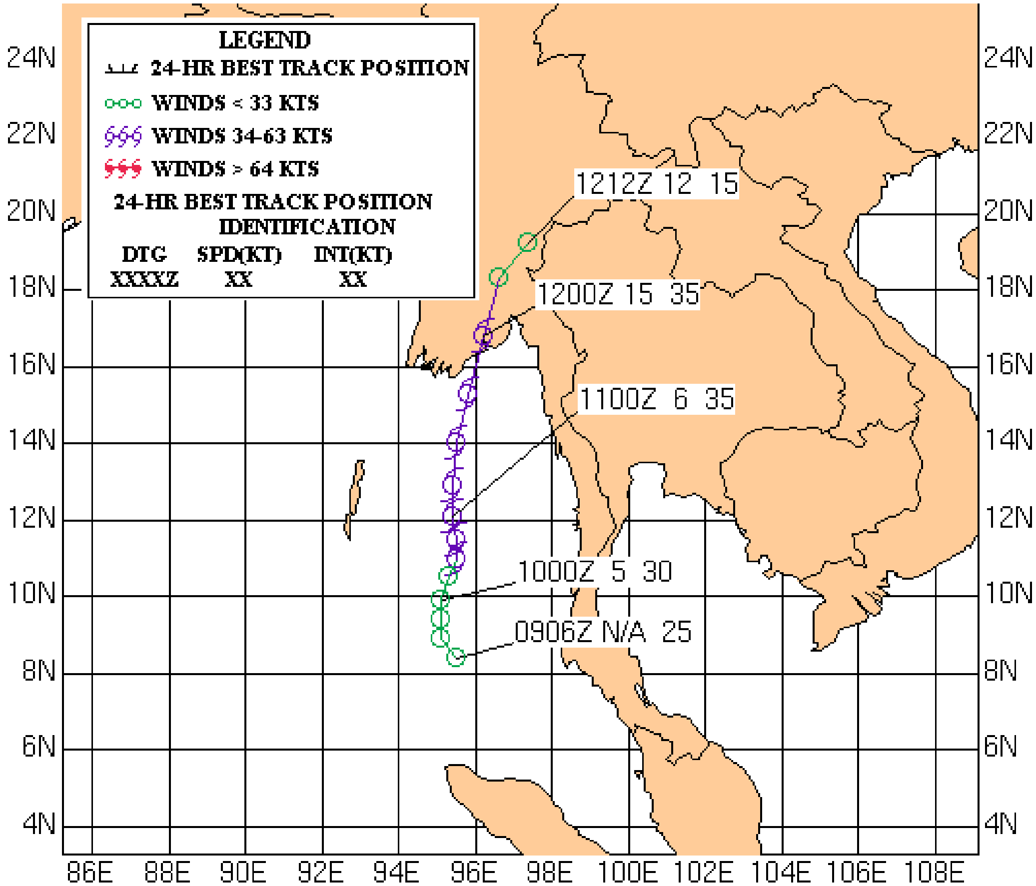



Figure 1-02B-1. 111742Z May 2002 multi-sensor satellite images of TC 02B, located 267 nm south of Rangoon, in the Bay of Bengal, with a maximum intensity of 45 knots.

TC 05B

# TROPICAL CYCLONE 02B
## 10-12 MAY 2002



Print Friendly (PDF)



# Tropical Cyclone (TC) 03B

Verification Statistics

First Poor : None
First Fair : 1800Z 09 Nov 02
First TCFA : 1700Z 10 Nov 02
First Warning : 1200Z 11 Nov 02
Last Warning : 1200Z 12 Nov 02
Max Intensity : 55 kts, Gusts To 70 kts
Landfall : 0800Z 12 Nov 02
Total Warnings : 5

STY10W Halong
TS 11W Nakri
STY12W Fengshen
TS 13W
TY 14W Fung-Wong
TD 15W Kalmaegi
TS 16W Kammuri
TD 17W
TS 18W
STY19W Phanfone
TS 20W Vongfong
TY 21W Rusa
TY 22W Sinlaku
TS 23W Hagupit
TS 24W Mekkhala
STY25W Higos
TY 26W Bavi
TD 27W
TD 28W
TS 29W Maysak
TY 30W Haishen
STY31W Pongsona
HUR02C Ele
HUR03C Huko
TC 01A
TC 02B
TC 03B
TC 04B

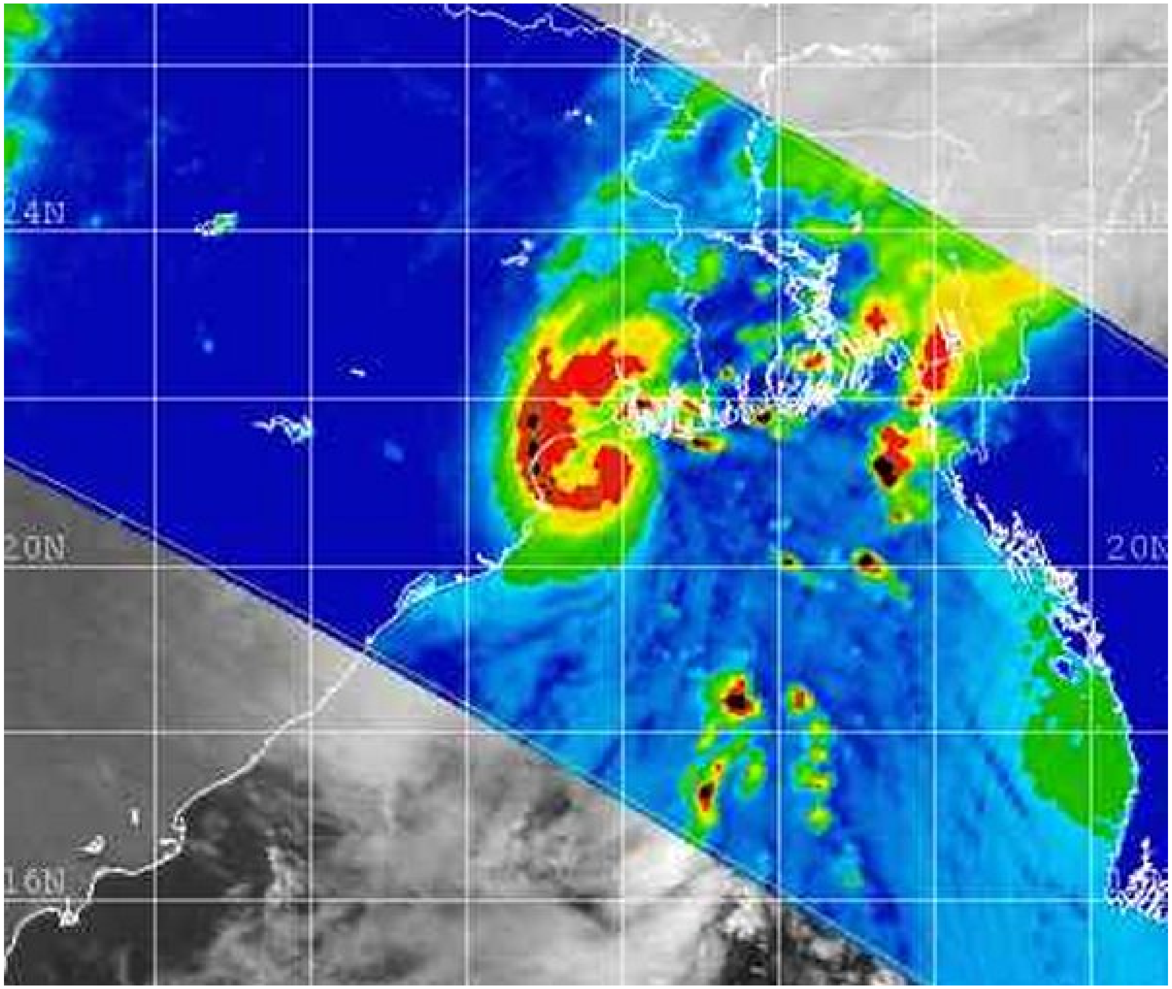
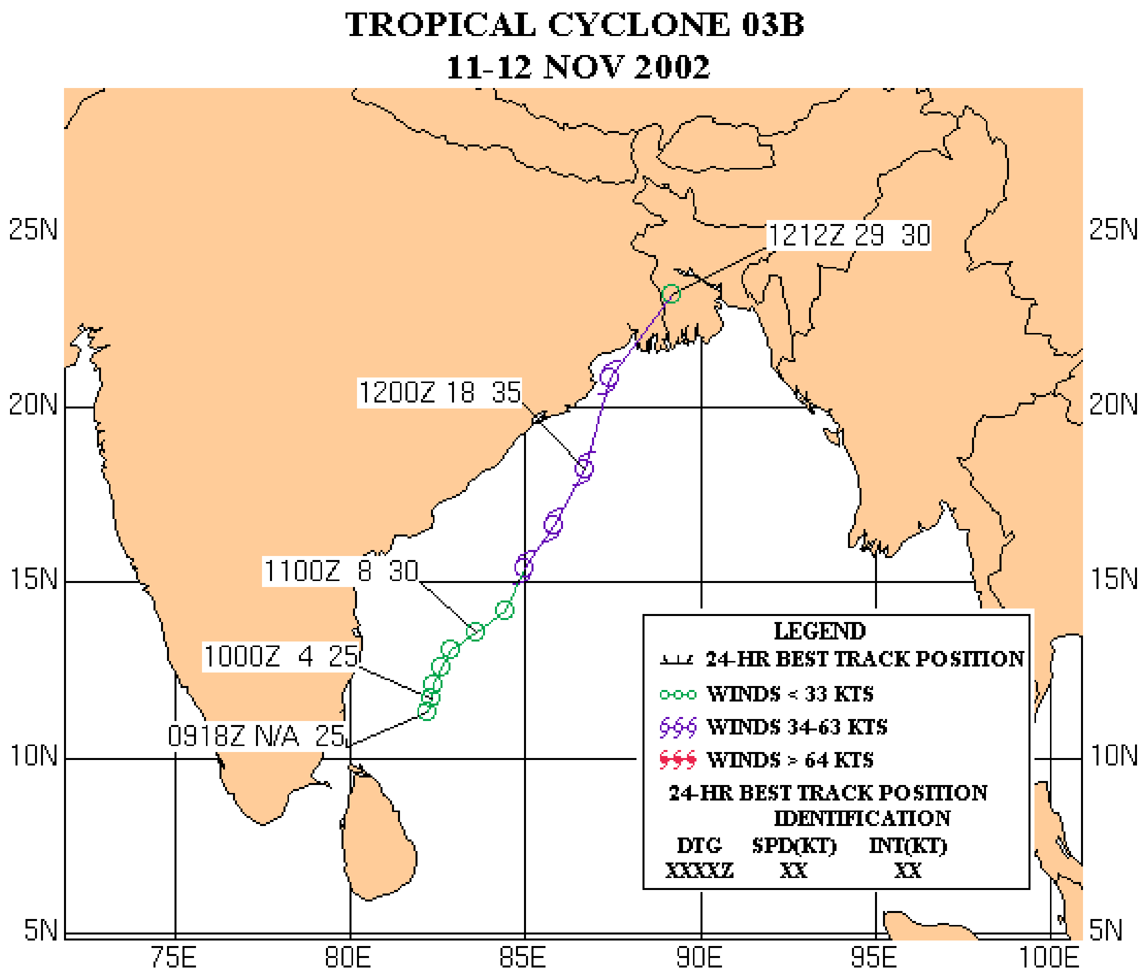



Figure 1-03B-1. 120513Z November 2002 85 GHz TRMM image of TC 03B, located 115 nm southwest of Calcutta with an estimated intensity of 55 knots.

TC 05B


TROPICAL CYCLONE 03B
11-12 NOV 2002
1212Z 29 30
1200Z 18 35
1100Z 8 30
1000Z 4 25
0918Z N/A 25
LEGEND
24-HR BEST TRACK POSITION
WINDS < 33 KTS
WINDS 34-63 KTS
WINDS > 64 KTS
24-HR BEST TRACK POSITION IDENTIFICATION
DTG SPD(KT) INT(KT)
XXXXZ XX XX
25N
20N
15N
10N
5N
75E
80E
85E
90E
95E
100E

Print Friendly (PDF)



# Tropical Cyclone (TC) 04B

Verification Statistics

First Poor : 1800Z 21 Nov 02
First Fair : 1400Z 22 Nov 02
First TCFA : 2100Z 22 Nov 02
First Warning : 1200Z 23 Nov 02
Last Warning : 1200Z 25 Nov 02
Max Intensity : 45 kts, Gusts To 55 kts
Landfall : None
Total Warnings : 9

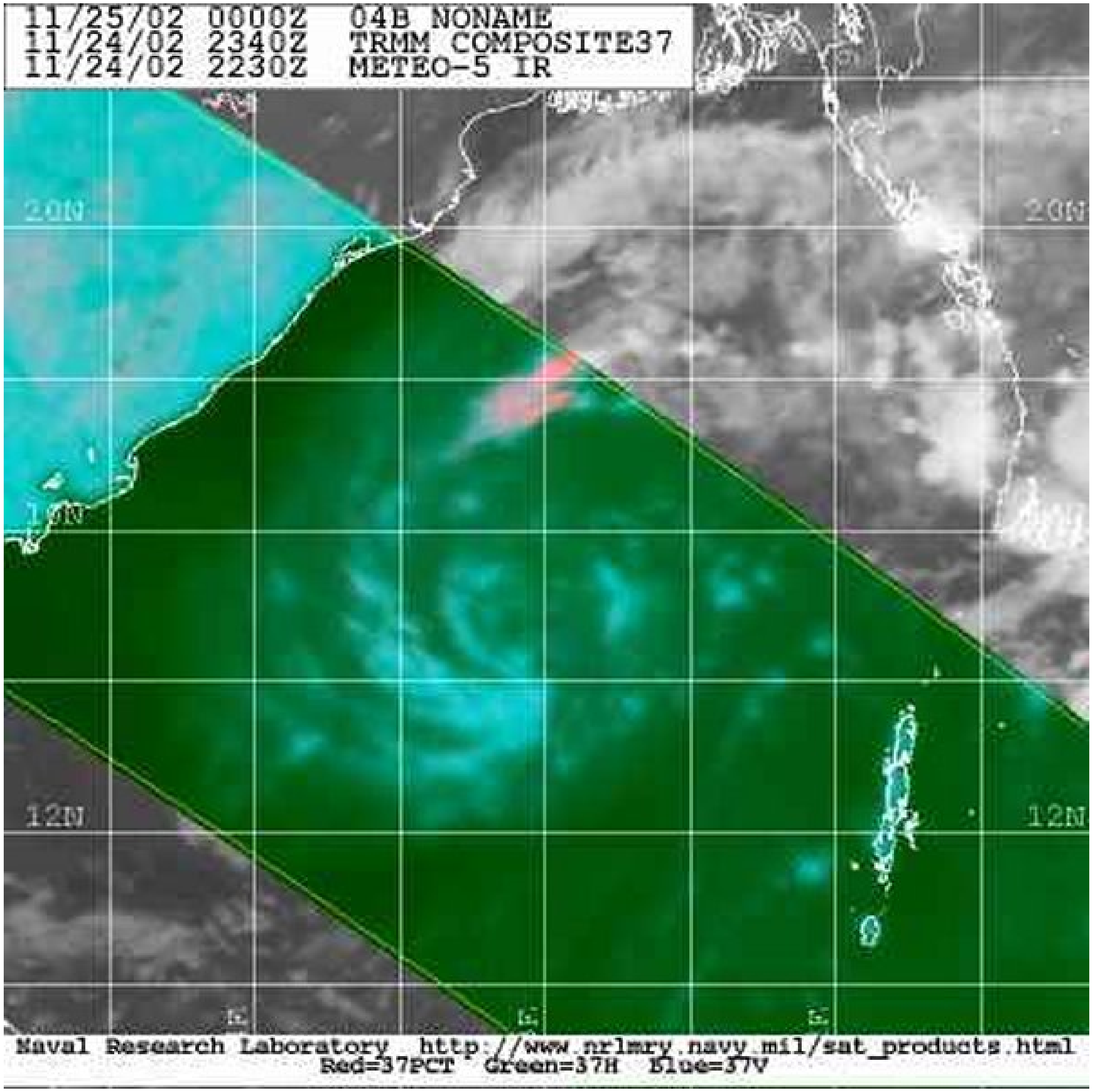
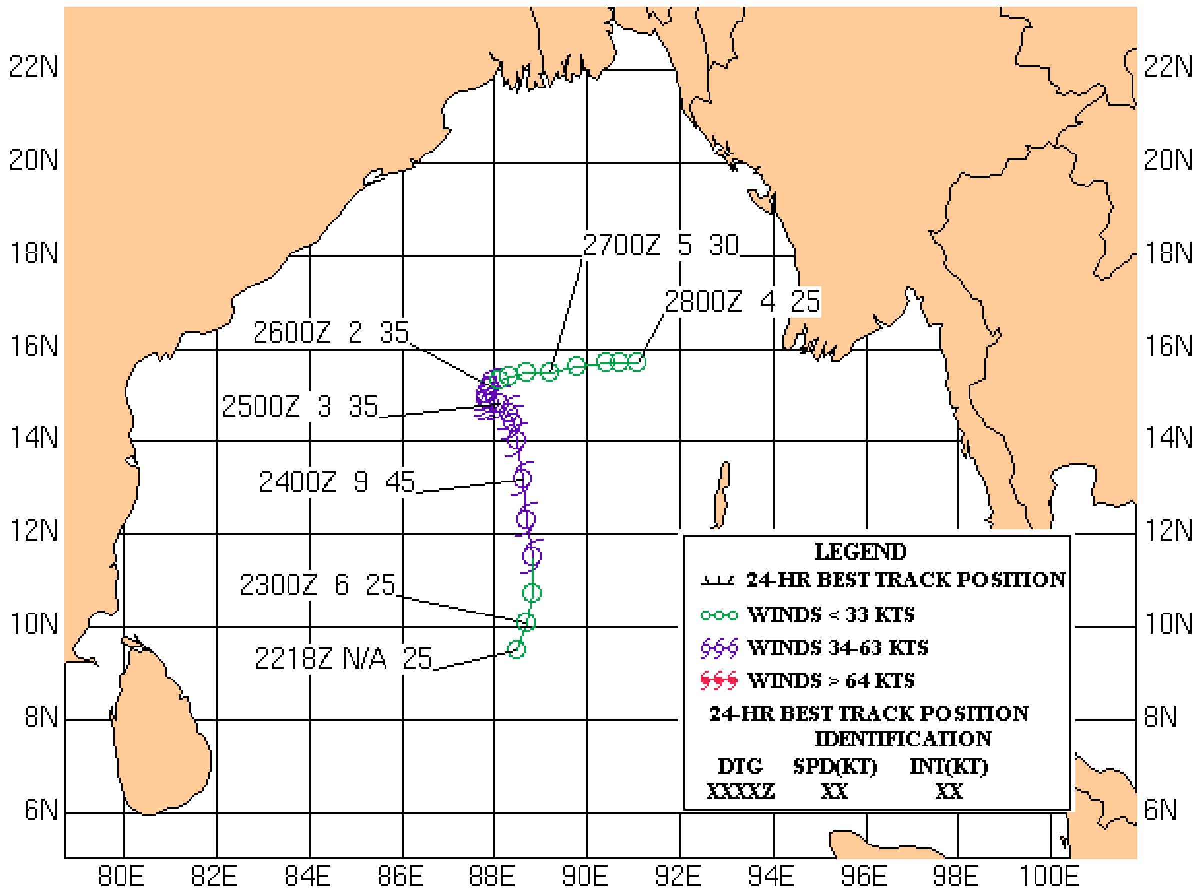



Figure 1-04B-1. 242340Z November 2002 color 37 TRMM image of TC 04B, located 425 nm south of Calcutta. The weakening system revealed an exposed low level circulation center with an estimated intensity of 35 knots.

TC 05B

# TROPICAL CYCLONE 04B
## 23-25 NOV 2002



# Tropical Cyclone (TC) 05B

Verification Statistics

First Poor : 0900Z 19 Dec 02
First Fair : 1100Z 20 Dec 02
First TCFA : 2000Z 20 Dec 02
First Warning : 1800Z 23 Dec 02
Last Warning : 1800Z 25 Dec 02
Max Intensity : 35 kts, Gusts To 45 kts
Landfall : None
Total Warnings : 5

STY10W Halong

TS 11W Nakri

STY12W Fengshen

TS 13W

TY 14W Fung-Wong

TD 15W Kalmaegi

TS 16W Kammuri

TD 17W

TS 18W

STY19W Phanfone

TS 20W Vongfong

TY 21W Rusa

TY 22W Sinlaku

TS 23W Hagupit

TS 24W Mekkhala

STY25W Higos

TY 26W Bavi

TD 27W

TD 28W

TS 29W Maysak

TY 30W Haishen

STY31W Pongsona

HUR02C Ele

HUR03C Huko

TC 01A

TC 02B

TC 03B

TC 04B

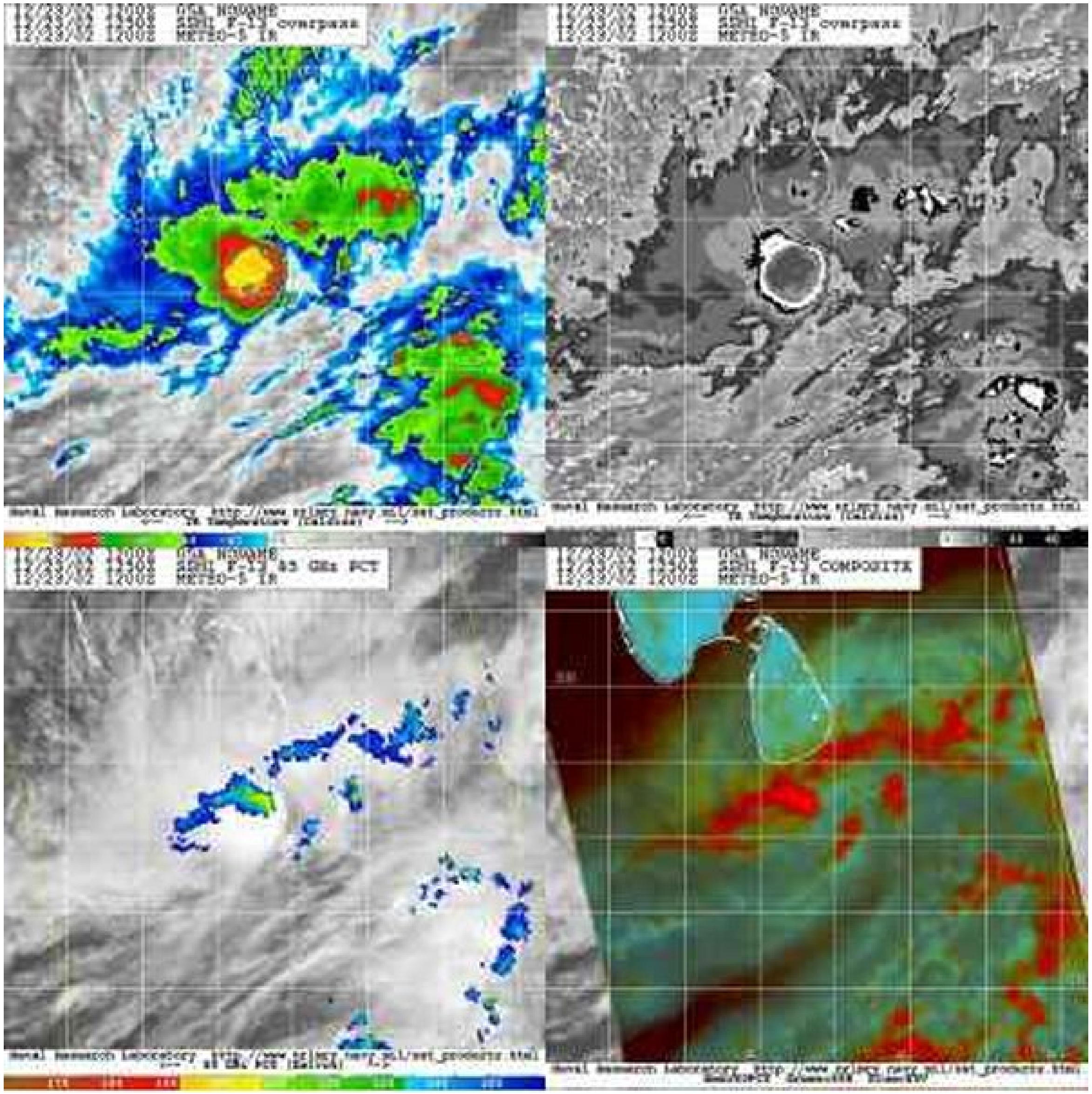
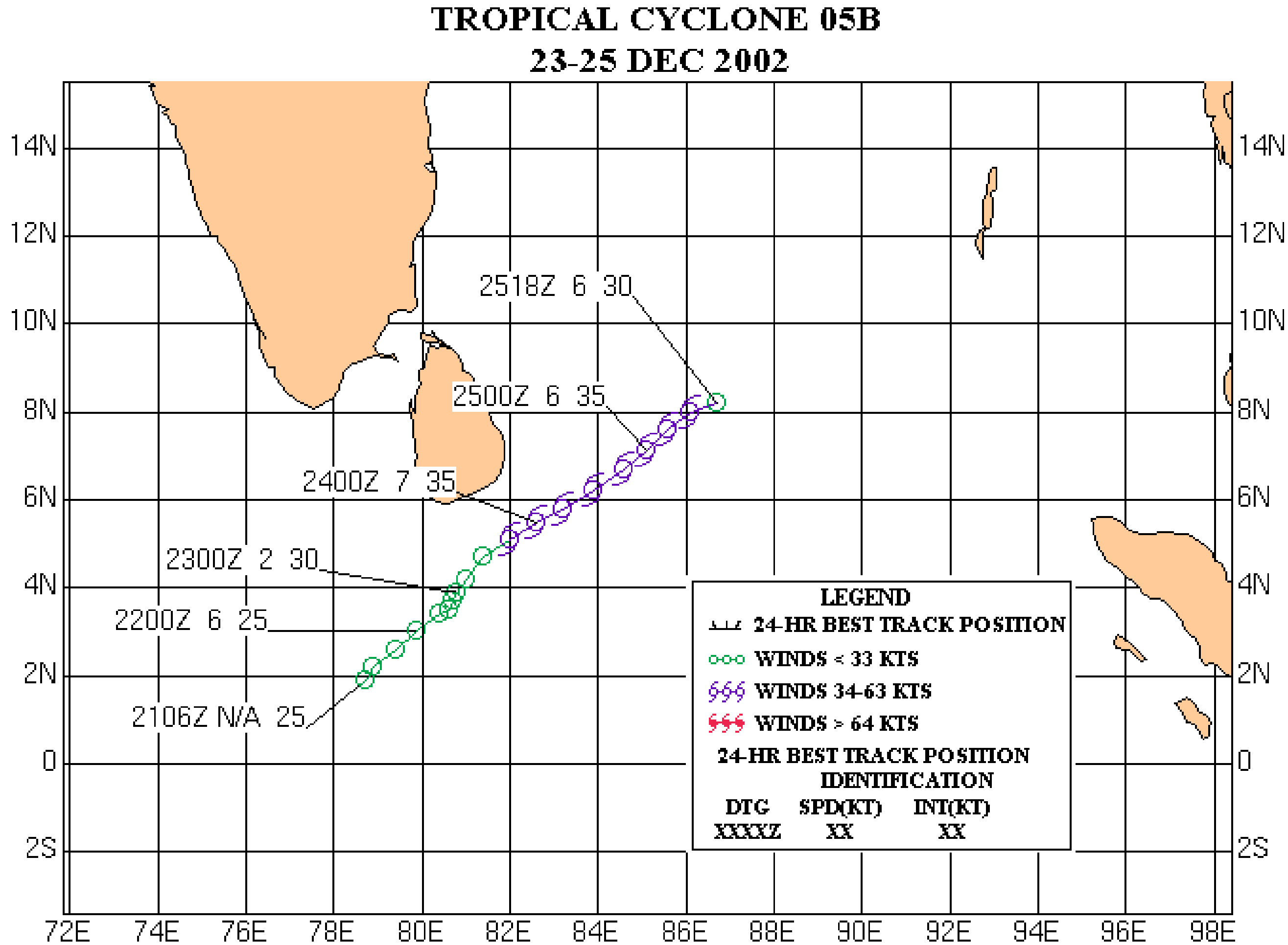


Figure 1-05B-1. 231250Z December 2002 multi-sensor satellite images TC 05B, located 95 nm southeast of Sri Lanka, with an estimated intensity of 25 knots.

TC 05B


TROPICAL CYCLONE 05B
23-25 DEC 2002
14N
12N
10N
8N
6N
4N
2N
0
2S
72E
74E
76E
78E
80E
82E
84E
86E
88E
90E
92E
94E
96E
98E
2518Z 6 30
2500Z 6 35
2400Z 7 35
2300Z 2 30
2200Z 6 25
2106Z N/A 25
LEGEND
24-HR BEST TRACK POSITION
WINDS < 33 KTS
WINDS 34-63 KTS
WINDS > 64 KTS
24-HR BEST TRACK POSITION IDENTIFICATION
DTG SPD(KT) INT(KT)
XXXXZ XX XX

**Statistics for JTWC on TC 04B**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02112218 | | 9.5N | 88.5E | 25 | | | | | | | | | | | | | | | | |
| 02112300 | | 10.1N | 88.7E | 25 | | | | | | | | | | | | | | | | |
| 02112306 | | 10.7N | 88.8E | 25 | | | | | | | | | | | | | | | | |
| 02112312 | 1 | 11.5N | 88.8E | 35 | 6 | 40 | 59 | 59 | 114 | 225 | | | 0 | -10 | 5 | 10 | 10 | 15 | | |
| 02112318 | 2 | 12.3N | 88.7E | 45 | 6 | 29 | 42 | 96 | 137 | 224 | | | 0 | 5 | 10 | 15 | 15 | 15 | | |
| 02112400 | 3 | 13.2N | 88.6E | 45 | 5 | 17 | 55 | 114 | 159 | 215 | | | 0 | 10 | 10 | 15 | 15 | 15 | | |
| 02112406 | 4 | 14.0N | 88.5E | 40 | 5 | 25 | 71 | 122 | 150 | 178 | | | 0 | 5 | 5 | 10 | 15 | 10 | | |
| 02112412 | 5 | 14.4N | 88.4E | 35 | 32 | 51 | 91 | 117 | 141 | 162 | | | 0 | 0 | 0 | 0 | 5 | 5 | | |
| 02112418 | 6 | 14.6N | 88.3E | 35 | 47 | 92 | 122 | 148 | 171 | 217 | | | 0 | 0 | 0 | 0 | 0 | -5 | | |
| 02112500 | 7 | 14.8N | 88.1E | 35 | 60 | 114 | 138 | 168 | 198 | 228 | | | 0 | 0 | -5 | 0 | -5 | 0 | | |
| 02112506 | 8 | 14.8N | 87.9E | 35 | 13 | 25 | 52 | 107 | 202 | | | | 0 | -5 | -5 | -5 | -10 | | | |
| 02112512 | 9 | 14.9N | 87.8E | 35 | 29 | 58 | 110 | 203 | | | | | 0 | -5 | -5 | -10 | | | | |
| 02112518 | | 15.0N | 87.8E | 35 | | | | | | | | | | | | | | | | |
| 02112600 | | 15.2N | 87.9E | 35 | | | | | | | | | | | | | | | | |
| 02112606 | | 15.3N | 88.1E | 30 | | | | | | | | | | | | | | | | |
| 02112612 | | 15.4N | 88.3E | 30 | | | | | | | | | | | | | | | | |
| 02112618 | | 15.5N | 88.7E | 30 | | | | | | | | | | | | | | | | |
| 02112700 | | 15.5N | 89.2E | 30 | | | | | | | | | | | | | | | | |
| 02112706 | | 15.6N | 89.8E | 30 | | | | | | | | | | | | | | | | |
| 02112712 | | 15.7N | 90.4E | 30 | | | | | | | | | | | | | | | | |
| 02112718 | | 15.7N | 90.7E | 30 | | | | | | | | | | | | | | | | |
| 02112800 | | 15.7N | 91.1E | 25 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 23 | 50 | 82 | 126 | 159 | 207 | | | 0 | 4 | 5 | 7 | 9 | 9 | | |
| | | | BIAS | | | | | | | | | | 0 | 0 | 2 | 4 | 6 | 8 | | |
| | | | # CASES | | 9 | 9 | 9 | 9 | 8 | 7 | | | 9 | 9 | 9 | 9 | 8 | 7 | | |

**Statistics for JTWC on TC 05B**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02122106 | | 1.9N | 78.7E | 25 | | | | | | | | | | | | | | | | |
| 02122112 | | 2.2N | 78.9E | 25 | | | | | | | | | | | | | | | | |
| 02122118 | | 2.6N | 79.4E | 25 | | | | | | | | | | | | | | | | |
| 02122200 | | 3.0N | 79.9E | 25 | | | | | | | | | | | | | | | | |
| 02122206 | | 3.4N | 80.4E | 25 | | | | | | | | | | | | | | | | |
| 02122212 | | 3.5N | 80.6E | 25 | | | | | | | | | | | | | | | | |
| 02122218 | | 3.7N | 80.7E | 30 | | | | | | | | | | | | | | | | |
| 02122300 | | 3.9N | 80.8E | 30 | | | | | | | | | | | | | | | | |
| 02122306 | | 4.2N | 81.0E | 30 | | | | | | | | | | | | | | | | |
| 02122312 | | 4.7N | 81.4E | 30 | | | | | | | | | | | | | | | | |
| 02122318 | 1 | 5.1N | 82.0E | 35 | 13 | 9 | 65 | 141 | 215 | | | | 0 | 5 | 10 | 10 | 20 | | | |
| 02122406 | 2 | 5.8N | 83.2E | 35 | 8 | 46 | 114 | 175 | | | | | 0 | 5 | 10 | 15 | | | | |
| 02122418 | 3 | 6.7N | 84.6E | 35 | 13 | 27 | 42 | | | | | | 0 | 5 | 15 | | | | | |
| 02122506 | 4 | 7.6N | 85.6E | 35 | 0 | 17 | | | | | | | 0 | 10 | | | | | | |
| 02122518 | 5 | 8.2N | 86.7E | 30 | 17 | | | | | | | | 5 | | | | | | | |
| | | | AVERAGE | | 11 | 24 | 74 | 158 | 215 | | | | 1 | 6 | 12 | 13 | 20 | | | |
| | | | BIAS | | | | | | | | | | 1 | 6 | 12 | 13 | 20 | | | |
| | | | # CASES | | 5 | 4 | 3 | 2 | 1 | | | | 5 | 4 | 3 | 2 | 1 | | | |

## 5.3 SOUTHERN HEMISPHERE VERIFICATION TABLES

This section includes this year's verification statistics for each Southern Hemisphere tropical cyclone warned on by JTWC.

**Statistics for JTWC on TC 01S**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 01100406 | | 9.7S | 81.9E | 25 | | | | | | | | | | | | | | | | |
| 01100412 | | 10.0S | 82.1E | 25 | | | | | | | | | | | | | | | | |
| 01100418 | | 10.0S | 82.4E | 25 | | | | | | | | | | | | | | | | |
| 01100500 | | 10.1S | 82.6E | 25 | | | | | | | | | | | | | | | | |
| 01100506 | | 10.2S | 82.7E | 25 | | | | | | | | | | | | | | | | |
| 01100512 | | 10.3S | 82.7E | 25 | | | | | | | | | | | | | | | | |
| 01100518 | | 10.4S | 82.8E | 25 | | | | | | | | | | | | | | | | |
| 01100600 | | 10.5S | 82.9E | 30 | | | | | | | | | | | | | | | | |

**TC 09P Bernie**

**TC 10S Dina**

**TC 11S Eddy**

**TC 12S Francesca**

**TC 13S Chris**

**TC 14P Claudia**

**TC 15S Guillaume**

**TC 16P**

**TC 17P Des**

**TC 18S Hary**

**TC 19P**

**TC 20S Ikala**

**TC 21S Dianne-Jery**

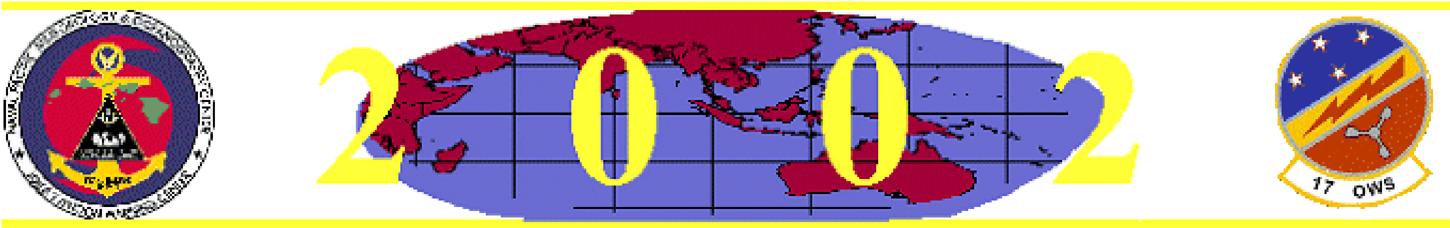
**TC 22S Bonnie**

**TC 23S Kesiny**

**TC 24S Errol**

**TC 25P Upia**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01100606 | 1 | 11.0S | 83.0E | 35 | 11 | 38 | 63 | 53 | 0 | 5 | 10 | 10 |
| 01100618 | 2 | 11.6S | 82.6E | 30 | 18 | 61 | 56 | | 0 | 5 | 10 | |
| 01100706 | 3 | 11.8S | 82.5E | 30 | 21 | 21 | | | 0 | 0 | | |
| 01100718 | 4 | 12.8S | 82.3E | 30 | 21 | | | | 0 | | | |
| | | | AVERAGE | | 18 | 40 | 59 | 53 | 0 | 3 | 10 | 10 |
| | | | BIAS | | | | | | 0 | 3 | 10 | 10 |
| | | | # CASES | | 4 | 3 | 2 | 1 | 4 | 3 | 2 | 1 |





**Statistics for JTWC on STY31W Pongsona**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02120106 | | 5.2N | 166.1E | 15 | | | | | | | | | | | | | | | | |
| 02120112 | | 5.5N | 165.8E | 15 | | | | | | | | | | | | | | | | |
| 02120118 | | 5.8N | 165.5E | 25 | | | | | | | | | | | | | | | | |
| 02120200 | | 6.2N | 165.0E | 25 | | | | | | | | | | | | | | | | |
| 02120206 | | 6.7N | 164.5E | 25 | | | | | | | | | | | | | | | | |
| 02120212 | | 7.3N | 164.0E | 25 | | | | | | | | | | | | | | | | |
| 02120218 | 1 | 8.0N | 163.4E | 25 | 36 | 54 | 27 | 30 | 47 | 53 | 83 | 77 | 0 | 0 | -5 | -5 | -5 | -10 | -25 | -35 |
| 02120300 | 2 | 8.7N | 162.9E | 35 | 8 | 27 | 36 | 67 | 76 | 98 | 156 | 144 | 0 | 5 | 5 | 10 | 10 | 0 | -15 | -30 |
| 02120306 | 3 | 8.9N | 162.1E | 35 | 18 | 48 | 86 | 110 | 118 | 142 | 166 | 154 | 0 | 0 | 0 | 5 | 5 | -5 | -20 | -50 |
| 02120312 | 4 | 8.9N | 161.2E | 40 | 18 | 56 | 94 | 120 | 122 | 128 | 142 | 134 | 0 | 5 | 10 | 5 | 0 | -5 | -25 | -45 |
| 02120318 | 5 | 8.8N | 160.5E | 45 | 18 | 61 | 98 | 109 | 126 | 131 | 143 | 105 | -5 | 0 | 0 | -5 | 0 | -10 | -25 | -45 |
| 02120400 | 6 | 8.6N | 159.9E | 45 | 16 | 61 | 66 | 107 | 145 | 196 | 122 | 59 | 0 | 0 | -5 | -10 | -5 | -15 | -35 | -40 |
| 02120406 | 7 | 8.5N | 159.4E | 50 | 8 | 18 | 27 | 55 | 72 | 112 | 105 | 117 | 0 | 5 | 5 | 5 | 0 | -15 | -50 | -40 |
| 02120412 | 8 | 8.5N | 158.7E | 50 | 13 | 30 | 25 | 22 | 51 | 82 | 115 | 269 | 0 | 0 | 0 | 0 | -5 | -20 | -40 | -20 |
| 02120418 | 9 | 8.4N | 157.9E | 55 | 17 | 38 | 21 | 18 | 38 | 80 | 205 | 409 | 0 | 0 | 5 | 0 | -5 | -20 | -35 | -20 |
| 02120500 | 10 | 8.4N | 156.8E | 60 | 18 | 61 | 80 | 91 | 84 | 103 | 274 | 574 | 0 | 0 | 5 | 0 | 0 | -20 | -25 | -10 |
| 02120506 | 11 | 8.4N | 155.8E | 65 | 13 | 45 | 64 | 58 | 38 | 64 | 351 | 543 | 0 | 5 | 10 | 5 | 0 | -25 | -35 | -10 |
| 02120512 | 12 | 8.5N | 154.9E | 70 | 8 | 12 | 12 | 18 | 21 | 94 | 410 | 416 | 0 | 5 | 5 | 5 | 0 | -25 | -30 | 0 |
| 02120518 | 13 | 8.8N | 153.9E | 70 | 5 | 13 | 22 | 43 | 93 | 184 | 294 | 262 | 0 | 0 | 0 | -5 | -10 | -25 | -30 | 10 |
| 02120600 | 14 | 9.0N | 152.9E | 75 | 17 | 32 | 30 | 63 | 105 | 197 | 280 | 243 | 0 | 0 | 0 | -10 | -20 | -30 | -35 | 5 |
| 02120606 | 15 | 9.2N | 151.9E | 80 | 13 | 6 | 38 | 71 | 121 | 242 | 383 | 297 | 0 | 0 | 0 | -5 | -25 | -25 | -10 | 5 |
| 02120612 | 16 | 9.4N | 150.9E | 85 | 5 | 6 | 38 | 80 | 119 | 237 | 175 | 56 | 0 | 0 | 0 | -10 | -20 | -20 | -10 | 0 |
| 02120618 | 17 | 9.8N | 150.0E | 90 | 13 | 18 | 66 | 95 | 156 | 217 | 146 | 153 | 0 | -5 | -10 | -25 | -20 | -20 | -5 | 5 |
| 02120700 | 18 | 10.3N | 149.1E | 95 | 5 | 48 | 80 | 99 | 144 | 113 | 113 | | 0 | 0 | -15 | -30 | -30 | -25 | 45 | |
| 02120706 | 19 | 10.8N | 148.1E | 100 | 5 | 40 | 64 | 84 | 102 | 69 | 248 | | 0 | -5 | -20 | -15 | -20 | 5 | 35 | |
| 02120712 | 20 | 11.3N | 147.2E | 105 | 0 | 21 | 25 | 53 | 78 | 72 | 292 | | 0 | -10 | -20 | -20 | -15 | 15 | 25 | |
| 02120718 | 21 | 11.9N | 146.3E | 110 | 6 | 6 | 13 | 13 | 26 | 150 | 481 | | 0 | -15 | -15 | -20 | -15 | 30 | 35 | |
| 02120800 | 22 | 12.6N | 145.6E | 120 | 5 | 12 | 27 | 38 | 46 | 188 | | | 0 | -10 | -10 | -10 | -15 | 20 | | |
| 02120806 | 23 | 13.5N | 145.1E | 130 | 5 | 8 | 8 | 13 | 82 | 244 | | | 0 | 0 | -10 | -10 | 5 | 25 | | |

TS 18W
STY19W Phanfone
TS 20W Vongfong
TY 21W Rusa
TY 22W Sinlaku
TS 23W Hagupit
TS 24W Mekkhala
STY25W Higos
TY 26W Bavi
TD 27W
TD 28W
TS 29W Maysak
TY 30W Haishen
STY31W Pongsona
TC 01A
TC 02B
TC 03B
TC 04B
TC 05B
5.3 SOUTHERN HEMISPHERE VERIFICATION TABLES
TC 01S
TC 02S Alex-Andre
TC 03S
TC 04S
TC 05S Bessi-Bako
TC 06P Trina
TC 07P Waka
TC 08S Cyprien
TC 09P Bernie
TC 10S Dina
TC 11S Eddy


| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02120812 | 24 | 14.3N | 144.7E | 130 | 0 | 12 | 12 | 43 | 119 | 281 | | | 0 | 0 | 0 | -10 | 15 | 20 | | |
| 02120818 | 25 | 15.2N | 144.2E | 125 | 0 | 6 | 33 | 13 | 8 | 59 | | | 5 | 0 | 5 | 15 | 35 | 30 | | |
| 02120900 | 26 | 16.1N | 143.8E | 125 | 6 | 18 | 24 | 6 | 40 | | | | 0 | 0 | -10 | 10 | 25 | | | |
| 02120906 | 27 | 17.0N | 143.7E | 125 | 6 | 29 | 5 | 8 | 19 | | | | 0 | 0 | 10 | 25 | 25 | | | |
| 02120912 | 28 | 18.1N | 143.6E | 115 | 8 | 26 | 28 | 42 | 130 | | | | 0 | -10 | 10 | 20 | 10 | | | |
| 02120918 | 29 | 19.2N | 144.2E | 110 | 6 | 35 | 34 | 87 | 134 | | | | 0 | 15 | 30 | 20 | 15 | | | |
| 02121000 | 30 | 20.6N | 145.8E | 110 | 6 | 33 | 26 | 84 | | | | | 0 | 20 | 30 | 20 | | | | |
| 02121006 | 31 | 22.4N | 147.7E | 85 | 17 | 42 | 76 | 122 | | | | | 15 | 30 | 20 | 10 | | | | |
| 02121012 | 32 | 24.2N | 150.3E | 75 | 6 | 12 | 82 | | | | | | 25 | 30 | 15 | | | | | |
| 02121018 | 33 | 25.6N | 153.0E | 55 | 0 | 16 | 67 | | | | | | 35 | 25 | 20 | | | | | |
| 02121100 | 34 | 27.2N | 156.2E | 50 | 12 | 49 | | | | | | | 25 | 10 | | | | | | |
| 02121106 | | 28.3N | 160.1E | 45 | | | | | | | | | | | | | | | | |
| 02121112 | | 29.1N | 163.4E | 45 | | | | | | | | | | | | | | | | |
| 02121118 | | 30.7N | 168.8E | 35 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 10 | 29 | 43 | 60 | 85 | 141 | 223 | 236 | 3 | 6 | 9 | 11 | 12 | 18 | 28 | 22 |
| | | | BIAS | | | | | | | | | | 3 | 3 | 2 | -1 | -2 | -7 | -15 | -19 |
| | | | # CASES | | 34 | 34 | 33 | 31 | 29 | 25 | 21 | 17 | 34 | 34 | 33 | 31 | 29 | 25 | 21 | 17 |

**Statistics for JTWC on HUR02C Ele**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02082500 | | 9.8N | 157.6W | 15 | | | | | | | | | | | | | | | | |
| 02082506 | | 9.9N | 158.7W | 15 | | | | | | | | | | | | | | | | |
| 02082512 | | 10.1N | 159.8W | 15 | | | | | | | | | | | | | | | | |
| 02082518 | | 10.2N | 160.9W | 15 | | | | | | | | | | | | | | | | |
| 02082600 | | 10.3N | 162.1W | 15 | | | | | | | | | | | | | | | | |
| 02082606 | 1 | 10.3N | 163.4W | 25 | 18 | | | | | | | | 0 | | | | | | | |
| 02082612 | 2 | 10.2N | 164.8W | 25 | 37 | | | | | | | | 0 | | | | | | | |
| 02082618 | 3 | 10.1N | 166.3W | 25 | 54 | | | | | | | | 0 | | | | | | | |
| 02082700 | 4 | 10.0N | 167.8W | 30 1 | 37 | | | | | | | | 0 | | | | | | | |
| 02082706 | 5 | 10.0N | 169.3W | 40 | 13 | | | | | | | | 0 | | | | | | | |
| 02082712 | 6 | 9.9N | 170.8W | 60 | 8 | | | | | | | | 0 | | | | | | | |
| 02082718 | 7 | 9.8N | 172.2W | 60 | 21 | | | | | | | | 0 | | | | | | | |
| 02082800 | 8 | 9.6N | 173.3W | 65 | 11 | | | | | | | | 0 | | | | | | | |
| 02082806 | 9 | 9.8N | 174.4W | 65 | 11 | | | | | | | | 0 | | | | | | | |
| 02082812 | 10 | 10.3N | 175.3W | 75 | 5 | | | | | | | | 0 | | | | | | | |
| 02082818 | 11 | 10.9N | 176.1W | 75 | 41 | | | | | | | | 0 | | | | | | | |
| 02082900 | 12 | 11.0N | 177.0W | 75 | 70 | | | | | | | | 0 | | | | | | | |
| 02082906 | 13 | 11.1N | 177.7W | 90 | 26 | | | | | | | | 0 | | | | | | | |
| 02082912 | 14 | 11.5N | 178.3W | 90 | 18 | | | | | | | | 0 | | | | | | | |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02082918 | 15 | 11.8N | 179.1W | 100 | 8 | | | | | | | | 0 | | | | | | | |
| 02083000 | 16 | 12.1N | 179.8W | 100 | 5 | | | | | | | | 15 | | | | | | | |
| 02083006 | 17 | 12.6N | 179.7E | 105 | 6 | 17 | 13 | 42 | 58 | 65 | 107 | 160 | 0 | 0 | -5 | 5 | 10 | 5 | 10 | 30 |
| 02083012 | 18 | 13.2N | 179.1E | 105 | 8 | 0 | 24 | 58 | 62 | 73 | 161 | 276 | 0 | -5 | 0 | 5 | 15 | 0 | 15 | 35 |
| 02083018 | 19 | 13.8N | 178.5E | 105 | 0 | 19 | 29 | 31 | 37 | 111 | 229 | 371 | 0 | -10 | -5 | 10 | 20 | 0 | -5 | -5 |
| 02083100 | 20 | 14.3N | 178.0E | 110 | 0 | 17 | 29 | 31 | 36 | 129 | 258 | 407 | 0 | 10 | 20 | 25 | 30 | 5 | 10 | 5 |
| 02083106 | 21 | 15.0N | 177.6E | 115 | 0 | 21 | 29 | 16 | 42 | 111 | 117 | 154 | 0 | 15 | 20 | 25 | 10 | 0 | 35 | 45 |
| 02083112 | 22 | 15.9N | 177.2E | 115 | 0 | 21 | 23 | 42 | 78 | 132 | 121 | 119 | 0 | 5 | 15 | 15 | -5 | -5 | 30 | 35 |
| 02083118 | 23 | 16.9N | 177.0E | 115 | 0 | 6 | 34 | 66 | 100 | 156 | 159 | 173 | 0 | 5 | 15 | 0 | -10 | 0 | 15 | 5 |
| 02090100 | 24 | 17.9N | 176.7E | 115 | 0 | 48 | 43 | 33 | 74 | 177 | 159 | 156 | 0 | 0 | 5 | -15 | -20 | 5 | 15 | 0 |
| 02090106 | 25 | 18.9N | 176.4E | 110 | 0 | 41 | 61 | 68 | 66 | 89 | 72 | 78 | 0 | 10 | -5 | -15 | -15 | 10 | 30 | 25 |
| 02090112 | 26 | 19.9N | 176.0E | 105 | 0 | 29 | 47 | 67 | 96 | 115 | 103 | 123 | 0 | 0 | -20 | -25 | -15 | 10 | 25 | 20 |
| 02090118 | 27 | 20.8N | 175.5E | 100 | 0 | 12 | 44 | 73 | 115 | 97 | 73 | 71 | -5 | -20 | -30 | -30 | -20 | 0 | 10 | 5 |
| 02090200 | 28 | 21.7N | 175.1E | 100 | 0 | 30 | 59 | 82 | 136 | 132 | 105 | 84 | 0 | -10 | -5 | 5 | 10 | 25 | 10 | 5 |
| 02090206 | 29 | 22.7N | 175.0E | 110 | 0 | 21 | 45 | 81 | 115 | 123 | 132 | 177 | 0 | 0 | 5 | 10 | 25 | 40 | 40 | 45 |
| 02090212 | 30 | 23.5N | 175.0E | 115 | 12 | 28 | 49 | 83 | 94 | 104 | 190 | 237 | -5 | -5 | 5 | 15 | 25 | 40 | 35 | 50 |
| 02090218 | 31 | 24.1N | 175.3E | 115 | 5 | 21 | 12 | 8 | 33 | 54 | 96 | 85 | -5 | 0 | 5 | 20 | 30 | 40 | 35 | 60 |
| 02090300 | 32 | 24.8N | 175.7E | 115 | 8 | 17 | 28 | 46 | 29 | 87 | 47 | 52 | 0 | 10 | 20 | 30 | 35 | 20 | 40 | 50 |
| 02090306 | 33 | 25.3N | 176.0E | 110 | 0 | 16 | 45 | 51 | 70 | 119 | 107 | 54 | 0 | 10 | 20 | 30 | 30 | 25 | 20 | 30 |
| 02090312 | 34 | 25.6N | 176.4E | 105 | 5 | 32 | 64 | 66 | 82 | 128 | 82 | 73 | 0 | 10 | 15 | 20 | 20 | 5 | 15 | 20 |
| 02090318 | 35 | 25.9N | 176.7E | 100 | 0 | 26 | 37 | 88 | 156 | 163 | 35 | 72 | 5 | 15 | 20 | 25 | 20 | 5 | 25 | 25 |
| 02090400 | 36 | 26.1N | 176.9E | 90 | 5 | 32 | 44 | 91 | 146 | 237 | 115 | 163 | 0 | 0 | 0 | 0 | -10 | -10 | 20 | 20 |
| 02090406 | 37 | 26.4N | 177.0E | 85 | 0 | 24 | 13 | 53 | 110 | 96 | | | 0 | 0 | 0 | -5 | -15 | -10 | | |
| 02090412 | 38 | 26.8N | 177.0E | 80 | 5 | 27 | 5 | 36 | 87 | 35 | | | 0 | 0 | -5 | -15 | -20 | -5 | | |
| 02090418 | 39 | 27.3N | 176.4E | 75 | 12 | 26 | 37 | 67 | 89 | 30 | | | 0 | 5 | -5 | -15 | -20 | 5 | | |
| 02090500 | 40 | 27.7N | 175.7E | 70 | 0 | 22 | 58 | 89 | 87 | 43 | | | 0 | 0 | -10 | -15 | -15 | 5 | | |
| 02090506 | 41 | 28.1N | 175.2E | 65 | 7 | 55 | 84 | 93 | 80 | 44 | | | 0 | -5 | -15 | -20 | -15 | -5 | | |
| 02090512 | 42 | 28.7N | 174.7E | 65 | 5 | 52 | 93 | 96 | 80 | 90 | | | 0 | -10 | -15 | -15 | -10 | 0 | | |
| 02090518 | 43 | 29.3N | 174.3E | 65 | 0 | 10 | 36 | 77 | 32 | 158 | | | 0 | -10 | -15 | -10 | 0 | 5 | | |
| 02090600 | 44 | 30.0N | 173.7E | 70 | 11 | 12 | 8 | 40 | 96 | 168 | | | 0 | -5 | -5 | 0 | 10 | 5 | | |
| 02090606 | 45 | 30.6N | 173.1E | 70 | 13 | 16 | 66 | 100 | 85 | 101 | | | 0 | -5 | -5 | 5 | 5 | 10 | | |
| 02090612 | 46 | 31.2N | 172.5E | 70 | 7 | 26 | 54 | 75 | 75 | 57 | | | 0 | -5 | 0 | 10 | 0 | 5 | | |
| 02090618 | 47 | 32.0N | 171.7E | 70 | 32 | 8 | 50 | 53 | 53 | 57 | | | 0 | 5 | 15 | 10 | 10 | 10 | | |
| 02090700 | 48 | 32.7N | 170.8E | 65 | 0 | 15 | 46 | 59 | 31 | 86 | | | 0 | 0 | 5 | -5 | -5 | 0 | | |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02090706 | 49 | 33.5N | 169.8E | 60 | 7 | 55 | 53 | 46 | 37 | 104 | | | 0 | 0 | 0 | -5 | 0 | 0 | | |
| 02090712 | 50 | 34.0N | 168.6E | 55 | 5 | 27 | 37 | 48 | 44 | | | | 0 | 0 | -5 | -5 | -5 | | | |
| 02090718 | 51 | 34.2N | 167.2E | 45 | 0 | 21 | 24 | 42 | 84 | | | | 0 | -5 | -5 | -5 | -10 | | | |
| 02090800 | 52 | 34.5N | 166.5E | 40 | 0 | 30 | 53 | 105 | | | | | 0 | -10 | -10 | -10 | | | | |
| 02090806 | 53 | 35.0N | 166.0E | 40 | 0 | 25 | 81 | 141 | | | | | 0 | -5 | -5 | -10 | | | | |
| 02090812 | 54 | 35.4N | 165.6E | 40 | 15 | 15 | 90 | 123 | | | | | 0 | -5 | -5 | -5 | | | | |
| 02090818 | 55 | 36.0N | 165.3E | 35 | 0 | 38 | 98 | 108 | | | | | 5 | 0 | -5 | -5 | | | | |
| 02090900 | 56 | 36.8N | 165.3E | 35 | 0 | 52 | 73 | | | | | | 0 | 0 | 0 | | | | | |
| 02090906 | 57 | 37.9N | 165.6E | 30 | 15 | 42 | 61 | | | | | | 5 | 0 | 0 | | | | | |
| 02090912 | 58 | 38.9N | 166.2E | 30 | 12 | 30 | | | | | | | 5 | 5 | | | | | | |
| 02090918 | 59 | 39.9N | 167.0E | 30 | 19 | 42 | | | | | | | 0 | -5 | | | | | | |
| 02091000 | 60 | 40.9N | 167.7E | 25 | 12 | | | | | | | | 5 | | | | | | | |
| 02091006 | 61 | 42.0N | 168.8E | 25 | 14 | | | | | | | | 0 | | | | | | | |
| | | | AVERAGE | | 12 | 26 | 46 | 66 | 77 | 105 | 123 | 154 | 1 | 5 | 9 | 13 | 15 | 10 | 22 | 26 |
| | | | BIAS | | | | | | | | | | 0 | 0 | 0 | 1 | 3 | 7 | 22 | 25 |
| | | | # CASES | | 61 | 43 | 41 | 39 | 35 | 33 | 20 | 20 | 61 | 43 | 41 | 39 | 35 | 33 | 20 | 20 |

**Statistics for JTWC on HUR03C Huko**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02102318 | | 8.7N | 153.8W | 20 | | | | | | | | | | | | | | | | |
| 02102400 | | 8.9N | 154.0W | 20 | | | | | | | | | | | | | | | | |
| 02102406 | | 9.1N | 154.2W | 20 | | | | | | | | | | | | | | | | |
| 02102412 | | 9.3N | 154.3W | 25 | | | | | | | | | | | | | | | | |
| 02102418 | 1 | 9.5N | 154.3W | 25 | 16 | | | | | | | | 0 | | | | | | | |
| 02102500 | 2 | 9.8N | 154.3W | 25 | 13 | | | | | | | | 0 | | | | | | | |
| 02102506 | 3 | 10.0N | 154.2W | 25 | 13 | | | | | | | | 0 | | | | | | | |
| 02102512 | 4 | 10.3N | 154.2W | 25 | 13 | | | | | | | | 0 | | | | | | | |
| 02102518 | 5 | 10.5N | 154.4W | 30 | 8 | | | | | | | | 0 | | | | | | | |
| 02102600 | 6 | 10.8N | 154.9W | 35 | 0 | | | | | | | | 0 | | | | | | | |
| 02102606 | 7 | 11.4N | 155.1W | 35 | 11 | | | | | | | | 0 | | | | | | | |
| 02102612 | 8 | 11.6N | 156.0W | 40 | 0 | | | | | | | | 0 | | | | | | | |
| 02102618 | 9 | 11.5N | 156.3W | 45 | 0 | | | | | | | | 0 | | | | | | | |
| 02102700 | 10 | 11.5N | 157.0W | 45 | 0 | | | | | | | | 0 | | | | | | | |
| 02102706 | 11 | 11.7N | 157.6W | 50 | 21 | | | | | | | | 0 | | | | | | | |
| 02102712 | 12 | 11.9N | 157.9W | 55 | 18 | | | | | | | | 0 | | | | | | | |
| 02102718 | 13 | 12.2N | 158.1W | 55 | 35 | | | | | | | | 0 | | | | | | | |
| 02102800 | 14 | 12.3N | 158.5W | 55 | 24 | | | | | | | | 0 | | | | | | | |
| 02102806 | 15 | 12.5N | 158.8W | 55 | 29 | | | | | | | | 0 | | | | | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02102812 | 16 | 12.7N | 159.0W | 60 | 18 | | | | | | 0 | | | | | |
| 02102818 | 17 | 12.8N | 159.4W | 65 | 8 | | | | | | 0 | | | | | |
| 02102900 | 18 | 12.8N | 159.7W | 65 | 17 | | | | | | 0 | | | | | |
| 02102906 | 19 | 12.9N | 160.0W | 65 | 41 | | | | | | 0 | | | | | |
| 02102912 | 20 | 13.2N | 160.3W | 65 | 11 | | | | | | 0 | | | | | |
| 02102918 | 21 | 13.6N | 160.4W | 65 | 11 | | | | | | 0 | | | | | |
| 02103000 | 22 | 14.0N | 161.3W | 55 | 0 | | | | | | 0 | | | | | |
| 02103006 | 23 | 14.0N | 162.6W | 55 | 0 | | | | | | 0 | | | | | |
| 02103012 | 24 | 13.8N | 163.4W | 50 | 0 | | | | | | 0 | | | | | |
| 02103018 | 25 | 13.7N | 164.3W | 55 | 0 | | | | | | -5 | | | | | |
| 02103100 | 26 | 13.4N | 165.2W | 60 | 30 | | | | | | 0 | | | | | |
| 02103106 | 27 | 13.2N | 166.2W | 65 | 36 | | | | | | 0 | | | | | |
| 02103112 | 28 | 13.2N | 166.9W | 65 | 30 | | | | | | 0 | | | | | |
| 02103118 | 29 | 13.2N | 168.1W | 65 | 32 | | | | | | 0 | | | | | |
| 02110100 | 30 | 13.4N | 169.2W | 65 | 0 | | | | | | 0 | | | | | |
| 02110106 | 31 | 13.7N | 170.3W | 65 | 0 | | | | | | 0 | | | | | |
| 02110112 | 32 | 14.1N | 171.4W | 75 | 0 | | | | | | 0 | | | | | |
| 02110118 | 33 | 14.3N | 172.0W | 75 | 18 | | | | | | 0 | | | | | |
| 02110200 | 34 | 14.5N | 172.7W | 75 | 13 | | | | | | 0 | | | | | |
| 02110206 | 35 | 14.7N | 173.5W | 75 | 0 | | | | | | 0 | | | | | |
| 02110212 | 36 | 14.8N | 174.2W | 75 | 8 | | | | | | 0 | | | | | |
| 02110218 | 37 | 15.0N | 175.3W | 75 | 28 | | | | | | 0 | | | | | |
| 02110300 | 38 | 15.3N | 176.8W | 75 | 40 | | | | | | 0 | | | | | |
| 02110306 | 39 | 15.5N | 178.6W | 75 | 31 | | | | | | 0 | | | | | |
| 02110312 | 40 | 15.7N | 179.6E | 75 | 16 | 52 | 82 | 103 | 55 | 239 | 0 | 5 | 5 | 5 | 0 | 10 |
| 02110318 | 41 | 16.1N | 177.5E | 75 | 18 | 70 | 136 | 132 | 148 | 296 | 0 | -5 | -5 | 0 | 10 | 5 |
| 02110400 | 42 | 16.7N | 174.9E | 70 | 0 | 21 | 57 | 94 | 150 | 335 | 0 | 0 | 10 | 10 | 10 | 5 |
| 02110406 | 43 | 17.5N | 172.3E | 70 | 0 | 36 | 69 | 121 | 227 | 481 | 0 | 0 | 0 | 10 | 0 | 5 |
| 02110412 | 44 | 18.7N | 169.9E | 70 | 33 | 51 | 69 | 159 | 252 | | 0 | 5 | 5 | 5 | -5 | |
| 02110418 | 45 | 19.8N | 167.3E | 75 | 0 | 79 | 157 | 268 | 392 | | 0 | -5 | 0 | -5 | -10 | |
| 02110500 | 46 | 20.6N | 165.4E | 70 | 17 | 25 | 118 | 245 | 339 | | 0 | -10 | -15 | -10 | -10 | |
| 02110506 | 47 | 21.7N | 163.9E | 75 | 0 | 35 | 187 | 291 | 492 | | 0 | 0 | -5 | -10 | 0 | |
| 02110512 | 48 | 23.1N | 163.1E | 70 | 0 | 74 | 201 | 343 | | | 0 | -5 | -5 | 0 | | |
| 02110518 | 49 | 24.3N | 162.7E | 65 | 0 | 84 | 191 | 391 | | | 0 | -5 | -10 | 5 | | |
| 02110600 | 50 | 25.3N | 162.8E | 65 | 0 | 104 | 223 | | | | 0 | 0 | 0 | | | |
| 02110606 | 51 | 25.9N | 164.2E | 60 | 0 | 58 | 210 | | | | 0 | -5 | 10 | | | |
| 02110612 | 52 | 26.8N | 166.2E | 55 | 0 | 92 | | | | | 0 | 0 | | | | |
| 02110618 | 53 | 27.1N | 168.9E | 55 | 0 | 11 | | | | | 0 | 15 | | | | |
| 02110700 | 54 | 27.6N | 171.7E | 45 | 0 | | | | | | 0 | | | | | |
| 02110706 | | 28.3N | 174.7E | 35 | | | | | | | | | | | | |

| | | | | | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | AVERAGE | 12 | 57 | 142 | 215 | 257 | 338 | | | 0 | 4 | 6 | 6 | 6 | 6 | | |
| | | | | BIAS | | | | | | | | | 0 | -1 | -1 | 1 | -1 | 6 | | |
| | | | | # CASES | 54 | 14 | 12 | 10 | 8 | 4 | | | 54 | 14 | 12 | 10 | 8 | 4 | | |

**Statistics for JTWC on TC 01A**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02050518 | | 8.6N | 67.7E | 25 | | | | | | | | | | | | | | | | |
| 02050600 | | 8.7N | 67.2E | 25 | | | | | | | | | | | | | | | | |
| 02050606 | | 9.2N | 66.5E | 30 | | | | | | | | | | | | | | | | |
| 02050612 | | 10.3N | 66.0E | 30 | | | | | | | | | | | | | | | | |
| 02050618 | 1 | 11.5N | 65.7E | 30 | 18 | 38 | 23 | 45 | 52 | | | | 0 | -5 | 5 | 10 | 15 | | | |
| 02050706 | 2 | 12.6N | 64.0E | 40 | 40 | 66 | 73 | 80 | 112 | 193 | | | 0 | 5 | 10 | 10 | 5 | 10 | | |
| 02050712 | 3 | 12.6N | 63.3E | 40 | 37 | 31 | 34 | 58 | 99 | 116 | | | 0 | 5 | 10 | 5 | 0 | 5 | | |
| 02050718 | 4 | 12.6N | 62.7E | 35 | 37 | 24 | 21 | 13 | 75 | 88 | | | 0 | 5 | 10 | 0 | -5 | 10 | | |
| 02050800 | 5 | 12.9N | 62.0E | 35 | 8 | 17 | 46 | 76 | 92 | | | | 0 | 5 | 5 | -5 | -10 | | | |
| 02050806 | 6 | 13.2N | 61.1E | 35 | 11 | 32 | 68 | 118 | 112 | | | | 0 | 0 | -10 | -10 | -5 | | | |
| 02050812 | 7 | 13.4N | 60.4E | 35 | 0 | 26 | 85 | 117 | 98 | | | | 0 | 0 | -5 | -10 | 0 | | | |
| 02050906 | 8 | 14.6N | 57.7E | 45 | 5 | 47 | 52 | 34 | | | | | 0 | 0 | -5 | -5 | | | | |
| 02050912 | 9 | 15.0N | 56.5E | 45 | 11 | 31 | 38 | | | | | | 0 | -10 | -5 | | | | | |
| 02050918 | 10 | 15.3N | 55.3E | 45 | 21 | 51 | 71 | | | | | | 0 | 0 | 0 | | | | | |
| 02051000 | 11 | 15.7N | 54.4E | 45 | 17 | 60 | | | | | | | 0 | 5 | | | | | | |
| 02051006 | 12 | 16.0N | 53.8E | 40 | 32 | 49 | | | | | | | 0 | 0 | | | | | | |
| 02051012 | 13 | 16.5N | 53.3E | 35 | 60 | | | | | | | | 0 | | | | | | | |
| 02051018 | | 17.4N | 53.1E | 30 | | | | | | | | | | | | | | | | |
| | | | | AVERAGE | 23 | 39 | 51 | 68 | 91 | 132 | | | 0 | 3 | 7 | 7 | 6 | 8 | | |
| | | | | BIAS | | | | | | | | | 0 | 1 | 2 | -1 | 0 | 8 | | |
| | | | | # CASES | 13 | 12 | 10 | 8 | 7 | 3 | | | 13 | 12 | 10 | 8 | 7 | 3 | | |

**Statistics for JTWC on TC 02B**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02050906 | | 8.4N | 95.5E | 25 | | | | | | | | | | | | | | | | |
| 02050912 | | 8.9N | 95.1E | 30 | | | | | | | | | | | | | | | | |
| 02050918 | | 9.4N | 95.1E | 30 | | | | | | | | | | | | | | | | |
| 02051000 | | 9.9N | 95.1E | 30 | | | | | | | | | | | | | | | | |
| 02051006 | | 10.5N | 95.3E | 30 | | | | | | | | | | | | | | | | |
| 02051012 | 1 | 11.0N | 95.5E | 35 | 65 | 71 | 100 | 192 | 282 | | | | 0 | 5 | -5 | 5 | 20 | | | |
| 02051018 | 2 | 11.5N | 95.5E | 35 | 8 | 32 | 68 | 169 | | | | | 0 | -5 | 0 | 20 | | | | |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02051100 | 3 | 12.1N | 95.4E | 35 | 8 | 54 | 154 | 235 | | | | | 0 | -5 | 10 | 30 | | | | |
| 02051106 | 4 | 12.9N | 95.4E | 45 | 13 | 60 | 155 | | | | | | 0 | 0 | 20 | | | | | |
| 02051112 | 5 | 14.0N | 95.5E | 45 | 11 | 93 | 165 | | | | | | 0 | 10 | 20 | | | | | |
| 02051118 | 6 | 15.3N | 95.8E | 45 | 50 | 149 | | | | | | | 0 | 20 | | | | | | |
| 02051200 | 7 | 16.8N | 96.2E | 35 | 8 | 18 | | | | | | | 0 | 10 | | | | | | |
| 02051206 | 8 | 18.3N | 96.6E | 25 | 0 | | | | | | | | 0 | | | | | | | |
| 02051212 | | 19.2N | 97.4E | 15 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 21 | 68 | 128 | 198 | 282 | | | | 0 | 8 | 11 | 18 | 20 | | | |
| | | | BIAS | | | | | | | | | | 0 | 5 | 9 | 18 | 20 | | | |
| | | | # CASES | | 8 | 7 | 5 | 3 | 1 | | | | 8 | 7 | 5 | 3 | 1 | | | |

**Statistics for JTWC on TC 03B**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02110918 | | 11.3N | 82.2E | 25 | | | | | | | | | | | | | | | | |
| 02111000 | | 11.7N | 82.3E | 25 | | | | | | | | | | | | | | | | |
| 02111006 | | 12.1N | 82.4E | 25 | | | | | | | | | | | | | | | | |
| 02111012 | | 12.6N | 82.6E | 25 | | | | | | | | | | | | | | | | |
| 02111018 | | 13.1N | 82.9E | 25 | | | | | | | | | | | | | | | | |
| 02111100 | | 13.6N | 83.6E | 30 | | | | | | | | | | | | | | | | |
| 02111106 | | 14.2N | 84.4E | 30 | | | | | | | | | | | | | | | | |
| 02111112 | 1 | 15.4N | 85.0E | 35 | 8 | 44 | 198 | | | | | | 0 | 0 | 5 | | | | | |
| 02111118 | 2 | 16.6N | 85.8E | 35 | 33 | 138 | | | | | | | 0 | -15 | | | | | | |
| 02111200 | 3 | 18.2N | 86.7E | 35 | 33 | 180 | | | | | | | 0 | 5 | | | | | | |
| 02111206 | 4 | 20.8N | 87.4E | 55 | 0 | | | | | | | | 0 | | | | | | | |
| 02111212 | 5 | 23.2N | 89.2E | 30 | 0 | | | | | | | | 0 | | | | | | | |
| | | | AVERAGE | | 15 | 120 | 198 | | | | | | 0 | 7 | 5 | | | | | |
| | | | BIAS | | | | | | | | | | 0 | -3 | 5 | | | | | |
| | | | # CASES | | 5 | 3 | 1 | | | | | | 5 | 3 | 1 | | | | | |

**Statistics for JTWC on TD 27W**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02101600 | | 18.3N | 161.6E | 15 | | | | | | | | | | | | | | | | |
| 02101606 | | 18.3N | 160.6E | 20 | | | | | | | | | | | | | | | | |
| 02101612 | | 18.2N | 159.6E | 20 | | | | | | | | | | | | | | | | |
| 02101618 | | 18.0N | 158.5E | 20 | | | | | | | | | | | | | | | | |
| 02101700 | 1 | 17.7N | 157.4E | 25 | 16 | 12 | 42 | 102 | 156 | 302 | | | 0 | 10 | 10 | 15 | 25 | 35 | | |
| 02101706 | 2 | 17.4N | 156.5E | 25 | 0 | 18 | 54 | 90 | 134 | 283 | | | 0 | 5 | 5 | 10 | 20 | 35 | | |
| 02101712 | 3 | 17.1N | 155.7E | 25 | 6 | 30 | 60 | 91 | 157 | 244 | | | 0 | 0 | 5 | 15 | 25 | 35 | | |
| 02101718 | 4 | 16.9N | 154.9E | 25 | 8 | 18 | 48 | 81 | 125 | 144 | | | 0 | 0 | 5 | 15 | 20 | 25 | | |
| 02101800 | 5 | 16.6N | 154.1E | 30 | 21 | 36 | 55 | 100 | 120 | | | | 0 | 5 | 15 | 20 | 20 | | | |
| 02101806 | 6 | 16.4N | 153.3E | 30 | 8 | 12 | 19 | 54 | 78 | | | | 0 | 5 | 15 | 20 | 30 | | | |
| 02101812 | 7 | 16.3N | 152.5E | 30 | 8 | 13 | 27 | 58 | 59 | | | | 0 | 10 | 20 | 20 | 30 | | | |
| 02101818 | 8 | 16.3N | 151.7E | 30 | 21 | 52 | 86 | 86 | 38 | | | | 0 | 10 | 15 | 25 | 30 | | | |
| 02101900 | 9 | 16.3N | 150.7E | 25 | 24 | 58 | 93 | | | | | | 0 | 5 | 0 | | | | | |
| 02101906 | 10 | 16.4N | 149.5E | 25 | 13 | 49 | 63 | | | | | | 0 | 0 | 5 | | | | | |
| 02101912 | | 16.5N | 148.3E | 20 | | | | | | | | | | | | | | | | |
| 02101918 | | 16.9N | 147.2E | 20 | | | | | | | | | | | | | | | | |
| 02102000 | | 17.2N | 146.1E | 20 | | | | | | | | | | | | | | | | |
| 02102006 | | 17.9N | 145.5E | 15 | | | | | | | | | | | | | | | | |
| 02102012 | | 18.6N | 145.4E | 15 | | | | | | | | | | | | | | | | |
| 02102018 | | 19.2N | 145.6E | 15 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 13 | 30 | 55 | 83 | 108 | 243 | | | 0 | 5 | 10 | 18 | 25 | 33 | | |
| | | | BIAS | | | | | | | | | | 0 | 5 | 10 | 18 | 25 | 33 | | |
| | | | # CASES | | 10 | 10 | 10 | 8 | 8 | 4 | | | 10 | 10 | 10 | 8 | 8 | 4 | | |

TD 17W

TS 18W

STY19W Phanfone

TS 20W Vongfong

TY 21W Rusa

TY 22W Sinlaku

TS 23W Hagupit

TS 24W Mekkhala

STY25W Higos

TY 26W Bavi

TD 27W

TD 28W

TS 29W Maysak

TY 30W Haishen

STY31W Pongsona

HUR02C Ele

HUR03C Huko

TC 01A

TC 02B

TC 03B

TC 04B

TC 05B

5.3 SOUTHERN HEMISPHERE VERIFICATION TABLES

TC 01S

TC 02S Alex-Andre

TC 03S

TC 04S

TC 05S Bessi-Bako

TC 06P Trina

TC 07P Waka

TC 08S Cyprien

**Statistics for JTWC on TD 28W**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02101712 | | 13.1N | 177.1E | 25 | | | | | | | | | | | | | | | | |
| 02101718 | | 13.4N | 176.3E | 25 | | | | | | | | | | | | | | | | |
| 02101800 | 1 | 14.0N | 175.9E | 25 | 24 | 101 | 229 | | | | | | 0 | 0 | 5 | | | | | |
| 02101806 | 2 | 14.7N | 175.7E | 30 | 42 | 158 | 323 | | | | | | 0 | 5 | 15 | | | | | |
| 02101812 | 3 | 15.4N | 175.8E | 30 | 29 | 156 | | | | | | | 0 | 5 | | | | | | |
| 02101818 | 4 | 16.2N | 176.0E | 30 | 12 | 93 | | | | | | | 0 | 10 | | | | | | |
| 02101900 | 5 | 17.2N | 176.4E | 30 | 12 | | | | | | | | 0 | | | | | | | |
| 02101906 | 6 | 18.3N | 177.0E | 25 | 57 | | | | | | | | 0 | | | | | | | |
| | | | AVERAGE | | 30 | 127 | 276 | | | | | | 0 | 5 | 10 | | | | | |
| | | | BIAS | | | | | | | | | | 0 | 5 | 10 | | | | | |
| | | | # CASES | | 6 | 4 | 2 | | | | | | 6 | 4 | 2 | | | | | |

**Statistics for JTWC on TS 29W Maysak**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02102500 | | 16.5N | 168.8E | 15 | | | | | | | | | | | | | | | | |
| 02102506 | | 16.6N | 168.3E | 15 | | | | | | | | | | | | | | | | |
| 02102512 | | 16.9N | 167.4E | 15 | | | | | | | | | | | | | | | | |
| 02102518 | | 17.1N | 166.6E | 15 | | | | | | | | | | | | | | | | |
| 02102600 | | 17.5N | 165.2E | 25 | | | | | | | | | | | | | | | | |
| 02102606 | | 18.2N | 163.2E | 25 | | | | | | | | | | | | | | | | |
| 02102612 | | 18.7N | 161.9E | 25 | | | | | | | | | | | | | | | | |
| 02102618 | 1 | 19.0N | 161.0E | 30 | 71 | 111 | 110 | 144 | 194 | 193 | | | 0 | 5 | -10 | -25 | -25 | -20 | | |
| 02102700 | 2 | 19.5N | 160.4E | 30 | 29 | 67 | 68 | 42 | 126 | 343 | | | 0 | 0 | -15 | -25 | -25 | -20 | | |
| 02102706 | 3 | 20.4N | 159.7E | 30 | 33 | 90 | 58 | 60 | 142 | | | | 0 | -15 | -30 | -35 | -35 | | | |
| 02102712 | 4 | 21.8N | 159.2E | 35 | 11 | 37 | 22 | 63 | 104 | | | | 0 | -20 | -30 | -35 | -40 | | | |
| 02102718 | 5 | 23.2N | 158.7E | 50 | 49 | 64 | 60 | 36 | 92 | | | | -5 | -15 | -25 | -25 | -30 | | | |
| 02102800 | 6 | 24.3N | 158.6E | 55 | 24 | 78 | 56 | 62 | 100 | | | | -5 | -15 | -20 | -30 | -25 | | | |
| 02102806 | 7 | 25.3N | 159.1E | 60 | 13 | 22 | 17 | 21 | | | | | -15 | -25 | -30 | -30 | | | | |
| 02102812 | 8 | 26.3N | 160.0E | 60 | 11 | 68 | 76 | 67 | | | | | -15 | -25 | -35 | -25 | | | | |
| 02102818 | 9 | 27.6N | 161.4E | 60 | 0 | 56 | 123 | | | | | | -5 | -10 | -10 | | | | | |
| 02102900 | 10 | 29.2N | 163.4E | 60 | 8 | 67 | 121 | | | | | | -10 | -15 | -5 | | | | | |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02102906 | 11 | 30.4N | 166.4E | 55 | 20 | 52 | | | | | | | -5 | -5 | | | | | | |
| 02102912 | 12 | 31.6N | 169.5E | 60 | 0 | 67 | | | | | | | -10 | 0 | | | | | | |
| 02102918 | | 32.6N | 172.8E | 50 | | | | | | | | | | | | | | | | |
| 02103000 | | 33.7N | 177.3E | 45 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 23 | 65 | 71 | 62 | 126 | 268 | | | 6 | 13 | 21 | 29 | 30 | 20 | | |
| | | | BIAS | | | | | | | | | | -6 | -12 | -21 | -29 | -30 | -20 | | |
| | | | # CASES | | 12 | 12 | 10 | 8 | 6 | 2 | | | 12 | 12 | 10 | 8 | 6 | 2 | | |

**Statistics for JTWC on TY 30W Haishen**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02111906 | | 9.4N | 153.8E | 25 | | | | | | | | | | | | | | | | |
| 02111912 | | 9.6N | 152.3E | 25 | | | | | | | | | | | | | | | | |
| 02111918 | | 10.0N | 150.5E | 25 | | | | | | | | | | | | | | | | |
| 02112000 | | 10.2N | 148.4E | 25 | | | | | | | | | | | | | | | | |
| 02112006 | 1 | 10.4N | 146.7E | 25 | 35 | 17 | 27 | 100 | 121 | 136 | | | 0 | 0 | 0 | 0 | -5 | -20 | | |
| 02112012 | 2 | 10.6N | 145.2E | 30 | 33 | 30 | 8 | 46 | 63 | 157 | 442 | | 0 | 5 | 5 | 0 | 0 | -5 | -10 | |
| 02112018 | 3 | 10.9N | 143.9E | 30 | 29 | 70 | 102 | 131 | 104 | 193 | 277 | | 0 | 5 | 0 | -5 | -5 | -25 | -5 | |
| 02112100 | 4 | 11.5N | 142.4E | 30 | 34 | 71 | 66 | 92 | 102 | 192 | 419 | | 0 | 0 | -5 | -5 | -10 | -30 | 5 | |
| 02112106 | 5 | 12.1N | 140.7E | 35 | 34 | 48 | 18 | 37 | 91 | 277 | | | 0 | 0 | -5 | -5 | -15 | -10 | | |
| 02112112 | 6 | 12.7N | 139.0E | 40 | 0 | 21 | 12 | 25 | 81 | 352 | | | 0 | -5 | 0 | -5 | -5 | 0 | | |
| 02112118 | 7 | 13.2N | 137.5E | 45 | 6 | 44 | 43 | 57 | 87 | 341 | | | 0 | 0 | 0 | -5 | -20 | 0 | | |
| 02112200 | 8 | 14.0N | 136.8E | 55 | 21 | 57 | 94 | 134 | 198 | 425 | | | 0 | 10 | 5 | -10 | -30 | 5 | | |
| 02112206 | 9 | 15.1N | 136.0E | 60 | 0 | 18 | 66 | 133 | 290 | | | | 0 | 5 | -5 | -15 | -20 | | | |
| 02112212 | 10 | 15.8N | 135.4E | 65 | 5 | 29 | 87 | 159 | 286 | | | | 0 | 0 | -5 | -15 | -10 | | | |
| 02112218 | 11 | 16.5N | 135.3E | 70 | 6 | 78 | 149 | 248 | 282 | | | | -5 | -15 | -20 | -10 | 0 | | | |
| 02112300 | 12 | 17.6N | 135.2E | 75 | 17 | 41 | 90 | 222 | 203 | | | | 0 | -5 | -20 | -5 | 10 | | | |
| 02112306 | 13 | 18.8N | 135.3E | 85 | 0 | 21 | 84 | 86 | | | | | 0 | -15 | -15 | 0 | | | | |
| 02112312 | 14 | 19.9N | 135.7E | 85 | 8 | 6 | 43 | 35 | | | | | 0 | -20 | -5 | 5 | | | | |
| 02112318 | 15 | 21.1N | 136.4E | 95 | 5 | 51 | 19 | | | | | | 0 | 5 | 10 | | | | | |
| 02112400 | 16 | 22.8N | 137.5E | 95 | 0 | 30 | 48 | | | | | | 0 | 15 | 20 | | | | | |
| 02112406 | 17 | 25.0N | 139.1E | 85 | 21 | 75 | | | | | | | 0 | 10 | | | | | | |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02112412 | 18 | 27.0N | 140.9E | 75 | 12 | 61 | | | | | | 0 | 5 | | | | | |
| 02112418 | 19 | 28.7N | 143.2E | 65 | 5 | | | | | | | 0 | | | | | | |
| 02112500 | | 30.1N | 145.6E | 55 | | | | | | | | | | | | | | |
| | | | AVERAGE | | 15 | 43 | 60 | 107 | 159 | 259 | 379 | 0 | 7 | 8 | 6 | 11 | 12 | 7 |
| | | | BIAS | | | | | | | | | 0 | 0 | -3 | -5 | -9 | -11 | -3 |
| | | | # CASES | | 19 | 18 | 16 | 14 | 12 | 8 | 3 | 19 | 18 | 16 | 14 | 12 | 8 | 3 |

**Statistics for JTWC on TS 23W Hagupit**

| | **WRN** | | **BEST TRACK** | | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02090906 | | 19.6N | 119.5E | 15 | | | | | | | | | | | | | | | | |
| 02090912 | | 19.5N | 119.3E | 15 | | | | | | | | | | | | | | | | |
| 02090918 | | 19.6N | 119.0E | 15 | | | | | | | | | | | | | | | | |
| 02091000 | 1 | 19.8N | 118.7E | 25 | 24 | 64 | 108 | 127 | 136 | | | | 0 | -5 | -5 | -5 | 20 | | | |
| 02091006 | 2 | 20.2N | 117.8E | 30 | 49 | 103 | 137 | 143 | 152 | | | | 0 | 0 | -5 | 20 | 20 | | | |
| 02091012 | 3 | 20.4N | 116.8E | 35 | 13 | 41 | 43 | 51 | 41 | | | | 0 | 0 | 0 | 15 | 15 | | | |
| 02091018 | 4 | 20.4N | 115.7E | 35 | 13 | 25 | 22 | 39 | | | | | 5 | -5 | 15 | 10 | | | | |
| 02091100 | 5 | 20.7N | 114.7E | 40 | 5 | 26 | 33 | 37 | | | | | 0 | 0 | 15 | 15 | | | | |
| 02091106 | 6 | 21.0N | 113.7E | 45 | 12 | 6 | 16 | | | | | | 0 | 20 | 15 | | | | | |
| 02091112 | 7 | 21.4N | 112.9E | 45 | 12 | 13 | 25 | | | | | | 0 | 15 | 15 | | | | | |
| 02091118 | 8 | 21.6N | 112.1E | 25 | 11 | 62 | | | | | | | 5 | 0 | | | | | | |
| 02091200 | 9 | 21.8N | 111.2E | 25 | 25 | 22 | | | | | | | 0 | 0 | | | | | | |
| 02091206 | 10 | 22.0N | 110.2E | 25 | 16 | | | | | | | | 0 | | | | | | | |
| 02091212 | | 22.1N | 109.8E | 20 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 18 | 40 | 55 | 79 | 110 | | | | 1 | 5 | 10 | 13 | 18 | | | |
| | | | BIAS | | | | | | | | | | 1 | 3 | 7 | 11 | 18 | | | |
| | | | # CASES | | 10 | 9 | 7 | 5 | 3 | | | | 10 | 9 | 7 | 5 | 3 | | | |

**Statistics for JTWC on TS 24W Mekkhala**

| | **WRN** | | **BEST TRACK** | | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02092106 | | 13.4N | 113.5E | 15 | | | | | | | | | | | | | | | | |
| 02092112 | | 13.5N | 113.4E | 15 | | | | | | | | | | | | | | | | |
| 02092118 | | 13.6N | 113.6E | 15 | | | | | | | | | | | | | | | | |
| 02092200 | | 13.6N | 113.9E | 15 | | | | | | | | | | | | | | | | |
| 02092206 | | 13.8N | 114.1E | 15 | | | | | | | | | | | | | | | | |
| 02092212 | | 14.0N | 114.3E | 20 | | | | | | | | | | | | | | | | |

TS 18W

STY19W Phanfone

TS 20W Vongfong

TY 21W Rusa

TY 22W Sinlaku

TS 23W Hagupit

TS 24W Mekkhala

STY25W Higos

TY 26W Bavi

TD 27W

TD 28W

TS 29W Maysak

TY 30W Haishen

STY31W Pongsona

HUR02C Ele

HUR03C Huko

TC 01A

TC 02B

TC 03B

TC 04B

TC 05B

5.3 SOUTHERN HEMISPHERE VERIFICATION TABLES

TC 01S

TC 02S Alex-Andre

TC 03S

TC 04S

TC 05S Bessi-Bako

TC 06P Trina

TC 07P Waka

TC 08S Cyprien

TC 09P Bernie

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02092218 | | 14.1N | 113.7E | 20 | | | | | | | | | | | | | | | | |
| 02092300 | | 14.1N | 113.0E | 20 | | | | | | | | | | | | | | | | |
| 02092306 | | 14.5N | 112.4E | 25 | | | | | | | | | | | | | | | | |
| 02092312 | 1 | 14.9N | 112.0E | 25 | 13 | 39 | 37 | 38 | 41 | 113 | 192 | | 0 | -5 | -5 | -15 | -25 | -15 | 5 | |
| 02092318 | 2 | 15.3N | 111.4E | 25 | 17 | 42 | 42 | 44 | 46 | 95 | 157 | | 0 | 0 | -5 | -15 | -25 | -10 | 5 | |
| 02092400 | 3 | 15.7N | 110.9E | 30 | 18 | 17 | 17 | 18 | 8 | 90 | 147 | | 0 | 0 | -15 | -20 | -15 | -5 | 10 | |
| 02092406 | 4 | 16.1N | 110.6E | 30 | 23 | 36 | 47 | 52 | 45 | 45 | | | 0 | -5 | -15 | -25 | -20 | 0 | | |
| 02092412 | 5 | 16.6N | 110.3E | 35 | 33 | 53 | 67 | 78 | 86 | 86 | | | -5 | -15 | -25 | -20 | -15 | -5 | | |
| 02092418 | 6 | 17.1N | 110.0E | 40 | 0 | 17 | 24 | 23 | 23 | 33 | | | 0 | -5 | -15 | -10 | -5 | 0 | | |
| 02092500 | 7 | 17.6N | 109.7E | 50 | 8 | 13 | 26 | 21 | 6 | 36 | | | 0 | -5 | 0 | -5 | 0 | 5 | | |
| 02092506 | 8 | 18.1N | 109.5E | 50 | 11 | 23 | 18 | 25 | 23 | | | | 0 | -10 | -5 | 0 | 5 | | | |
| 02092512 | 9 | 18.4N | 109.3E | 55 | 29 | 36 | 25 | 13 | 42 | | | | 0 | 5 | 5 | 10 | 10 | | | |
| 02092518 | 10 | 18.8N | 109.0E | 55 | 8 | 6 | 23 | 22 | 46 | | | | 0 | 10 | 10 | 15 | 5 | | | |
| 02092600 | 11 | 19.2N | 108.8E | 45 | 12 | 29 | 36 | 41 | 61 | | | | 0 | 0 | 0 | 0 | 0 | | | |
| 02092606 | 12 | 19.6N | 108.5E | 45 | 12 | 21 | 29 | 21 | | | | | 0 | 0 | 5 | 0 | | | | |
| 02092612 | 13 | 20.1N | 108.3E | 40 | 8 | 12 | 25 | 57 | | | | | 0 | 5 | 5 | 5 | | | | |
| 02092618 | 14 | 20.7N | 108.4E | 35 | 12 | 22 | 57 | | | | | | 0 | 5 | 0 | | | | | |
| 02092700 | 15 | 21.2N | 108.4E | 30 | 11 | 34 | 41 | | | | | | 0 | 0 | 0 | | | | | |
| 02092706 | 16 | 21.5N | 108.7E | 25 | 21 | 51 | | | | | | | 0 | -5 | | | | | | |
| 02092712 | | 21.4N | 108.9E | 25 | | | | | | | | | | | | | | | | |
| 02092718 | | 21.3N | 109.2E | 25 | | | | | | | | | | | | | | | | |
| 02092800 | | 21.3N | 109.5E | 20 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 15 | 28 | 34 | 35 | 39 | 71 | 165 | | 0 | 5 | 7 | 11 | 11 | 6 | 7 | |
| | | | BIAS | | | | | | | | | | 0 | -2 | -4 | -6 | -8 | -4 | 7 | |
| | | | # CASES | | 16 | 16 | 15 | 13 | 11 | 7 | 3 | | 16 | 16 | 15 | 13 | 11 | 7 | 3 | |

**Statistics for JTWC on STY25W Higos**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02092500 | | 14.7N | 162.9E | 15 | | | | | | | | | | | | | | | | |
| 02092506 | | 14.9N | 161.8E | 15 | | | | | | | | | | | | | | | | |
| 02092512 | | 15.0N | 160.5E | 15 | | | | | | | | | | | | | | | | |
| 02092518 | | 15.3N | 159.1E | 15 | | | | | | | | | | | | | | | | |
| 02092600 | | 15.7N | 157.3E | 20 | | | | | | | | | | | | | | | | |
| 02092606 | 1 | 15.6N | 155.8E | 25 | 21 | 33 | 46 | 49 | 85 | 47 | 96 | 551 | 0 | 0 | -10 | -15 | -15 | -60 | -60 | -25 |
| 02092612 | 2 | 15.5N | 154.5E | 30 | 11 | 38 | 64 | 79 | 83 | 67 | 239 | 748 | 0 | -10 | -10 | -10 | -30 | -65 | -50 | -10 |
| 02092618 | 3 | 15.7N | 153.3E | 35 | 29 | 51 | 76 | 115 | 116 | 121 | 246 | 924 | -5 | -10 | -15 | -20 | -45 | -60 | -35 | 15 |
| 02092700 | 4 | 16.0N | 152.1E | 45 | 5 | 24 | 53 | 74 | 67 | 53 | 356 | 1029 | -5 | -5 | 0 | -15 | -35 | -30 | -5 | 55 |

TC 10S Dina
TC 11S Eddy
TC 12S Francesca
TC 13S Chris
TC 14P Claudia
TC 15S Guillaume
TC 16P
TC 17P Des
TC 18S Hary
TC 19P
TC 20S Ikala
TC 21S Dianne-Jery
TC 22S Bonnie
TC 23S Kesiny
TC 24S Errol
TC 25P Upia

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02092706 | 5 | 16.4N | 150.7E | 50 | 5 | 21 | 62 | 95 | 97 | 25 | 424 | 914 | -5 | -5 | -5 | -25 | -40 | -15 | -5 | 55 |
| 02092712 | 6 | 16.9N | 149.2E | 55 | 5 | 18 | 42 | 46 | 36 | 81 | 586 | | 0 | 0 | -5 | -25 | -30 | 5 | 25 | |
| 02092718 | 7 | 17.4N | 147.5E | 65 | 18 | 11 | 13 | 31 | 21 | 179 | 810 | | 0 | 5 | -15 | -30 | -20 | 10 | 45 | |
| 02092800 | 8 | 18.0N | 145.8E | 65 | 0 | 23 | 46 | 34 | 13 | 261 | 874 | | 0 | -10 | -30 | -35 | -20 | 10 | 55 | |
| 02092806 | 9 | 18.6N | 144.0E | 75 | 0 | 26 | 38 | 40 | 20 | 366 | 1006 | | 0 | -20 | -30 | -20 | -5 | 25 | 65 | |
| 02092812 | 10 | 19.0N | 142.1E | 90 | 0 | 36 | 19 | 21 | 65 | 447 | | | -5 | -20 | -25 | -15 | 10 | 30 | | |
| 02092818 | 11 | 19.4N | 140.5E | 105 | 6 | 36 | 30 | 23 | 89 | 621 | | | 0 | -15 | -5 | 5 | 5 | 35 | | |
| 02092900 | 12 | 19.8N | 138.8E | 120 | 0 | 23 | 28 | 77 | 199 | 690 | | | 0 | -5 | 0 | 10 | 0 | 45 | | |
| 02092906 | 13 | 20.2N | 137.6E | 130 | 0 | 11 | 53 | 128 | 248 | 513 | | | 0 | 10 | 20 | 10 | 10 | 40 | | |
| 02092912 | 14 | 20.9N | 136.7E | 135 | 0 | 22 | 65 | 133 | 223 | | | | 0 | 5 | 15 | 0 | 10 | | | |
| 02092918 | 15 | 21.5N | 136.0E | 130 | 0 | 34 | 105 | 215 | 405 | | | | 0 | 0 | 0 | 5 | 15 | | | |
| 02093000 | 16 | 22.5N | 135.8E | 130 | 0 | 47 | 144 | 253 | 396 | | | | 0 | 5 | -5 | 10 | 10 | | | |
| 02093006 | 17 | 23.7N | 135.8E | 120 | 0 | 30 | 141 | 267 | 255 | | | | 0 | -5 | -5 | 5 | 0 | | | |
| 02093012 | 18 | 25.2N | 136.1E | 110 | 0 | 37 | 104 | 233 | | | | | 0 | -15 | -5 | 0 | | | | |
| 02093018 | 19 | 27.1N | 136.6E | 110 | 0 | 42 | 108 | 119 | | | | | 0 | -5 | 10 | 5 | | | | |
| 02100100 | 20 | 29.6N | 137.5E | 110 | 0 | 8 | 101 | | | | | | 0 | 5 | 0 | | | | | |
| 02100106 | 21 | 32.7N | 138.3E | 95 | 0 | 85 | 93 | | | | | | 0 | 5 | 5 | | | | | |
| 02100112 | 22 | 35.7N | 139.8E | 80 | 0 | 85 | | | | | | | 0 | 5 | | | | | | |
| 02100118 | 23 | 40.6N | 141.5E | 65 | 0 | 21 | | | | | | | -10 | -5 | | | | | | |
| 02100200 | 24 | 43.9N | 141.5E | 55 | 0 | | | | | | | | 0 | | | | | | | |
| 02100206 | 25 | 46.9N | 142.9E | 50 | 56 | | | | | | | | 0 | | | | | | | |
| | | | | AVERAGE | 6 | 33 | 68 | 107 | 142 | 267 | 515 | 833 | 1 | 7 | 10 | 14 | 18 | 33 | 38 | 32 |
| | | | | BIAS | | | | | | | | | -1 | -4 | -5 | -8 | -11 | -2 | 4 | 18 |
| | | | | # CASES | 25 | 23 | 21 | 19 | 17 | 13 | 9 | 5 | 25 | 23 | 21 | 19 | 17 | 13 | 9 | 5 |

**Statistics for JTWC on TY 26W Bavi**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02100712 | | 9.8N | 163.2E | 15 | | | | | | | | | | | | | | | | |
| 02100718 | | 10.1N | 162.5E | 25 | | | | | | | | | | | | | | | | |
| 02100800 | | 10.5N | 161.6E | 25 | | | | | | | | | | | | | | | | |
| 02100806 | | 11.5N | 160.7E | 25 | | | | | | | | | | | | | | | | |
| 02100812 | | 12.1N | 159.4E | 25 | | | | | | | | | | | | | | | | |
| 02100818 | | 12.8N | 157.6E | 25 | | | | | | | | | | | | | | | | |
| 02100900 | | 13.1N | 155.6E | 25 | | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02100906 | 1 | 12.8N | 153.3E | 25 | 38 | 23 | 80 | 162 | 196 | 283 | 457 | 920 | 0 | 0 | 0 | 5 | -5 | 0 | 0 | 35 |
| 02100912 | 2 | 12.9N | 151.4E | 25 | 5 | 58 | 154 | 212 | 244 | 344 | 524 | | 0 | 0 | -5 | -10 | -5 | -5 | 0 | |
| 02100918 | 3 | 13.4N | 150.3E | 30 | 8 | 52 | 101 | 158 | 211 | 384 | 774 | | 0 | 0 | 5 | -5 | 5 | 15 | 70 | |
| 02101000 | 4 | 14.2N | 150.1E | 30 | 5 | 47 | 118 | 194 | 238 | 446 | 900 | | 0 | 0 | -5 | 0 | 5 | 25 | 35 | |
| 02101006 | 5 | 15.6N | 150.1E | 35 | 24 | 54 | 99 | 160 | 240 | 463 | 908 | | 0 | 5 | -5 | 5 | 10 | 40 | 70 | |
| 02101012 | 6 | 17.2N | 149.5E | 40 | 37 | 40 | 70 | 147 | 238 | 444 | | | 0 | -5 | 0 | 5 | 10 | 40 | | |
| 02101018 | 7 | 18.3N | 149.3E | 40 | 11 | 18 | 13 | 65 | 54 | 97 | | | 5 | -5 | 5 | 15 | 20 | 30 | | |
| 02101100 | 8 | 19.1N | 149.2E | 55 | 12 | 54 | 38 | 32 | 40 | 104 | | | 0 | 5 | 10 | 20 | 20 | 25 | | |
| 02101106 | 9 | 19.9N | 148.9E | 60 | 0 | 18 | 34 | 34 | 51 | 127 | | | 0 | 10 | 15 | 15 | 20 | 20 | | |
| 02101112 | 10 | 20.9N | 148.6E | 60 | 0 | 6 | 0 | 12 | 99 | | | | 0 | 5 | 5 | 15 | 10 | | | |
| 02101118 | 11 | 22.1N | 148.0E | 60 | 12 | 30 | 40 | 122 | 239 | | | | 0 | 0 | 5 | 10 | 10 | | | |
| 02101200 | 12 | 23.3N | 147.5E | 65 | 8 | 30 | 78 | 208 | 223 | | | | -5 | 5 | 5 | 0 | 15 | | | |
| 02101206 | 13 | 24.5N | 147.1E | 65 | 12 | 8 | 73 | 182 | 198 | | | | 0 | 5 | 10 | 5 | 15 | | | |
| 02101212 | 14 | 25.8N | 146.8E | 70 | 12 | 34 | 130 | 186 | | | | | 0 | 10 | 5 | 15 | | | | |
| 02101218 | 15 | 27.1N | 146.7E | 70 | 5 | 72 | 186 | 160 | | | | | 0 | 10 | 5 | 10 | | | | |
| 02101300 | 16 | 28.4N | 146.8E | 65 | 13 | 57 | 109 | | | | | | 0 | 0 | 15 | | | | | |
| 02101306 | 17 | 29.6N | 147.6E | 55 | 0 | 118 | 177 | | | | | | 0 | 5 | 15 | | | | | |
| 02101312 | 18 | 30.8N | 148.7E | 55 | 10 | 50 | | | | | | | 0 | 15 | | | | | | |
| 02101318 | 19 | 32.2N | 150.0E | 45 | 0 | 53 | | | | | | | -10 | 10 | | | | | | |
| 02101400 | 20 | 34.7N | 152.3E | 35 | 0 | | | | | | | | 0 | | | | | | | |
| 02101406 | 21 | 37.1N | 155.7E | 30 | 0 | | | | | | | | 0 | | | | | | | |
| | | | | AVERAGE | 10 | 43 | 88 | 136 | 175 | 299 | 713 | 920 | 1 | 5 | 7 | 9 | 12 | 22 | 35 | 35 |
| | | | | BIAS | | | | | | | | | 0 | 4 | 5 | 7 | 10 | 21 | 35 | 35 |
| | | | | # CASES | 21 | 19 | 17 | 15 | 13 | 9 | 5 | 1 | 21 | 19 | 17 | 15 | 13 | 9 | 5 | 1 |

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5.1 WARNING VERIFICATION STATISTICS

5.2 WESTERN NORTH PACIFIC AND NORTH INDIAN OCEAN VERIFICATION TABLES

TS 01W Tapah

STY02W Mitag

TD 03W

TD 04W

STY05W Hagibis

TD 06W

TY 07W Noguri

STY08W Chataan

TY 09W Rammasun

STY10W Halong

TS 11W Nakri

STY12W Fengshen

TS 13W

TY 14W Fung-Wong

TD 15W Kalmaegi

TS 16W Kammuri

TD 17W

**Statistics for JTWC on TY 21W Rusa**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02082200 | | 14.2N | 164.0E | 20 | | | | | | | | | | | | | | | | |
| 02082206 | | 14.7N | 163.5E | 25 | | | | | | | | | | | | | | | | |
| 02082212 | 1 | 15.1N | 162.9E | 30 | 11 | 54 | 113 | 164 | 167 | 197 | 187 | 241 | 0 | -15 | -15 | -25 | -20 | -30 | -70 | -35 |
| 02082218 | 2 | 15.6N | 162.1E | 30 | 29 | 76 | 133 | 166 | 199 | 239 | 228 | 289 | 0 | -10 | -10 | -15 | -10 | -20 | -55 | -25 |
| 02082300 | 3 | 16.2N | 161.3E | 45 | 0 | 29 | 28 | 43 | 57 | 81 | 131 | 152 | -5 | 10 | 5 | 20 | 25 | 10 | -15 | 15 |
| 02082306 | 4 | 16.8N | 160.4E | 45 | 18 | 13 | 32 | 45 | 42 | 78 | 90 | 146 | 0 | 5 | 10 | 20 | 25 | 0 | 0 | 25 |
| 02082312 | 5 | 17.6N | 159.5E | 50 | 12 | 23 | 33 | 37 | 78 | 74 | 76 | 140 | 0 | 0 | 15 | 20 | 25 | 0 | 20 | 25 |
| 02082318 | 6 | 18.3N | 158.3E | 55 | 16 | 46 | 62 | 86 | 94 | 79 | 97 | 151 | 0 | 5 | 15 | 15 | 20 | 5 | 15 | 35 |
| 02082400 | 7 | 18.9N | 157.2E | 65 | 5 | 24 | 45 | 78 | 75 | 62 | 84 | 148 | 0 | 15 | 15 | 20 | 15 | 10 | 30 | 40 |
| 02082406 | 8 | 19.2N | 156.0E | 65 | 8 | 29 | 61 | 77 | 64 | 40 | 114 | 233 | 0 | 0 | -5 | -5 | -20 | 0 | 15 | 35 |
| 02082412 | 9 | 19.7N | 154.9E | 65 | 20 | 47 | 117 | 131 | 98 | 60 | 142 | 249 | 0 | -5 | -10 | -15 | -20 | 15 | 20 | 40 |
| 02082418 | 10 | 20.2N | 153.7E | 70 | 30 | 70 | 90 | 100 | 72 | 68 | 132 | 244 | 0 | 0 | 0 | -20 | -10 | 15 | 25 | 40 |
| 02082500 | 11 | 20.7N | 152.5E | 75 | 0 | 61 | 65 | 65 | 49 | 73 | 129 | 173 | 0 | 5 | -5 | -15 | -5 | 20 | 25 | 20 |
| 02082506 | 12 | 21.1N | 150.9E | 80 | 8 | 8 | 30 | 30 | 12 | 74 | 116 | 24 | 0 | 0 | -15 | -5 | 15 | 35 | 45 | 45 |
| 02082512 | 13 | 21.4N | 149.3E | 85 | 16 | 6 | 37 | 33 | 5 | 48 | 24 | 75 | 0 | -5 | -10 | 0 | 30 | 35 | 40 | 35 |
| 02082518 | 14 | 21.8N | 148.0E | 90 | 8 | 11 | 18 | 49 | 66 | 79 | 27 | 153 | 0 | -15 | -5 | 10 | 30 | 40 | 35 | 35 |
| 02082600 | 15 | 22.1N | 146.8E | 100 | 5 | 13 | 25 | 53 | 67 | 96 | 91 | 238 | 0 | -5 | 0 | 35 | 35 | 45 | 35 | 40 |
| 02082606 | 16 | 22.5N | 145.6E | 115 | 0 | 18 | 24 | 40 | 64 | 114 | 154 | 302 | 0 | 5 | 25 | 35 | 40 | 50 | 50 | 60 |
| 02082612 | 17 | 22.8N | 144.4E | 115 | 8 | 12 | 24 | 55 | 69 | 113 | 203 | 359 | 0 | 10 | 40 | 30 | 35 | 40 | 45 | 70 |
| 02082618 | 18 | 23.2N | 143.2E | 115 | 0 | 12 | 26 | 55 | 73 | 133 | 277 | 515 | 0 | 15 | 30 | 40 | 45 | 50 | 60 | 75 |
| 02082700 | 19 | 23.5N | 141.9E | 115 | 5 | 20 | 36 | 60 | 69 | 124 | 305 | 426 | 0 | 25 | 25 | 35 | 45 | 45 | 60 | 80 |
| 02082706 | 20 | 23.9N | 140.5E | 105 | 0 | 16 | 37 | 48 | 73 | 144 | 314 | 508 | 0 | 10 | 20 | 30 | 35 | 35 | 45 | 80 |
| 02082712 | 21 | 24.3N | 139.1E | 90 | 12 | 32 | 36 | 42 | 45 | 82 | 214 | | 0 | -10 | -5 | 5 | 10 | 15 | 35 | |
| 02082718 | 22 | 24.8N | 137.8E | 95 | 5 | 5 | 33 | 37 | 55 | 94 | 187 | | 0 | 5 | 15 | 15 | 10 | 15 | 35 | |
| 02082800 | 23 | 25.3N | 136.5E | 95 | 5 | 11 | 27 | 36 | 42 | 97 | 255 | | 0 | 5 | 15 | 15 | 10 | 15 | 45 | |
| 02082806 | 24 | 25.8N | 135.1E | 90 | 5 | 11 | 32 | 26 | 32 | 86 | 254 | | 0 | 10 | 20 | 15 | 15 | 20 | 60 | |
| 02082812 | 25 | 26.3N | 133.9E | 90 | 6 | 21 | 11 | 20 | 12 | 76 | | | 0 | 10 | 15 | 15 | 15 | 30 | | |
| 02082818 | 26 | 26.8N | 132.7E | 85 | 5 | 13 | 13 | 18 | 47 | 72 | | | 0 | 5 | 5 | 0 | 10 | 10 | | |
| 02082900 | 27 | 27.3N | 131.5E | 85 | 0 | 18 | 6 | 24 | 57 | 141 | | | 0 | 5 | 5 | 5 | 5 | 20 | | |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02082906 | 28 | 27.9N | 130.4E | 80 | 5 | 8 | 19 | 24 | 21 | 22 | | | 0 | 0 | -5 | 0 | -10 | -5 | | |
| 02082912 | 29 | 28.4N | 129.5E | 80 | 7 | 19 | 32 | 19 | 5 | | | | 0 | -5 | -5 | -5 | 0 | | | |
| 02082918 | 30 | 28.8N | 128.9E | 80 | 8 | 5 | 12 | 37 | 44 | | | | 0 | -5 | 0 | -10 | -5 | | | |
| 02083000 | 31 | 29.2N | 128.3E | 80 | 5 | 20 | 26 | 49 | 118 | | | | 0 | -5 | -10 | -5 | -10 | | | |
| 02083006 | 32 | 29.9N | 128.0E | 80 | 8 | 24 | 55 | 12 | 78 | | | | 0 | 0 | -10 | -10 | 0 | | | |
| 02083012 | 33 | 30.7N | 127.8E | 75 | 13 | 43 | 49 | 70 | | | | | -5 | -10 | 0 | -5 | | | | |
| 02083018 | 34 | 31.6N | 127.7E | 70 | 10 | 30 | 42 | 96 | | | | | 0 | -5 | -5 | 5 | | | | |
| 02083100 | 35 | 32.8N | 127.5E | 70 | 7 | 20 | 65 | | | | | | 0 | 5 | 5 | | | | | |
| 02083106 | 36 | 34.1N | 127.4E | 70 | 13 | 15 | 78 | | | | | | 0 | -5 | 5 | | | | | |
| 02083112 | 37 | 35.1N | 127.4E | 55 | 15 | 24 | | | | | | | 0 | -5 | | | | | | |
| 02083118 | 38 | 36.2N | 127.6E | 55 | 23 | 52 | | | | | | | 0 | 5 | | | | | | |
| 02090100 | 39 | 37.6N | 128.2E | 45 | 25 | | | | | | | | 0 | | | | | | | |
| 02090106 | 40 | 39.1N | 129.5E | 35 | 17 | | | | | | | | 0 | | | | | | | |
| | | | AVERAGE | | 10 | 25 | 44 | 57 | 64 | 94 | 160 | 238 | 0 | 7 | 11 | 15 | 19 | 23 | 37 | 43 |
| | | | BIAS | | | | | | | | | | 0 | 1 | 5 | 7 | 12 | 19 | 25 | 37 |
| | | | # CASES | | 40 | 38 | 36 | 34 | 32 | 28 | 24 | 20 | 40 | 38 | 36 | 34 | 32 | 28 | 24 | 20 |

**Statistics for JTWC on TY 22W Sinlaku**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02082806 | | 16.3N | 155.6E | 20 | | | | | | | | | | | | | | | | |
| 02082812 | | 16.7N | 155.2E | 20 | | | | | | | | | | | | | | | | |
| 02082818 | 1 | 17.2N | 155.0E | 25 | 50 | 113 | 161 | 204 | 220 | 132 | | | 0 | -5 | -15 | -15 | -30 | -45 | | |
| 02082900 | 2 | 17.7N | 154.9E | 30 | 29 | 74 | 109 | 158 | 144 | 87 | 124 | 154 | 0 | -10 | -10 | -20 | -35 | -35 | -40 | -20 |
| 02082906 | 3 | 18.3N | 154.9E | 35 | 5 | 8 | 12 | 16 | 50 | 12 | 8 | 69 | 0 | -5 | -5 | -20 | -40 | -30 | -5 | 0 |
| 02082912 | 4 | 19.0N | 154.8E | 45 | 6 | 19 | 30 | 30 | 6 | 38 | 86 | 214 | 0 | 0 | -5 | -20 | -30 | -25 | -10 | -5 |
| 02082918 | 5 | 19.7N | 154.4E | 50 | 6 | 26 | 36 | 36 | 30 | 45 | 97 | 230 | -5 | 0 | -20 | -40 | -30 | -20 | -5 | -5 |
| 02083000 | 6 | 20.5N | 154.0E | 55 | 6 | 30 | 31 | 39 | 77 | 77 | 103 | 232 | 0 | -5 | -20 | -30 | -20 | -10 | 10 | 15 |
| 02083006 | 7 | 21.5N | 153.4E | 55 | 0 | 6 | 25 | 36 | 62 | 45 | 189 | 195 | 0 | -15 | -25 | -15 | -15 | 5 | 15 | 0 |
| 02083012 | 8 | 22.5N | 152.6E | 70 | 0 | 21 | 45 | 65 | 50 | 85 | 148 | 162 | 0 | -15 | -20 | -10 | -10 | 20 | 10 | 20 |
| 02083018 | 9 | 23.0N | 151.6E | 80 | 5 | 40 | 70 | 93 | 112 | 150 | 149 | 229 | 0 | -20 | -15 | -10 | 0 | 25 | 10 | 5 |
| 02083100 | 10 | 23.5N | 150.7E | 95 | 8 | 6 | 45 | 77 | 95 | 121 | 157 | 258 | -5 | -15 | -5 | -5 | 10 | 25 | 10 | 15 |
| 02083106 | 11 | 23.7N | 149.7E | 110 | 0 | 19 | 20 | 24 | 24 | 55 | 89 | 258 | 0 | 15 | 10 | 10 | 10 | 10 | 15 | 10 |
| 02083112 | 12 | 23.8N | 148.7E | 110 | 8 | 22 | 30 | 39 | 45 | 54 | 98 | 275 | 0 | 10 | 0 | 5 | 10 | 5 | 10 | 5 |
| 02083118 | 13 | 23.8N | 147.7E | 105 | 8 | 8 | 16 | 13 | 53 | 60 | 125 | 286 | 0 | -5 | -5 | 0 | 5 | 0 | -10 | -5 |

TC 10S Dina
TC 11S Eddy
TC 12S Francesca
TC 13S Chris
TC 14P Claudia
TC 15S Guillaume
TC 16P
TC 17P Des
TC 18S Hary
TC 19P
TC 20S Ikala
TC 21S Dianne-Jery
TC 22S Bonnie
TC 23S Kesiny
TC 24S Errol
TC 25P Upia

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02090100 | 14 | 23.8N | 146.7E | 105 | 0 | 13 | 8 | 30 | 40 | 67 | | | 0 | -5 | 0 | 5 | 5 | 0 | | |
| 02090106 | 15 | 24.0N | 145.6E | 110 | 8 | 11 | 23 | 36 | 32 | 60 | 122 | 265 | 5 | 10 | 15 | 10 | 5 | 5 | 5 | 10 |
| 02090112 | 16 | 24.1N | 144.4E | 110 | 8 | 26 | 51 | 49 | 36 | 76 | 196 | 389 | 5 | 10 | 15 | 5 | 5 | 5 | 5 | 10 |
| 02090118 | 17 | 24.2N | 143.1E | 105 | 0 | 8 | 24 | 26 | 32 | 74 | 216 | 370 | 0 | 5 | 0 | -5 | 0 | 0 | 0 | 10 |
| 02090200 | 18 | 24.3N | 141.8E | 100 | 5 | 19 | 16 | 12 | 30 | 112 | 244 | 313 | 0 | 5 | 0 | 0 | 0 | 0 | -10 | -5 |
| 02090206 | 19 | 24.4N | 140.4E | 95 | 0 | 28 | 27 | 30 | 47 | 76 | 179 | 274 | 0 | -5 | 0 | 0 | 0 | 0 | 5 | 20 |
| 02090212 | 20 | 24.3N | 139.1E | 90 | 8 | 23 | 48 | 48 | 73 | 162 | 272 | 301 | 0 | 5 | 5 | 5 | 5 | 0 | 10 | 25 |
| 02090218 | 21 | 24.5N | 137.8E | 90 | 0 | 19 | 30 | 48 | 84 | 150 | 312 | 342 | 0 | 0 | 0 | 0 | -5 | -5 | 10 | 50 |
| 02090300 | 22 | 24.8N | 136.3E | 90 | 5 | 30 | 30 | 54 | 84 | 126 | 303 | 369 | 0 | 0 | 0 | 0 | -5 | -5 | 20 | 55 |
| 02090306 | 23 | 25.1N | 134.8E | 90 | 0 | 13 | 24 | 55 | 78 | 147 | 291 | | 0 | 5 | 5 | 0 | 0 | 0 | 15 | |
| 02090312 | 24 | 25.5N | 133.4E | 90 | 20 | 20 | 40 | 60 | 66 | 159 | 294 | | 0 | 5 | 5 | 0 | 0 | 0 | 15 | |
| 02090318 | 25 | 25.6N | 132.1E | 90 | 0 | 12 | 12 | 32 | 48 | 169 | 223 | | 0 | 5 | 5 | 10 | 0 | 5 | 45 | |
| 02090400 | 26 | 25.8N | 130.8E | 90 | 0 | 13 | 26 | 32 | 19 | 117 | 257 | | 0 | 5 | 0 | 0 | -5 | 10 | 55 | |
| 02090406 | 27 | 26.0N | 129.6E | 90 | 0 | 13 | 19 | 16 | 42 | 134 | | | 0 | -5 | 0 | -5 | -10 | 0 | | |
| 02090412 | 28 | 26.2N | 128.5E | 90 | 0 | 8 | 22 | 38 | 93 | 168 | | | 0 | -5 | 0 | -5 | -10 | 0 | | |
| 02090418 | 29 | 26.4N | 127.5E | 95 | 0 | 8 | 29 | 47 | 66 | 108 | | | 0 | 0 | 0 | 0 | -5 | 30 | | |
| 02090500 | 30 | 26.5N | 126.8E | 95 | 0 | 22 | 40 | 50 | 65 | 150 | | | 0 | 0 | -5 | -5 | -5 | 20 | | |
| 02090506 | 31 | 26.5N | 126.2E | 90 | 8 | 13 | 26 | 33 | 32 | | | | 0 | -5 | -5 | -10 | -10 | | | |
| 02090512 | 32 | 26.5N | 125.8E | 90 | 8 | 29 | 37 | 54 | 61 | | | | 0 | -5 | -10 | -5 | -15 | | | |
| 02090518 | 33 | 26.4N | 125.4E | 90 | 6 | 19 | 16 | 36 | 63 | | | | 0 | -5 | -10 | -10 | 15 | | | |
| 02090600 | 34 | 26.2N | 125.1E | 90 | 5 | 12 | 38 | 71 | 120 | | | | 0 | -5 | 0 | -5 | 15 | | | |
| 02090606 | 35 | 26.2N | 124.7E | 85 | 6 | 34 | 61 | 68 | | | | | 0 | -5 | -5 | 15 | | | | |
| 02090612 | 36 | 26.3N | 124.4E | 85 | 5 | 42 | 64 | 110 | | | | | 0 | 5 | -5 | 20 | | | | |
| 02090618 | 37 | 26.5N | 123.8E | 80 | 12 | 13 | 34 | | | | | | 0 | 0 | 25 | | | | | |
| 02090700 | 38 | 26.9N | 122.8E | 70 | 10 | 24 | 68 | | | | | | 0 | -10 | 5 | | | | | |
| 02090706 | 39 | 27.1N | 121.5E | 70 | 13 | 21 | | | | | | | 0 | 15 | | | | | | |
| 02090712 | 40 | 27.3N | 120.2E | 65 | 18 | 32 | | | | | | | 0 | 15 | | | | | | |
| 02090718 | 41 | 27.3N | 118.7E | 35 | 10 | | | | | | | | 0 | | | | | | | |
| 02090800 | 42 | 28.1N | 117.2E | 30 | 12 | | | | | | | | 0 | | | | | | | |
| | | | AVERAGE | | 7 | 23 | 38 | 52 | 64 | 101 | 178 | 259 | 0 | 7 | 7 | 9 | 11 | 11 | 14 | 15 |
| | | | BIAS | | | | | | | | | | 0 | -1 | -3 | -4 | -6 | 0 | 8 | 11 |
| | | | # CASES | | 42 | 40 | 38 | 36 | 34 | 30 | 24 | 20 | 42 | 40 | 38 | 36 | 34 | 30 | 24 | 20 |

**Statistics for JTWC on TD 17W**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02080218 | | 33.8N | 140.2E | 15 | | | | | | | | | | | | | | | | |
| 02080300 | | 33.2N | 141.0E | 15 | | | | | | | | | | | | | | | | |
| 02080306 | | 32.8N | 142.0E | 15 | | | | | | | | | | | | | | | | |
| 02080312 | | 32.8N | 142.9E | 15 | | | | | | | | | | | | | | | | |
| 02080318 | | 32.8N | 143.6E | 20 | | | | | | | | | | | | | | | | |
| 02080400 | | 32.8N | 144.4E | 20 | | | | | | | | | | | | | | | | |
| 02080406 | | 33.0N | 145.7E | 20 | | | | | | | | | | | | | | | | |
| 02080412 | | 33.3N | 147.0E | 20 | | | | | | | | | | | | | | | | |
| 02080418 | | 33.6N | 148.3E | 20 | | | | | | | | | | | | | | | | |
| 02080500 | | 34.0N | 149.4E | 20 | | | | | | | | | | | | | | | | |
| 02080506 | 1 | 34.2N | 150.6E | 25 | 0 | 8 | 48 | | | | | | 0 | 0 | -5 | | | | | |
| 02080512 | 2 | 34.4N | 151.8E | 25 | 5 | 35 | | | | | | | 0 | -5 | | | | | | |
| 02080518 | | 34.8N | 152.7E | 25 | | | | | | | | | | | | | | | | |
| 02080600 | | 35.1N | 153.4E | 25 | | | | | | | | | | | | | | | | |
| 02080606 | | 35.4N | 154.1E | 25 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 3 | 21 | 48 | | | | | | 0 | 3 | 5 | | | | | |
| | | | BIAS | | | | | | | | | | 0 | -3 | -5 | | | | | |
| | | | # CASES | | 2 | 2 | 1 | | | | | | 2 | 2 | 1 | | | | | |

TS 18W
STY19W Phanfone
TS 20W Vongfong
TY 21W Rusa
TY 22W Sinlaku
TS 23W Hagupit
TS 24W Mekkhala
STY25W Higos
TY 26W Bavi
TD 27W
TD 28W
TS 29W Maysak
TY 30W Haishen
STY31W Pongsona
HUR02C Ele
HUR03C Huko
TC 01A
TC 02B
TC 03B
TC 04B
TC 05B
5.3 SOUTHERN HEMISPHERE VERIFICATION TABLES
TC 01S
TC 02S Alex-Andre
TC 03S
TC 04S
TC 05S Bessi-Bako
TC 06P Trina
TC 07P Waka
TC 08S Cyprien
TC 09P Bernie

**Statistics for JTWC on TS 18W**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02081006 | | 10.6N | 131.2E | 20 | | | | | | | | | | | | | | | | |
| 02081012 | | 10.5N | 131.0E | 20 | | | | | | | | | | | | | | | | |
| 02081018 | 1 | 10.4N | 130.7E | 25 | 29 | 99 | 193 | 285 | 375 | 632 | 585 | | 0 | -5 | 0 | 5 | 15 | 35 | 25 | |
| 02081100 | 2 | 10.5N | 130.4E | 30 | 34 | 117 | 217 | 298 | 389 | 595 | | | -5 | 0 | 0 | 5 | 25 | 40 | | |
| 02081106 | 3 | 10.7N | 130.0E | 30 | 18 | 72 | 161 | 280 | 441 | 671 | | | 0 | 5 | 5 | 10 | 15 | 25 | | |
| 02081112 | 4 | 11.1N | 129.5E | 30 | 37 | 38 | 129 | 276 | 459 | 641 | | | 0 | 0 | 0 | 10 | 20 | 15 | | |
| 02081118 | 5 | 11.5N | 128.9E | 30 | 11 | 67 | 163 | 303 | 466 | 587 | | | 0 | 0 | 0 | 0 | 5 | 0 | | |
| 02081200 | 6 | 12.1N | 128.2E | 30 | 0 | 34 | 124 | 267 | 371 | | | | 0 | -5 | 0 | 5 | 5 | | | |
| 02081206 | 7 | 12.7N | 127.7E | 30 | 13 | 82 | 228 | 372 | 432 | | | | 0 | -5 | 0 | 5 | 0 | | | |
| 02081212 | 8 | 13.3N | 126.7E | 35 | 29 | 113 | 244 | 345 | 355 | | | | 0 | 10 | 15 | 15 | 10 | | | |
| 02081218 | 9 | 13.8N | 125.7E | 30 | 0 | 111 | 212 | 221 | 104 | | | | 5 | 10 | 10 | 5 | 5 | | | |
| 02081300 | 10 | 14.2N | 124.2E | 25 | 0 | 85 | 138 | 81 | | | | | 0 | 0 | 0 | 0 | | | | |
| 02081306 | 11 | 14.4N | 122.5E | 25 | 12 | 93 | 101 | 63 | | | | | 0 | 0 | 5 | 10 | | | | |
| 02081312 | 12 | 14.4N | 120.9E | 20 | 24 | 138 | 149 | | | | | | 5 | 0 | 0 | | | | | |
| 02081318 | | 13.9N | 119.5E | 20 | | | | | | | | | | | | | | | | |
| 02081400 | | 13.5N | 118.5E | 20 | | | | | | | | | | | | | | | | |
| 02081406 | | 13.8N | 117.8E | 20 | | | | | | | | | | | | | | | | |
| 02081412 | | 14.5N | 117.2E | 20 | | | | | | | | | | | | | | | | |
| 02081418 | | 15.0N | 118.0E | 20 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 18 | 87 | 172 | 254 | 377 | 625 | 585 | | 1 | 3 | 3 | 6 | 11 | 23 | 25 | |
| | | | BIAS | | | | | | | | | | 0 | 1 | 3 | 6 | 11 | 23 | 25 | |
| | | | # CASES | | 12 | 12 | 12 | 11 | 9 | 5 | 1 | | 12 | 12 | 12 | 11 | 9 | 5 | 1 | |

**Statistics for JTWC on STY19W Phanfone**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02081018 | | 10.3N | 160.2E | 20 | | | | | | | | | | | | | | | | |
| 02081100 | 1 | 10.6N | 159.6E | 25 | 54 | 32 | 26 | 85 | 167 | 252 | 336 | 434 | 0 | 0 | -5 | -10 | 0 | 0 | -40 | -55 |
| 02081106 | 2 | 10.4N | 158.9E | 25 | 35 | 18 | 54 | 123 | 228 | 264 | 357 | 444 | 0 | -5 | -5 | -5 | 0 | -5 | -35 | -40 |
| 02081112 | 3 | 10.2N | 158.3E | 30 | 26 | 45 | 91 | 180 | 227 | 223 | 277 | 325 | 0 | 0 | -5 | 0 | 0 | -5 | -50 | -60 |
| 02081118 | 4 | 10.6N | 158.0E | 40 | 26 | 98 | 175 | 272 | 277 | 252 | 298 | 278 | 0 | 15 | 20 | 25 | 25 | 25 | -35 | -5 |
| 02081200 | 5 | 11.0N | 157.8E | 40 | 51 | 118 | 205 | 264 | 280 | 277 | 318 | 285 | 0 | 0 | 10 | 15 | 20 | 5 | -35 | -10 |
| 02081206 | 6 | 11.5N | 157.6E | 45 | 25 | 68 | 161 | 199 | 242 | 297 | 360 | 410 | 0 | 5 | 10 | 10 | 15 | -10 | -25 | -20 |
| 02081212 | 7 | 12.2N | 157.4E | 55 | 33 | 88 | 156 | 212 | 221 | 319 | 386 | 397 | 0 | 10 | 15 | 20 | 20 | -15 | -15 | -10 |

**TC 10S Dina**
**TC 11S Eddy**
**TC 12S Francesca**
**TC 13S Chris**
**TC 14P Claudia**
**TC 15S Guillaume**
**TC 16P**
**TC 17P Des**
**TC 18S Hary**
**TC 19P**
**TC 20S Ikala**
**TC 21S Dianne-Jery**
**TC 22S Bonnie**
**TC 23S Kesiny**
**TC 24S Errol**
**TC 25P Upia**

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02081218 | 8 | 13.0N | 157.1E | 55 | 26 | 78 | 100 | 116 | 123 | 206 | 221 | 217 | 0 | 5 | 5 | 10 | 10 | -25 | -20 | 0 |
| 02081300 | 9 | 14.1N | 156.9E | 60 | 18 | 83 | 124 | 151 | 181 | 221 | 157 | 128 | 0 | 0 | 5 | 10 | 5 | -10 | -10 | 15 |
| 02081306 | 10 | 15.6N | 156.2E | 65 | 13 | 21 | 50 | 74 | 96 | 105 | 85 | 133 | 0 | 0 | 5 | 10 | -5 | -10 | -5 | 20 |
| 02081312 | 11 | 16.6N | 154.9E | 70 | 13 | 6 | 38 | 38 | 45 | 65 | 89 | 168 | 0 | 10 | 10 | 5 | -20 | -10 | -5 | 30 |
| 02081318 | 12 | 17.5N | 153.6E | 75 | 8 | 12 | 16 | 26 | 43 | 66 | 117 | 159 | 0 | 10 | 5 | -10 | -20 | 5 | 5 | 35 |
| 02081400 | 13 | 18.4N | 152.2E | 75 | 6 | 42 | 82 | 108 | 151 | 48 | 39 | 200 | 0 | 0 | -10 | -30 | -20 | 0 | 5 | 30 |
| 02081406 | 14 | 19.0N | 150.7E | 80 | 5 | 6 | 8 | 37 | 56 | 50 | 5 | 204 | 0 | 0 | -15 | -25 | -15 | 5 | 15 | 45 |
| 02081412 | 15 | 19.5N | 149.3E | 85 | 13 | 36 | 49 | 92 | 85 | 110 | 37 | 210 | 0 | 0 | -20 | -15 | -10 | 10 | 30 | 60 |
| 02081418 | 16 | 20.3N | 148.1E | 90 | 16 | 25 | 49 | 49 | 32 | 84 | 16 | 183 | 0 | -15 | -25 | -15 | -10 | 0 | 20 | 55 |
| 02081500 | 17 | 21.2N | 146.9E | 100 | 0 | 20 | 13 | 16 | 21 | 36 | 83 | 268 | 0 | -20 | -15 | -15 | 0 | 10 | 30 | 65 |
| 02081506 | 18 | 22.0N | 145.7E | 115 | 6 | 18 | 29 | 34 | 42 | 21 | 147 | 472 | -5 | -20 | -20 | -10 | -10 | 0 | 25 | 55 |
| 02081512 | 19 | 22.9N | 144.6E | 130 | 0 | 41 | 28 | 16 | 25 | 18 | 187 | 622 | -10 | 0 | -10 | -5 | -10 | 10 | 35 | 70 |
| 02081518 | 20 | 23.9N | 143.3E | 135 | 0 | 19 | 32 | 37 | 27 | 70 | 139 | 266 | 0 | 10 | 10 | 0 | -5 | 10 | 45 | 70 |
| 02081600 | 21 | 24.8N | 142.0E | 130 | 0 | 47 | 61 | 12 | 57 | 70 | 76 | | 0 | 0 | 0 | -15 | -10 | 5 | 40 | |
| 02081606 | 22 | 25.4N | 141.0E | 130 | 0 | 39 | 24 | 41 | 76 | 76 | 238 | | 0 | 0 | -10 | -15 | -5 | 10 | 35 | |
| 02081612 | 23 | 26.0N | 140.1E | 130 | 13 | 24 | 49 | 63 | 57 | 43 | 378 | | 0 | 5 | -10 | -5 | 5 | 25 | 35 | |
| 02081618 | 24 | 26.8N | 139.4E | 120 | 0 | 5 | 19 | 42 | 27 | 93 | 173 | | 0 | -5 | -5 | -5 | 0 | 20 | 55 | |
| 02081700 | 25 | 27.6N | 138.7E | 115 | 8 | 30 | 33 | 38 | 25 | 84 | | | 0 | -5 | -5 | 5 | 5 | 30 | | |
| 02081706 | 26 | 28.5N | 138.1E | 115 | 0 | 12 | 27 | 32 | 57 | 132 | | | 0 | -5 | 0 | 0 | 10 | 25 | | |
| 02081712 | 27 | 29.5N | 137.7E | 115 | 6 | 35 | 57 | 73 | 97 | 177 | | | 0 | 0 | 5 | 0 | 10 | 30 | | |
| 02081718 | 28 | 30.3N | 137.2E | 110 | 6 | 47 | 60 | 106 | 182 | 66 | | | 5 | 0 | 0 | 5 | 15 | 30 | | |
| 02081800 | 29 | 30.7N | 136.6E | 105 | 10 | 20 | 36 | 75 | 84 | | | | 0 | 5 | 0 | 10 | 20 | | | |
| 02081806 | 30 | 31.0N | 136.5E | 100 | 6 | 31 | 56 | 54 | 141 | | | | 0 | 0 | 5 | 15 | 15 | | | |
| 02081812 | 31 | 31.4N | 136.9E | 90 | 7 | 21 | 35 | 80 | 171 | | | | 10 | 0 | 10 | 15 | 25 | | | |
| 02081818 | 32 | 31.8N | 137.7E | 90 | 0 | 6 | 51 | 170 | 218 | | | | 0 | 5 | 15 | 10 | 20 | | | |
| 02081900 | 33 | 32.2N | 138.7E | 85 | 15 | 41 | 23 | 115 | | | | | 0 | 10 | 15 | 20 | | | | |
| 02081906 | 34 | 32.7N | 139.7E | 75 | 7 | 16 | 108 | 144 | | | | | 0 | 10 | 5 | 15 | | | | |
| 02081912 | 35 | 33.2N | 141.1E | 65 | 0 | 47 | 123 | | | | | | 0 | 5 | 10 | | | | | |
| 02081918 | 36 | 33.5N | 142.6E | 55 | 0 | 113 | 158 | | | | | | 0 | 0 | 10 | | | | | |
| 02082000 | 37 | 34.2N | 145.4E | 50 | 59 | 210 | | | | | | | 0 | 10 | | | | | | |
| 02082006 | 38 | 36.0N | 148.8E | 50 | 0 | 57 | | | | | | | 0 | 10 | | | | | | |
| 02082012 | | 38.2N | 152.5E | 35 | | | | | | | | | | | | | | | | |
| 02082018 | | 41.7N | 153.4E | 35 | | | | | | | | | | | | | | | | |
| | | | | AVERAGE | 14 | 44 | 67 | 93 | 118 | 133 | 188 | 290 | 1 | 5 | 9 | 11 | 11 | 12 | 27 | 38 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIAS | | | | | | | | | 0 | 1 | 0 | 1 | 3 | 6 | 4 | 18 |
| # CASES | 38 | 38 | 36 | 34 | 32 | 28 | 24 | 20 | 38 | 38 | 36 | 34 | 32 | 28 | 24 | 20 |

**Statistics for JTWC on TS 20W Vongfong**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02081412 | | 14.4N | 115.2E | 20 | | | | | | | | | | | | | | | | |
| 02081418 | | 14.4N | 115.0E | 20 | | | | | | | | | | | | | | | | |
| 02081500 | | 14.4N | 114.8E | 20 | | | | | | | | | | | | | | | | |
| 02081506 | | 14.4N | 114.7E | 20 | | | | | | | | | | | | | | | | |
| 02081512 | 1 | 14.4N | 114.5E | 25 | 87 | 42 | 58 | 80 | 132 | 150 | | | 0 | 5 | 5 | 5 | 0 | 0 | | |
| 02081518 | 2 | 14.5N | 114.3E | 25 | 37 | 50 | 47 | 94 | 101 | 154 | | | 0 | 5 | 5 | 5 | 5 | -10 | | |
| 02081600 | 3 | 14.6N | 114.1E | 25 | 24 | 35 | 59 | 121 | 127 | 137 | | | 0 | 0 | 0 | 0 | 0 | -10 | | |
| 02081606 | 4 | 14.8N | 114.2E | 25 | 16 | 27 | 64 | 89 | 150 | 151 | | | 0 | 0 | 0 | 0 | -5 | -25 | | |
| 02081612 | 5 | 15.0N | 114.4E | 25 | 13 | 17 | 96 | 102 | 153 | 238 | | | 0 | 0 | -5 | -5 | -5 | -25 | | |
| 02081618 | 6 | 15.3N | 114.6E | 25 | 18 | 79 | 90 | 161 | 182 | 354 | | | 0 | 5 | 0 | -5 | -15 | -10 | | |
| 02081700 | 7 | 16.0N | 114.5E | 25 | 8 | 81 | 79 | 131 | 103 | | | | 0 | 0 | -5 | 0 | -10 | | | |
| 02081706 | 8 | 16.3N | 113.8E | 25 | 11 | 42 | 53 | 29 | 82 | | | | 0 | -5 | -5 | -15 | -25 | | | |
| 02081712 | 9 | 15.8N | 113.2E | 30 | 8 | 86 | 179 | 141 | 210 | | | | 0 | -5 | -5 | -15 | -20 | | | |
| 02081718 | 10 | 16.3N | 113.5E | 30 | 24 | 93 | 108 | 161 | 270 | | | | 0 | 0 | -10 | -20 | -5 | | | |
| 02081800 | 11 | 16.4N | 113.0E | 35 | 23 | 97 | 85 | 160 | | | | | 0 | 0 | -10 | -15 | | | | |
| 02081806 | 12 | 16.6N | 112.2E | 35 | 0 | 42 | 94 | 198 | | | | | 0 | -10 | -15 | 5 | | | | |
| 02081812 | 13 | 17.3N | 111.6E | 35 | 35 | 85 | 148 | | | | | | 0 | -5 | -10 | | | | | |
| 02081818 | 14 | 18.1N | 111.8E | 45 | 12 | 29 | 94 | | | | | | 0 | -10 | -5 | | | | | |
| 02081900 | 15 | 18.8N | 111.8E | 45 | 16 | 59 | | | | | | | 0 | 0 | | | | | | |
| 02081906 | 16 | 19.9N | 111.1E | 55 | 6 | 60 | | | | | | | 0 | 5 | | | | | | |
| 02081912 | 17 | 21.3N | 110.6E | 55 | 13 | | | | | | | | -5 | | | | | | | |
| 02081918 | 18 | 23.0N | 110.1E | 40 | 31 | | | | | | | | 0 | | | | | | | |
| | | | AVERAGE | | 22 | 58 | 90 | 122 | 151 | 197 | | | 0 | 3 | 6 | 8 | 9 | 13 | | |
| | | | BIAS | | | | | | | | | | 0 | -1 | -4 | -5 | -8 | -13 | | |
| | | | # CASES | | 18 | 16 | 14 | 12 | 10 | 6 | | | 18 | 16 | 14 | 12 | 10 | 6 | | |

**Statistics for JTWC on TS 13W**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02071712 | | 8.4N | 130.3E | 25 | | | | | | | | | | | | | | | | |
| 02071718 | | 8.5N | 129.5E | 25 | | | | | | | | | | | | | | | | |
| 02071800 | | 8.8N | 128.6E | 25 | | | | | | | | | | | | | | | | |
| 02071806 | | 9.1N | 127.9E | 25 | | | | | | | | | | | | | | | | |
| 02071812 | 1 | 9.6N | 127.1E | 30 | 24 | 70 | 146 | 158 | 152 | 162 | | | 0 | 5 | 5 | 10 | 10 | 20 | | |
| 02071818 | 2 | 10.2N | 126.3E | 30 | 13 | 80 | 154 | 140 | 151 | 149 | | | 0 | 5 | 5 | 10 | 10 | 20 | | |
| 02071900 | 3 | 11.1N | 125.6E | 30 | 37 | 112 | 149 | 139 | 112 | | | | 0 | 0 | 5 | 5 | 10 | | | |
| 02071906 | 4 | 12.0N | 124.5E | 30 | 16 | 19 | 49 | 72 | 78 | | | | 0 | 5 | 5 | 0 | -5 | | | |
| 02071912 | 5 | 12.5N | 123.5E | 30 | 16 | 6 | 31 | 40 | 29 | | | | 0 | 5 | -5 | -5 | -5 | | | |
| 02071918 | 6 | 12.9N | 122.7E | 30 | 13 | 13 | 18 | 8 | 6 | | | | 0 | -5 | -5 | 0 | 5 | | | |
| 02072000 | 7 | 13.2N | 122.2E | 30 | 5 | 12 | 6 | 6 | | | | | 0 | -10 | -5 | 0 | | | | |
| 02072006 | 8 | 13.4N | 121.9E | 30 | 13 | 17 | 27 | 25 | | | | | 0 | -5 | -5 | 5 | | | | |
| 02072012 | 9 | 13.7N | 121.5E | 35 | 8 | 46 | 42 | | | | | | 0 | 0 | 0 | | | | | |
| 02072018 | 10 | 14.2N | 121.1E | 30 | 29 | 29 | 6 | | | | | | 0 | 0 | 5 | | | | | |
| 02072100 | 11 | 14.7N | 121.0E | 30 | 18 | 36 | | | | | | | 0 | -5 | | | | | | |
| 02072106 | 12 | 15.4N | 120.8E | 30 | 16 | 70 | | | | | | | 0 | 0 | | | | | | |
| 02072112 | 13 | 16.0N | 120.4E | 30 | 16 | | | | | | | | 0 | | | | | | | |
| 02072118 | 14 | 16.6N | 120.0E | 25 | 13 | | | | | | | | 0 | | | | | | | |
| | | | AVERAGE | | 17 | 42 | 63 | 74 | 88 | 156 | | | 0 | 4 | 5 | 4 | 8 | 20 | | |
| | | | BIAS | | | | | | | | | | 0 | 0 | 1 | 3 | 4 | 20 | | |
| | | | # CASES | | 14 | 12 | 10 | 8 | 6 | 2 | | | 14 | 12 | 10 | 8 | 6 | 2 | | |

TS 18W
STY19W Phanfone
TS 20W Vongfong
TY 21W Rusa
TY 22W Sinlaku
TS 23W Hagupit
TS 24W Mekkhala
STY25W Higos
TY 26W Bavi
TD 27W
TD 28W
TS 29W Maysak
TY 30W Haishen
STY31W Pongsona
HUR02C Ele
HUR03C Huko
TC 01A
TC 02B
TC 03B
TC 04B
TC 05B
5.3 SOUTHERN HEMISPHERE VERIFICATION TABLES
TC 01S
TC 02S Alex-Andre
TC 03S
TC 04S
TC 05S Bessi-Bako
TC 06P Trina
TC 07P Waka
TC 08S Cyprien
TC 09P Bernie

**Statistics for JTWC on TY 14W Fung-Wong**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02072000 | | 23.9N | 143.7E | 25 | | | | | | | | | | | | | | | | |
| 02072006 | | 23.8N | 142.2E | 25 | | | | | | | | | | | | | | | | |
| 02072012 | 1 | 23.8N | 141.1E | 30 | 18 | 40 | 68 | 91 | 120 | 144 | 281 | 481 | -5 | -5 | -10 | -15 | -20 | -35 | -20 | -20 |
| 02072018 | 2 | 23.8N | 140.0E | 35 | 24 | 66 | 98 | 114 | 118 | 101 | 188 | 320 | 0 | -5 | -5 | -20 | -20 | -30 | -20 | -15 |
| 02072100 | 3 | 23.7N | 138.8E | 35 | 12 | 24 | 40 | 48 | 64 | 54 | 298 | 528 | 0 | -5 | -15 | -20 | -20 | -25 | -20 | -20 |
| 02072106 | 4 | 23.7N | 137.7E | 40 | 5 | 28 | 58 | 67 | 50 | 122 | 342 | 477 | 0 | 0 | -15 | -15 | -25 | -25 | -15 | -15 |
| 02072112 | 5 | 23.6N | 136.6E | 40 | 13 | 29 | 58 | 51 | 46 | 195 | 388 | | 0 | -10 | -15 | -15 | -30 | -20 | -15 | |
| 02072118 | 6 | 23.5N | 135.7E | 40 | 21 | 20 | 0 | 38 | 50 | 79 | 272 | 539 | 0 | -15 | -20 | -30 | -35 | -25 | -20 | -5 |
| 02072200 | 7 | 23.4N | 134.8E | 50 | 6 | 6 | 13 | 45 | 48 | 112 | 345 | 660 | 0 | -10 | -15 | -25 | -20 | -15 | -15 | 10 |
| 02072206 | 8 | 23.3N | 133.9E | 55 | 0 | 13 | 13 | 13 | 26 | 181 | 438 | 752 | 0 | -5 | -15 | -20 | -20 | -15 | -10 | 15 |
| 02072212 | 9 | 23.2N | 133.2E | 55 | 12 | 20 | 0 | 21 | 37 | 183 | 492 | 825 | -5 | -10 | -20 | -20 | -20 | -15 | -10 | 10 |
| 02072218 | 10 | 23.1N | 132.4E | 55 | 8 | 24 | 35 | 36 | 58 | 217 | | | 0 | -15 | -20 | -20 | -20 | -15 | | |
| 02072300 | 11 | 23.0N | 131.8E | 55 | 12 | 39 | 43 | 48 | 86 | 248 | | | 0 | -5 | -5 | -10 | -15 | -20 | | |
| 02072306 | 12 | 22.9N | 131.1E | 65 | 5 | 13 | 11 | 41 | 45 | 88 | | | 0 | -10 | -10 | -15 | -20 | -15 | | |
| 02072312 | 13 | 22.5N | 130.5E | 65 | 6 | 6 | 24 | 45 | 114 | 84 | | | 0 | -5 | -10 | -15 | -15 | -25 | | |
| 02072318 | 14 | 22.1N | 130.2E | 65 | 0 | 18 | 33 | 64 | 162 | | | | 0 | -10 | -10 | -25 | -30 | | | |
| 02072400 | 15 | 21.6N | 130.3E | 60 | 16 | 63 | 79 | 116 | 188 | | | | 0 | -5 | -10 | -20 | -35 | | | |
| 02072406 | 16 | 21.1N | 130.9E | 60 | 23 | 31 | 25 | 79 | 61 | | | | -5 | -10 | -20 | -25 | -25 | | | |
| 02072412 | 17 | 20.6N | 131.9E | 55 | 11 | 25 | 43 | 77 | 79 | | | | -5 | -10 | -15 | -25 | -20 | | | |
| 02072418 | 18 | 20.5N | 132.7E | 55 | 0 | 58 | 117 | 131 | 175 | | | | -5 | -10 | -15 | -25 | -15 | | | |
| 02072500 | 19 | 20.7N | 134.0E | 55 | 12 | 114 | 152 | 178 | 262 | | | | -5 | -5 | -20 | -20 | -10 | | | |
| 02072506 | 20 | 21.9N | 135.0E | 55 | 16 | 74 | 113 | 166 | 228 | | | | -5 | -5 | -15 | -10 | -5 | | | |
| 02072512 | 21 | 23.4N | 135.4E | 50 | 6 | 45 | 74 | 167 | | | | | 0 | -15 | -15 | -10 | | | | |
| 02072518 | 22 | 24.6N | 134.9E | 50 | 5 | 26 | 84 | 114 | 136 | | | | 0 | -10 | -5 | 0 | -5 | | | |
| 02072600 | 23 | 25.8N | 134.4E | 55 | 17 | 44 | 49 | 30 | | | | | 0 | 0 | 5 | 5 | | | | |
| 02072606 | 24 | 27.0N | 133.9E | 50 | 5 | 21 | 34 | 54 | | | | | 0 | 10 | 10 | 5 | | | | |
| 02072612 | 25 | 28.2N | 133.3E | 45 | 0 | 21 | 28 | | | | | | 0 | 5 | 5 | | | | | |

| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02072618 | 26 | 29.4N | 132.1E | 35 | 13 | 32 | 91 | | | | | | 0 | 5 | 0 | | | | | |
| 02072700 | 27 | 30.4N | 131.0E | 30 | 7 | 43 | | | | | | | 0 | 0 | | | | | | |
| 02072706 | 28 | 31.0N | 130.0E | 25 | 0 | 20 | | | | | | | 0 | -5 | | | | | | |
| 02072712 | | 31.7N | 129.0E | 25 | | | | | | | | | | | | | | | | |
| 02072718 | | 32.3N | 128.3E | 25 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 10 | 34 | 53 | 76 | 102 | 139 | 338 | 573 | 1 | 7 | 12 | 17 | 20 | 22 | 16 | 14 |
| | | | BIAS | | | | | | | | | | -1 | -6 | -11 | -16 | -20 | -22 | -16 | -5 |
| | | | # CASES | | 28 | 28 | 26 | 24 | 21 | 13 | 9 | 8 | 28 | 28 | 26 | 24 | 21 | 13 | 9 | 8 |

**Statistics for JTWC on TD 15W Kalmaegi**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02071706 | | 9.3N | 178.1W | 25 | | | | | | | | | | | | | | | | |
| 02071712 | | 10.4N | 177.5W | 25 | | | | | | | | | | | | | | | | |
| 02071718 | | 11.4N | 176.9W | 25 | | | | | | | | | | | | | | | | |
| 02071800 | | 12.4N | 176.7W | 25 | | | | | | | | | | | | | | | | |
| 02071806 | | 12.9N | 176.8W | 20 | | | | | | | | | | | | | | | | |
| 02071812 | | 13.3N | 177.0W | 20 | | | | | | | | | | | | | | | | |
| 02071818 | | 14.0N | 177.3W | 20 | | | | | | | | | | | | | | | | |
| 02071900 | | 14.7N | 177.5W | 20 | | | | | | | | | | | | | | | | |
| 02071906 | | 15.1N | 177.8W | 20 | | | | | | | | | | | | | | | | |
| 02071912 | | 15.3N | 178.2W | 25 | | | | | | | | | | | | | | | | |
| 02071918 | | 15.3N | 178.6W | 25 | | | | | | | | | | | | | | | | |
| 02072000 | | 15.5N | 179.1W | 25 | | | | | | | | | | | | | | | | |
| 02072006 | | 16.0N | 179.9W | 25 | | | | | | | | | | | | | | | | |
| 02072012 | | 16.5N | 179.4E | 25 | | | | | | | | | | | | | | | | |
| 02072018 | 1 | 17.0N | 178.8E | 30 | 31 | 86 | | | | | | | 0 | 10 | | | | | | |
| 02072100 | 2 | 17.6N | 178.3E | 30 | 12 | | | | | | | | 0 | | | | | | | |
| 02072106 | 3 | 18.1N | 177.9E | 25 | 20 | | | | | | | | 0 | | | | | | | |
| | | | AVERAGE | | 22 | 86 | | | | | | | 0 | 10 | | | | | | |
| | | | BIAS | | | | | | | | | | 0 | 10 | | | | | | |
| | | | # CASES | | 3 | 1 | | | | | | | 3 | 1 | | | | | | |

**Statistics for JTWC on TS 16W Kammuri**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02080200 | | 18.8N | 119.1E | 25 | | | | | | | | | | | | | | | | |
| 02080206 | 1 | 18.9N | 118.5E | 30 | 24 | 58 | 73 | 58 | 29 | 109 | | | 0 | 5 | 5 | -5 | -5 | 15 | | |
| 02080212 | 2 | 19.3N | 118.1E | 30 | 45 | 93 | 51 | 50 | 36 | 110 | | | 0 | 5 | 5 | 0 | 0 | 10 | | |
| 02080218 | 3 | 19.8N | 117.8E | 30 | 16 | 45 | 89 | 114 | 102 | 110 | | | 0 | 5 | 0 | 0 | -10 | 15 | | |
| 02080300 | 4 | 20.8N | 117.4E | 30 | 17 | 125 | 188 | 188 | 166 | | | | 0 | 0 | -5 | 0 | -10 | | | |
| 02080306 | 5 | 20.9N | 116.3E | 30 | 30 | 57 | 66 | 55 | 20 | | | | 0 | -5 | -5 | -15 | 0 | | | |
| 02080312 | 6 | 21.0N | 115.7E | 35 | 34 | 41 | 71 | 72 | 85 | | | | -5 | -10 | -5 | -15 | 10 | | | |
| 02080318 | 7 | 21.0N | 115.4E | 40 | 61 | 118 | 156 | 174 | 191 | | | | 0 | 0 | -5 | 5 | 10 | | | |
| 02080400 | 8 | 21.0N | 115.1E | 45 | 34 | 97 | 145 | 188 | | | | | 0 | 0 | -5 | 15 | | | | |
| 02080406 | 9 | 21.3N | 115.2E | 45 | 8 | 13 | 61 | 96 | | | | | 0 | -5 | 15 | 15 | | | | |
| 02080412 | 10 | 21.7N | 115.4E | 45 | 12 | 25 | 72 | | | | | | 0 | -5 | 15 | | | | | |
| 02080418 | 11 | 22.1N | 115.5E | 50 | 8 | 42 | 81 | | | | | | -5 | 10 | 15 | | | | | |
| 02080500 | 12 | 23.0N | 115.6E | 50 | 16 | 17 | | | | | | | -5 | 15 | | | | | | |
| 02080506 | 13 | 24.0N | 115.6E | 30 | 12 | 30 | | | | | | | 5 | 10 | | | | | | |
| 02080512 | 14 | 25.0N | 115.7E | 20 | 12 | | | | | | | | 5 | | | | | | | |
| 02080518 | | 25.9N | 115.6E | 20 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 24 | 59 | 96 | 111 | 90 | 110 | | | 2 | 6 | 7 | 8 | 6 | 13 | | |
| | | | BIAS | | | | | | | | | | 0 | 2 | 3 | 0 | -1 | 13 | | |
| | | | # CASES | | 14 | 13 | 11 | 9 | 7 | 3 | | | 14 | 13 | 11 | 9 | 7 | 3 | | |

**Statistics for JTWC on STY10W Halong**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02070512 | | 11.3N | 160.3E | 20 | | | | | | | | | | | | | | | | |
| 02070518 | | 10.8N | 160.4E | 20 | | | | | | | | | | | | | | | | |
| 02070600 | | 10.3N | 160.3E | 20 | | | | | | | | | | | | | | | | |
| 02070606 | | 9.8N | 159.9E | 20 | | | | | | | | | | | | | | | | |
| 02070612 | | 9.4N | 159.6E | 25 | | | | | | | | | | | | | | | | |
| 02070618 | | 8.9N | 159.0E | 25 | | | | | | | | | | | | | | | | |
| 02070700 | 1 | 8.7N | 158.2E | 25 | 5 | 43 | 83 | 133 | 168 | 207 | 239 | 294 | 0 | 0 | 0 | 5 | 0 | -35 | -45 | -40 |
| 02070706 | 2 | 8.8N | 157.3E | 30 | 5 | 24 | 51 | 95 | 128 | 224 | 299 | 295 | 0 | -5 | -5 | 0 | -5 | -40 | -45 | -50 |
| 02070712 | 3 | 9.0N | 156.4E | 30 | 5 | 27 | 67 | 105 | 127 | 247 | 324 | 350 | 0 | 0 | 0 | -5 | -15 | -40 | -40 | -55 |
| 02070718 | 4 | 9.3N | 155.4E | 35 | 5 | 75 | 125 | 156 | 182 | 259 | | | 0 | 5 | 10 | 10 | 0 | -15 | | |
| 02070800 | 5 | 9.6N | 154.3E | 35 | 24 | 80 | 133 | 173 | 213 | 299 | | | 0 | 5 | 5 | 0 | -15 | -10 | | |
| 02070806 | 6 | 9.9N | 152.9E | 40 | 5 | 54 | 95 | 132 | 177 | 266 | 284 | 306 | 0 | 0 | -5 | -15 | -30 | -20 | -40 | -60 |
| 02070812 | 7 | 10.2N | 151.7E | 40 | 16 | 48 | 83 | 127 | 196 | 281 | 273 | 276 | 0 | -5 | -15 | -30 | -30 | -15 | -45 | -50 |
| 02070818 | 8 | 10.6N | 150.5E | 45 | 30 | 55 | 97 | 134 | 198 | 293 | 307 | 400 | 0 | -5 | -20 | -30 | -25 | -10 | -45 | -45 |
| 02070900 | 9 | 10.9N | 149.3E | 50 | 18 | 25 | 73 | 139 | 171 | 237 | 256 | 416 | 0 | -5 | -20 | -20 | -10 | -5 | -45 | -25 |
| 02070906 | 10 | 11.1N | 148.3E | 55 | 17 | 59 | 100 | 159 | 209 | 315 | | | 0 | -15 | -25 | -20 | -10 | -15 | | |
| 02070912 | 11 | 11.4N | 147.3E | 65 | 37 | 76 | 124 | 173 | 236 | 307 | 389 | 425 | 0 | -20 | -15 | -10 | 0 | -15 | -35 | 5 |
| 02070918 | 12 | 11.7N | 146.3E | 75 | 11 | 56 | 132 | 185 | 242 | 274 | 320 | 315 | 0 | -15 | -5 | 5 | 15 | 0 | -20 | 35 |
| 02071000 | 13 | 12.0N | 145.2E | 90 | 0 | 54 | 98 | 151 | 191 | 215 | 353 | 294 | 0 | 5 | 15 | 25 | 25 | -5 | 5 | 50 |
| 02071006 | 14 | 12.2N | 144.2E | 95 | 18 | 38 | 54 | 109 | 133 | 172 | 205 | 100 | 0 | 5 | 15 | 25 | 15 | -10 | 20 | 60 |
| 02071012 | 15 | 12.2N | 143.2E | 95 | 5 | 12 | 38 | 86 | 136 | 143 | 166 | 21 | 0 | 5 | 15 | 15 | 5 | -5 | 30 | 70 |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02071018 | 16 | 12.4N | 142.3E | 95 | 0 | 8 | 45 | 78 | 85 | 132 | 167 | 66 | 0 | 5 | 15 | 5 | 0 | -10 | 35 | 70 |
| 02071100 | 17 | 12.9N | 141.5E | 95 | 0 | 35 | 86 | 99 | 103 | 149 | 28 | 545 | 0 | 10 | 15 | 5 | -10 | 0 | 40 | 65 |
| 02071106 | 18 | 13.2N | 140.5E | 95 | 0 | 60 | 83 | 90 | 107 | 143 | 109 | 528 | 0 | 10 | 5 | 0 | -15 | 20 | 55 | 85 |
| 02071112 | 19 | 13.7N | 139.4E | 90 | 0 | 42 | 57 | 74 | 124 | 97 | 227 | | 0 | -5 | -15 | -30 | -15 | 30 | 55 | |
| 02071118 | 20 | 14.1N | 138.4E | 90 | 8 | 12 | 40 | 96 | 150 | 86 | 341 | | 0 | -10 | -15 | -30 | -15 | 40 | 65 | |
| 02071200 | 21 | 14.9N | 137.5E | 95 | 17 | 21 | 43 | 109 | 93 | 56 | 513 | | 0 | -5 | -20 | -10 | 0 | 30 | 60 | |
| 02071206 | 22 | 15.7N | 136.6E | 105 | 0 | 27 | 16 | 63 | 45 | 129 | 605 | | 0 | 0 | -15 | 0 | 30 | 60 | 95 | |
| 02071212 | 23 | 16.5N | 135.7E | 110 | 0 | 13 | 48 | 72 | 32 | 160 | | | 0 | -15 | 0 | 15 | 40 | 65 | | |
| 02071218 | 24 | 17.5N | 134.7E | 115 | 0 | 12 | 22 | 56 | 45 | 145 | | | 0 | -20 | 0 | 30 | 45 | 70 | | |
| 02071300 | 25 | 18.7N | 133.7E | 130 | 0 | 29 | 39 | 28 | 34 | 222 | | | 0 | 15 | 20 | 40 | 50 | 60 | | |
| 02071306 | 26 | 20.2N | 132.2E | 135 | 0 | 18 | 64 | 103 | 151 | 283 | | | 0 | 15 | 35 | 50 | 55 | 75 | | |
| 02071312 | 27 | 21.7N | 130.8E | 125 | 0 | 40 | 91 | 130 | 174 | | | | 0 | 0 | 15 | 25 | 35 | | | |
| 02071318 | 28 | 22.8N | 129.4E | 125 | 0 | 54 | 68 | 90 | 168 | | | | 0 | 15 | 25 | 25 | 20 | | | |
| 02071400 | 29 | 23.9N | 128.4E | 115 | 0 | 16 | 64 | 127 | 156 | | | | 0 | 0 | 5 | 20 | -10 | | | |
| 02071406 | 30 | 25.0N | 127.7E | 100 | 0 | 47 | 99 | 160 | 230 | | | | 0 | 5 | 10 | 10 | 10 | | | |
| 02071412 | 31 | 26.2N | 127.6E | 90 | 0 | 29 | 120 | 150 | | | | | 0 | 5 | 15 | -5 | | | | |
| 02071500 | 32 | 28.7N | 128.4E | 75 | 0 | 52 | 26 | | | | | | 0 | 5 | -20 | | | | | |
| 02071506 | 33 | 29.9N | 130.1E | 65 | 13 | 55 | 102 | | | | | | 0 | 5 | 0 | | | | | |
| 02071512 | 34 | 30.9N | 132.1E | 55 | 6 | 61 | | | | | | | 0 | -10 | | | | | | |
| 02071518 | 35 | 32.8N | 135.0E | 45 | 44 | 88 | | | | | | | -5 | -15 | | | | | | |
| 02071600 | | 34.1N | 138.1E | 55 | | | | | | | | | | | | | | | | |
| 02071606 | | 36.4N | 142.0E | 35 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 9 | 41 | 75 | 116 | 147 | 205 | 284 | 309 | 0 | 8 | 13 | 17 | 18 | 27 | 43 | 51 |
| | | | BIAS | | | | | | | | | | 0 | -1 | 1 | 3 | 5 | 8 | 5 | 8 |
| | | | # CASES | | 35 | 35 | 33 | 31 | 30 | 26 | 19 | 15 | 35 | 35 | 33 | 31 | 30 | 26 | 19 | 15 |

**Statistics for JTWC on TS 11W Nakri**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02070800 | | 21.6N | 117.5E | 20 | | | | | | | | | | | | | | | | |
| 02070806 | | 21.9N | 117.8E | 25 | | | | | | | | | | | | | | | | |
| 02070812 | 1 | 22.2N | 118.1E | 25 | 13 | 66 | 95 | 122 | 176 | 304 | | | 0 | -5 | -5 | -5 | -5 | -5 | | |
| 02070818 | 2 | 22.7N | 118.6E | 35 | 8 | 12 | 16 | 12 | 82 | 152 | | | 0 | 0 | -5 | 0 | -10 | -5 | | |
| 02070900 | 3 | 23.3N | 119.2E | 35 | 13 | 11 | 0 | 42 | 72 | 123 | 161 | | 0 | 5 | 0 | -5 | -10 | -5 | -5 | |
| 02070906 | 4 | 23.8N | 119.6E | 35 | 37 | 50 | 30 | 65 | 87 | 49 | 205 | | 0 | 5 | 10 | 0 | 0 | 0 | 10 | |
| 02070912 | 5 | 24.1N | 120.0E | 35 | 37 | 36 | 25 | 66 | 82 | 66 | | | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 02070918 | 6 | 24.6N | 120.5E | 35 | 8 | 44 | 110 | 135 | 134 | 272 | | | 0 | 5 | -5 | 0 | 0 | 5 | | |
| 02071000 | 7 | 24.9N | 121.0E | 35 | 37 | 45 | 103 | 142 | 124 | 265 | | | 0 | 0 | -5 | 0 | 0 | 5 | | |
| 02071006 | 8 | 25.1N | 121.8E | 30 | 8 | 66 | 98 | 116 | 119 | 396 | | | 0 | -5 | -5 | -5 | -10 | 0 | | |
| 02071012 | 9 | 25.3N | 122.9E | 35 | 13 | 36 | 74 | 93 | 167 | 399 | | | 0 | -5 | 0 | -5 | -10 | 5 | | |
| 02071018 | 10 | 25.3N | 124.0E | 40 | 27 | 49 | 57 | 69 | 126 | | | | 0 | 0 | 5 | -5 | -5 | | | |
| 02071100 | 11 | 25.3N | 124.8E | 40 | 26 | 45 | 49 | 80 | 160 | | | | 0 | 0 | 5 | -5 | -5 | | | |
| 02071106 | 12 | 25.3N | 125.5E | 40 | 17 | 28 | 45 | 68 | 124 | | | | 0 | 5 | 0 | 0 | 0 | | | |
| 02071112 | 13 | 25.4N | 126.1E | 40 | 20 | 53 | 74 | 58 | 97 | | | | 0 | 0 | 0 | 0 | 10 | | | |
| 02071118 | 14 | 25.5N | 126.4E | 40 | 10 | 48 | 97 | 48 | | | | | 0 | 0 | 0 | 0 | | | | |
| 02071200 | 15 | 25.6N | 126.7E | 40 | 5 | 45 | 80 | 5 | | | | | 0 | 0 | 0 | 5 | | | | |
| 02071206 | 16 | 26.0N | 126.8E | 40 | 8 | 69 | 96 | | | | | | 0 | 5 | 0 | | | | | |
| 02071212 | 17 | 26.6N | 126.8E | 40 | 6 | 61 | 168 | | | | | | 0 | 0 | 5 | | | | | |
| 02071218 | 18 | 28.0N | 126.5E | 35 | 7 | 67 | | | | | | | 0 | 5 | | | | | | |
| 02071300 | 19 | 28.7N | 126.5E | 35 | 0 | 55 | | | | | | | 0 | 5 | | | | | | |
| 02071306 | 20 | 30.5N | 127.2E | 30 | 5 | | | | | | | | 0 | | | | | | | |
| 02071312 | | 31.5N | 127.7E | 25 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 16 | 47 | 72 | 75 | 119 | 225 | 183 | | 0 | 3 | 3 | 2 | 5 | 3 | 8 | |
| | | | BIAS | | | | | | | | | | 0 | 1 | 0 | -2 | -3 | 0 | 3 | |
| | | | # CASES | | 20 | 19 | 17 | 15 | 13 | 9 | 2 | | 20 | 19 | 17 | 15 | 13 | 9 | 2 | |

**Statistics for JTWC on STY12W Fengshen**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02071318 | | 10.9N | 171.2E | 20 | | | | | | | | | | | | | | | | |
| 02071400 | | 11.3N | 171.0E | 25 | | | | | | | | | | | | | | | | |
| 02071406 | 1 | 11.7N | 170.7E | 25 | 11 | 6 | 70 | 128 | 135 | 167 | | | 0 | -25 | -50 | -50 | -65 | -65 | | |
| 02071412 | 2 | 12.0N | 170.3E | 35 | 0 | 26 | 76 | 99 | 120 | 196 | 241 | 294 | -5 | -45 | -45 | -55 | -60 | -60 | -70 | -75 |
| 02071418 | 3 | 12.5N | 170.2E | 55 | 6 | 26 | 30 | 18 | 25 | 70 | 81 | 54 | -10 | -25 | -20 | -30 | -35 | -10 | -20 | -50 |
| 02071500 | 4 | 13.0N | 170.3E | 80 | 6 | 8 | 0 | 30 | 44 | 85 | 104 | 185 | 0 | 0 | -5 | -10 | -10 | -10 | -20 | -25 |
| 02071506 | 5 | 13.5N | 170.5E | 85 | 0 | 18 | 47 | 59 | 79 | 159 | 173 | 220 | 0 | 0 | -15 | -20 | -10 | -20 | -25 | -25 |
| 02071512 | 6 | 13.9N | 170.5E | 90 | 5 | 26 | 54 | 68 | 109 | 189 | 282 | 358 | 0 | -10 | -15 | -20 | -15 | -25 | -30 | -25 |
| 02071518 | 7 | 14.3N | 170.3E | 95 | 5 | 50 | 75 | 102 | 138 | 189 | 266 | 337 | 0 | -20 | -25 | -20 | -15 | -20 | -30 | -25 |
| 02071600 | 8 | 14.5N | 169.9E | 105 | 0 | 42 | 74 | 118 | 157 | 202 | 208 | 230 | 0 | 0 | -10 | -10 | -10 | -20 | -20 | -20 |
| 02071606 | 9 | 14.5N | 169.4E | 115 | 5 | 32 | 67 | 103 | 140 | 182 | 244 | 308 | 0 | -10 | -5 | -5 | -10 | -15 | -15 | -15 |
| 02071612 | 10 | 14.5N | 168.9E | 115 | 5 | 17 | 51 | 89 | 115 | 152 | 220 | 248 | 0 | -5 | 0 | -5 | -10 | -10 | -10 | -15 |
| 02071618 | 11 | 14.5N | 168.4E | 125 | 11 | 13 | 34 | 55 | 64 | 78 | 128 | 134 | 0 | 5 | 5 | -5 | -5 | -5 | -10 | -5 |
| 02071700 | 12 | 14.6N | 167.9E | 125 | 6 | 13 | 46 | 62 | 79 | 93 | 114 | 174 | 0 | 0 | -5 | -5 | -10 | -5 | -10 | -5 |
| 02071706 | 13 | 14.6N | 167.2E | 125 | 5 | 21 | 27 | 30 | 36 | 71 | 113 | 143 | 0 | 0 | -10 | -5 | -10 | -5 | -10 | 0 |
| 02071712 | 14 | 14.6N | 166.4E | 125 | 5 | 31 | 54 | 73 | 95 | 133 | 163 | 193 | 0 | -5 | -10 | -10 | -10 | 0 | -15 | 5 |
| 02071718 | 15 | 14.6N | 165.5E | 125 | 5 | 31 | 54 | 72 | 93 | 78 | 135 | 194 | 5 | -5 | 0 | -5 | -5 | 0 | -5 | 10 |
| 02071800 | 16 | 14.6N | 164.6E | 130 | 5 | 13 | 25 | 48 | 67 | 87 | 164 | 210 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 |
| 02071806 | 17 | 14.6N | 163.8E | 135 | 5 | 6 | 13 | 24 | 66 | 128 | 198 | 218 | 0 | 0 | 0 | 0 | 0 | -5 | 0 | 30 |
| 02071812 | 18 | 14.8N | 163.0E | 135 | 6 | 17 | 31 | 52 | 80 | 140 | 185 | 211 | 0 | -5 | 0 | 0 | 0 | -10 | 5 | 40 |
| 02071818 | 19 | 14.9N | 162.1E | 135 | 0 | 19 | 46 | 71 | 86 | 129 | 185 | 199 | 0 | -5 | 0 | 0 | 5 | 5 | 15 | 60 |
| 02071900 | 20 | 15.1N | 161.3E | 140 | 0 | 21 | 50 | 81 | 90 | 119 | 174 | 213 | 0 | 0 | 0 | 5 | 5 | 5 | 25 | 65 |
| 02071906 | 21 | 15.3N | 160.5E | 140 | 8 | 17 | 52 | 58 | 87 | 136 | 192 | 273 | 0 | 0 | 0 | 0 | 5 | 5 | 30 | 70 |
| 02071912 | 22 | 15.5N | 159.8E | 140 | 8 | 30 | 46 | 66 | 103 | 158 | 224 | 311 | 0 | 0 | 5 | 5 | -5 | 10 | 45 | 70 |
| 02071918 | 23 | 15.8N | 159.1E | 140 | 5 | 21 | 17 | 45 | 66 | 126 | 224 | 425 | 0 | 0 | 0 | 5 | 0 | 10 | 55 | 75 |
| 02072000 | 24 | 16.0N | 158.5E | 140 | 0 | 36 | 51 | 64 | 90 | 138 | 178 | 288 | 0 | 5 | 0 | -5 | 0 | 20 | 60 | 75 |
| 02072006 | 25 | 16.5N | 158.1E | 140 | 8 | 12 | 42 | 48 | 83 | 113 | 163 | 319 | 0 | 0 | 0 | 0 | 5 | 30 | 65 | 80 |
| 02072012 | 26 | 17.2N | 157.6E | 135 | 0 | 21 | 38 | 54 | 98 | 114 | 191 | 311 | 0 | -5 | -5 | 0 | 10 | 45 | 70 | 85 |
| 02072018 | 27 | 18.0N | 156.9E | 140 | 13 | 25 | 29 | 58 | 79 | 110 | 171 | 364 | 0 | 0 | 0 | 5 | 10 | 55 | 75 | 85 |
| 02072100 | 28 | 18.9N | 156.1E | 140 | 8 | 12 | 30 | 60 | 72 | 132 | 271 | 425 | 0 | -5 | 0 | 10 | 20 | 55 | 75 | 85 |
| 02072106 | 29 | 19.7N | 155.3E | 140 | 0 | 18 | 33 | 49 | 45 | 130 | 323 | 489 | 0 | 0 | 5 | 10 | 25 | 55 | 75 | 85 |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02072112 | 30 | 20.5N | 154.3E | 145 | 0 | 6 | 37 | 42 | 47 | 84 | 300 | 462 | 0 | 0 | 10 | 20 | 40 | 60 | 80 | 85 |
| 02072118 | 31 | 21.3N | 153.4E | 140 | 0 | 30 | 51 | 69 | 97 | 154 | 274 | 302 | 0 | 5 | 10 | 30 | 50 | 65 | 80 | 95 |
| 02072200 | 32 | 22.2N | 152.2E | 140 | 0 | 30 | 42 | 80 | 91 | 168 | 273 | 357 | 0 | 10 | 20 | 40 | 50 | 60 | 80 | 95 |
| 02072206 | 33 | 23.3N | 151.2E | 135 | 5 | 13 | 24 | 69 | 85 | 190 | 264 | 382 | 5 | 5 | 20 | 40 | 50 | 55 | 80 | 90 |
| 02072212 | 34 | 24.2N | 150.0E | 130 | 5 | 6 | 24 | 66 | 98 | 173 | 249 | | 0 | 5 | 25 | 35 | 35 | 45 | 60 | |
| 02072218 | 35 | 25.0N | 148.8E | 130 | 6 | 19 | 61 | 68 | 87 | 151 | 275 | | -10 | 15 | 35 | 40 | 45 | 50 | 70 | |
| 02072300 | 36 | 25.8N | 147.5E | 120 | 11 | 32 | 68 | 76 | 117 | 176 | 285 | | 0 | 20 | 30 | 35 | 30 | 40 | 60 | |
| 02072306 | 37 | 26.6N | 146.2E | 110 | 0 | 19 | 24 | 44 | 78 | 117 | 257 | | 0 | 5 | 5 | 10 | 5 | 5 | 20 | |
| 02072312 | 38 | 27.4N | 144.7E | 95 | 0 | 17 | 21 | 53 | 72 | 114 | | | 0 | 0 | 5 | 5 | 10 | 0 | | |
| 02072318 | 39 | 28.1N | 143.0E | 85 | 16 | 25 | 29 | 45 | 84 | 169 | | | 0 | 5 | 10 | 5 | 5 | 10 | | |
| 02072400 | 40 | 28.3N | 141.3E | 80 | 12 | 26 | 25 | 47 | 93 | 143 | | | 0 | 5 | 5 | 10 | 0 | 15 | | |
| 02072406 | 41 | 28.4N | 139.6E | 75 | 24 | 24 | 55 | 68 | 67 | 77 | | | 0 | 0 | 0 | 0 | 5 | 10 | | |
| 02072412 | 42 | 28.6N | 138.0E | 70 | 12 | 16 | 20 | 26 | 31 | | | | 0 | 0 | 5 | 5 | 5 | | | |
| 02072418 | 43 | 29.0N | 136.1E | 65 | 13 | 32 | 24 | 42 | 54 | | | | 0 | 0 | 0 | 5 | 10 | | | |
| 02072500 | 44 | 29.4N | 134.2E | 65 | 0 | 22 | 28 | 48 | 68 | | | | 0 | 5 | 5 | 5 | 15 | | | |
| 02072506 | 45 | 30.0N | 132.4E | 60 | 6 | 0 | 12 | 16 | 40 | | | | 0 | 0 | 5 | 10 | 15 | | | |
| 02072512 | 46 | 30.5N | 130.9E | 55 | 6 | 16 | 36 | 43 | | | | | 0 | 0 | 0 | 10 | | | | |
| 02072518 | 47 | 31.1N | 129.3E | 55 | 21 | 52 | 82 | 112 | | | | | 0 | 0 | 5 | 10 | | | | |
| 02072600 | 48 | 31.7N | 128.0E | 50 | 7 | 13 | 30 | | | | | | 5 | 0 | 10 | | | | | |
| 02072606 | 49 | 32.4N | 126.8E | 45 | 7 | 13 | 42 | | | | | | 0 | 5 | 10 | | | | | |
| 02072612 | 50 | 33.0N | 125.7E | 45 | 0 | 26 | | | | | | | 0 | 10 | | | | | | |
| 02072618 | 51 | 33.6N | 124.5E | 35 | 20 | | | | | | | | 0 | | | | | | | |
| 02072700 | 52 | 34.2N | 123.4E | 30 | 18 | | | | | | | | 0 | | | | | | | |
| 02072706 | 53 | 34.9N | 122.3E | 25 | 18 | | | | | | | | 0 | | | | | | | |
| | | | AVERAGE | | 7 | 21 | 41 | 62 | 83 | 135 | 208 | 276 | 1 | 6 | 9 | 13 | 16 | 24 | 39 | 50 |
| | | | BIAS | | | | | | | | | | 0 | -1 | 0 | 2 | 4 | 10 | 23 | 32 |
| | | | # CASES | | 53 | 50 | 49 | 47 | 45 | 41 | 36 | 32 | 53 | 50 | 49 | 47 | 45 | 41 | 36 | 32 |

**Statistics for JTWC on TY 07W Noguri**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02060400 | | 19.5N | 112.3E | 20 | | | | | | | | | | | | | | | | |
| 02060406 | | 19.6N | 112.5E | 20 | | | | | | | | | | | | | | | | |
| 02060412 | | 19.8N | 112.7E | 20 | | | | | | | | | | | | | | | | |
| 02060418 | | 20.0N | 112.8E | 20 | | | | | | | | | | | | | | | | |
| 02060500 | | 20.1N | 113.0E | 20 | | | | | | | | | | | | | | | | |
| 02060506 | | 20.2N | 113.3E | 20 | | | | | | | | | | | | | | | | |
| 02060512 | | 20.3N | 113.7E | 20 | | | | | | | | | | | | | | | | |
| 02060518 | | 20.3N | 114.2E | 25 | | | | | | | | | | | | | | | | |
| 02060600 | 1 | 20.2N | 114.9E | 30 | 6 | 29 | 68 | 141 | 208 | 314 | | | 0 | 0 | 5 | 0 | -15 | -55 | | |
| 02060606 | 2 | 20.3N | 115.6E | 30 | 34 | 70 | 142 | 191 | 241 | 238 | | | 0 | 0 | 0 | -5 | -15 | -55 | | |
| 02060612 | 3 | 20.3N | 116.4E | 30 | 11 | 34 | 101 | 140 | 169 | 140 | | | 0 | 0 | 0 | -15 | -30 | -60 | | |
| 02060618 | 4 | 20.3N | 117.0E | 30 | 8 | 41 | 69 | 110 | 123 | 181 | | | 0 | 0 | -5 | -15 | -40 | -55 | | |
| 02060700 | 5 | 20.4N | 118.0E | 30 | 11 | 64 | 107 | 140 | 147 | 205 | | | 0 | 0 | -15 | -25 | -60 | -50 | | |
| 02060706 | 6 | 20.5N | 119.1E | 30 | 22 | 46 | 90 | 111 | 106 | 218 | | | 0 | -5 | -15 | -40 | -60 | -45 | | |
| 02060712 | 7 | 20.6N | 120.2E | 30 | 23 | 46 | 66 | 73 | 65 | 181 | | | 0 | -15 | -25 | -60 | -60 | -35 | | |
| 02060718 | 8 | 20.7N | 121.1E | 35 | 12 | 24 | 22 | 66 | 104 | 67 | | | 0 | -10 | -20 | -50 | -45 | -5 | | |
| 02060800 | 9 | 20.9N | 122.1E | 45 | 8 | 8 | 48 | 89 | 104 | 221 | | | 0 | -5 | -35 | -40 | -35 | 10 | | |
| 02060806 | 10 | 21.2N | 123.0E | 45 | 17 | 42 | 72 | 96 | 175 | | | | 0 | -15 | -35 | -30 | -20 | | | |
| 02060812 | 11 | 21.5N | 123.8E | 55 | 5 | 33 | 61 | 79 | 126 | | | | -5 | -25 | -20 | -5 | 15 | | | |
| 02060818 | 12 | 22.0N | 124.3E | 65 | 8 | 35 | 65 | 84 | 116 | | | | -10 | -20 | -10 | 5 | 35 | | | |
| 02060900 | 13 | 22.7N | 124.7E | 85 | 8 | 40 | 50 | 66 | 238 | | | | 0 | 10 | 25 | 40 | 65 | | | |
| 02060906 | 14 | 23.2N | 124.8E | 85 | 54 | 8 | 69 | 123 | | | | | -10 | 10 | 25 | 55 | | | | |
| 02060912 | 15 | 23.8N | 125.0E | 85 | 5 | 52 | 123 | 301 | | | | | -10 | 10 | 30 | 50 | | | | |
| 02060918 | 16 | 24.7N | 125.3E | 80 | 5 | 39 | 75 | | | | | | 5 | 15 | 40 | | | | | |
| 02061000 | 17 | 26.0N | 126.1E | 75 | 13 | 37 | 133 | | | | | | 0 | 5 | 30 | | | | | |
| 02061006 | 18 | 27.2N | 127.1E | 65 | 8 | 18 | | | | | | | 0 | 25 | | | | | | |
| 02061012 | 19 | 28.6N | 128.3E | 55 | 16 | 93 | | | | | | | 0 | 20 | | | | | | |
| 02061018 | 20 | 30.2N | 130.0E | 30 | 0 | | | | | | | | 0 | | | | | | | |
| 02061100 | 21 | 32.6N | 133.2E | 25 | 26 | | | | | | | | 0 | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AVERAGE | 15 | 40 | 80 | 121 | 148 | 196 | 2 | 10 | 20 | 29 | 38 | 41 |
| BIAS | | | | | | | -1 | 0 | -1 | -9 | -20 | -39 |
| # CASES | 21 | 19 | 17 | 15 | 13 | 9 | 21 | 19 | 17 | 15 | 13 | 9 |

**Statistics for JTWC on STY08W Chataan**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02062706 | | 3.9N | 155.3E | 20 | | | | | | | | | | | | | | | | |
| 02062712 | | 4.2N | 154.6E | 25 | | | | | | | | | | | | | | | | |
| 02062718 | | 4.7N | 154.0E | 25 | | | | | | | | | | | | | | | | |
| 02062800 | 1 | 5.0N | 153.9E | 25 | 13 | 27 | 84 | 126 | 156 | 226 | 287 | 332 | 0 | 0 | -5 | -10 | -10 | 0 | -10 | 0 |
| 02062806 | 2 | 5.2N | 153.9E | 25 | 21 | 72 | 133 | 157 | 187 | 222 | 252 | 314 | 0 | -5 | -15 | -10 | -10 | 0 | -5 | -5 |
| 02062812 | 3 | 5.2N | 154.2E | 25 | 46 | 113 | 158 | 209 | 254 | 277 | 282 | 305 | 0 | -5 | -10 | -10 | -5 | 0 | -5 | -5 |
| 02062818 | 4 | 5.3N | 154.7E | 30 | 11 | 78 | 129 | 196 | 225 | 234 | 237 | 230 | 0 | -10 | -5 | -5 | 0 | 5 | 10 | -15 |
| 02062900 | 5 | 5.3N | 155.2E | 35 | 21 | 59 | 89 | 115 | 128 | 106 | 100 | 83 | 0 | -5 | -5 | 0 | 0 | 5 | 5 | -25 |
| 02062906 | 6 | 5.4N | 155.6E | 45 | 6 | 24 | 57 | 57 | 48 | 51 | 90 | 56 | 0 | 15 | 20 | 30 | 40 | 55 | 35 | 25 |
| 02062912 | 7 | 5.5N | 155.8E | 45 | 32 | 68 | 90 | 80 | 80 | 51 | 55 | 93 | 0 | 10 | 20 | 30 | 40 | 50 | 35 | 10 |
| 02062918 | 8 | 5.5N | 155.9E | 45 | 43 | 110 | 131 | 124 | 144 | 120 | 114 | 88 | 0 | 10 | 20 | 30 | 40 | 55 | 35 | 10 |
| 02063000 | 9 | 5.5N | 156.1E | 50 | 11 | 40 | 51 | 81 | 59 | 36 | 84 | 132 | 0 | 10 | 20 | 30 | 40 | 50 | 25 | 5 |
| 02063006 | 10 | 5.6N | 156.3E | 50 | 26 | 30 | 54 | 71 | 22 | 72 | 112 | 88 | 0 | 5 | 15 | 25 | 35 | 35 | 5 | -10 |
| 02063012 | 11 | 5.8N | 156.2E | 50 | 13 | 45 | 25 | 48 | 67 | 42 | 111 | 122 | 0 | 5 | 15 | 25 | 30 | 35 | -10 | -15 |
| 02063018 | 12 | 6.0N | 155.8E | 50 | 11 | 12 | 22 | 55 | 97 | 85 | 53 | 79 | 0 | 5 | 15 | 30 | 35 | 20 | -10 | -30 |
| 02070100 | 13 | 6.3N | 155.5E | 50 | 0 | 30 | 37 | 83 | 132 | 151 | 113 | 54 | 0 | 5 | 15 | 25 | 30 | 10 | -15 | -30 |
| 02070106 | 14 | 6.7N | 155.2E | 50 | 13 | 27 | 59 | 121 | 139 | 121 | 35 | 32 | 0 | 5 | 20 | 30 | 25 | 10 | -20 | -25 |
| 02070112 | 15 | 7.0N | 155.0E | 50 | 18 | 40 | 98 | 129 | 127 | 79 | 19 | 38 | 0 | 5 | 15 | 25 | 25 | -5 | -25 | -15 |
| 02070118 | 16 | 7.2N | 154.4E | 50 | 29 | 96 | 138 | 161 | 162 | 134 | 120 | 81 | 0 | 10 | 15 | 10 | 10 | -5 | -35 | -15 |
| 02070200 | 17 | 7.4N | 153.4E | 50 | 0 | 67 | 138 | 163 | 188 | 198 | 189 | 145 | 0 | 5 | 10 | 15 | 5 | -10 | -30 | -15 |
| 02070206 | 18 | 7.5N | 152.4E | 45 | 5 | 88 | 143 | 194 | 206 | 238 | 312 | 306 | 0 | 5 | 0 | 0 | 0 | -20 | -35 | -35 |
| 02070212 | 19 | 7.5N | 151.7E | 50 | 6 | 51 | 97 | 142 | 139 | 169 | 242 | 195 | 0 | 0 | 0 | -10 | -15 | -25 | -25 | -40 |
| 02070218 | 20 | 7.6N | 151.0E | 45 | 11 | 35 | 59 | 100 | 95 | 113 | 133 | 201 | 0 | -5 | -10 | -10 | -15 | -30 | -25 | -50 |
| 02070300 | 21 | 7.9N | 150.4E | 50 | 34 | 60 | 87 | 119 | 113 | 142 | 180 | 215 | 0 | 0 | -15 | -20 | -15 | -25 | -20 | -45 |
| 02070306 | 22 | 8.4N | 149.9E | 55 | 29 | 38 | 84 | 87 | 88 | 74 | 100 | 114 | 0 | -10 | -15 | -20 | -20 | -25 | -35 | -45 |

**TC 10S Dina**
**TC 11S Eddy**
**TC 12S Francesca**
**TC 13S Chris**
**TC 14P Claudia**
**TC 15S Guillaume**
**TC 16P**
**TC 17P Des**
**TC 18S Hary**
**TC 19P**
**TC 20S Ikala**
**TC 21S Dianne-Jery**
**TC 22S Bonnie**
**TC 23S Kesiny**
**TC 24S Errol**
**TC 25P Upia**

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02070312 | 23 | 9.1N | 149.5E | 55 | 8 | 38 | 63 | 76 | 75 | 100 | 123 | 114 | 0 | -20 | -30 | -25 | -25 | -15 | -40 | -35 |
| 02070318 | 24 | 9.9N | 149.1E | 65 | 13 | 60 | 76 | 81 | 76 | 75 | 154 | 163 | 0 | -5 | -15 | -20 | -25 | -15 | -50 | -35 |
| 02070400 | 25 | 10.8N | 148.8E | 75 | 5 | 43 | 64 | 63 | 56 | 48 | 115 | 215 | 0 | -10 | -5 | -10 | -15 | -5 | -50 | -30 |
| 02070406 | 26 | 12.1N | 147.9E | 75 | 13 | 36 | 38 | 57 | 72 | 73 | 105 | 117 | 0 | 0 | -5 | -15 | -20 | -35 | -40 | -30 |
| 02070412 | 27 | 12.8N | 146.6E | 90 | 5 | 18 | 42 | 72 | 104 | 94 | 195 | 244 | 0 | 5 | -10 | -20 | -15 | -40 | -35 | -15 |
| 02070418 | 28 | 13.3N | 145.6E | 90 | 11 | 55 | 96 | 124 | 128 | 79 | 196 | 272 | 5 | 0 | -15 | -20 | -15 | -50 | -35 | -5 |
| 02070500 | 29 | 13.8N | 144.5E | 95 | 0 | 27 | 59 | 103 | 115 | 90 | 168 | 236 | 5 | 0 | -10 | -5 | -15 | -50 | -30 | 5 |
| 02070506 | 30 | 14.2N | 143.6E | 100 | 5 | 8 | 37 | 63 | 59 | 95 | 180 | 326 | 5 | -5 | -10 | -5 | -25 | -45 | -20 | 20 |
| 02070512 | 31 | 14.7N | 142.7E | 105 | 8 | 13 | 50 | 47 | 69 | 55 | 138 | 184 | 0 | -5 | 0 | -5 | -30 | -35 | -5 | 30 |
| 02070518 | 32 | 15.3N | 141.9E | 110 | 0 | 25 | 30 | 18 | 29 | 103 | 137 | 304 | 0 | -5 | 0 | -20 | -40 | -40 | 5 | 35 |
| 02070600 | 33 | 15.9N | 141.0E | 110 | 0 | 21 | 21 | 16 | 57 | 95 | 151 | | 0 | 10 | 5 | -20 | -35 | -30 | 20 | |
| 02070606 | 34 | 16.5N | 140.2E | 110 | 0 | 17 | 13 | 40 | 97 | 145 | 340 | | 0 | 10 | -10 | -30 | -35 | -25 | 30 | |
| 02070612 | 35 | 17.2N | 139.3E | 100 | 13 | 21 | 11 | 58 | 110 | 181 | 395 | | 0 | 0 | -25 | -35 | -25 | -10 | 40 | |
| 02070618 | 36 | 17.9N | 138.2E | 100 | 8 | 16 | 40 | 88 | 121 | 184 | 356 | | 0 | -15 | -35 | -35 | -25 | 0 | 50 | |
| 02070700 | 37 | 18.8N | 137.3E | 100 | 0 | 21 | 61 | 86 | 113 | 208 | | | 0 | -25 | -35 | -25 | -25 | 10 | | |
| 02070706 | 38 | 19.5N | 136.1E | 115 | 0 | 38 | 58 | 76 | 113 | 254 | | | 0 | -10 | -10 | -5 | 0 | 25 | | |
| 02070712 | 39 | 20.2N | 134.9E | 120 | 0 | 46 | 71 | 97 | 97 | 303 | | | 0 | -10 | 0 | 5 | 20 | 35 | | |
| 02070718 | 40 | 20.8N | 134.0E | 130 | 5 | 41 | 68 | 95 | 120 | 321 | | | 0 | -5 | 0 | 0 | 10 | 40 | | |
| 02070800 | 41 | 21.6N | 133.7E | 130 | 0 | 54 | 50 | 73 | 113 | | | | 0 | 5 | 5 | 10 | 15 | | | |
| 02070806 | 42 | 22.8N | 133.2E | 130 | 0 | 21 | 45 | 60 | 86 | | | | 0 | 5 | 10 | 20 | 25 | | | |
| 02070812 | 43 | 24.0N | 132.9E | 120 | 0 | 12 | 49 | 66 | 94 | | | | 0 | 5 | 15 | 30 | 40 | | | |
| 02070818 | 44 | 25.2N | 132.5E | 120 | 5 | 32 | 62 | 82 | 95 | | | | 0 | 0 | 15 | 20 | 30 | | | |
| 02070900 | 45 | 26.4N | 132.5E | 115 | 5 | 32 | 73 | 75 | | | | | 0 | 10 | 20 | 25 | | | | |
| 02070906 | 46 | 27.6N | 132.6E | 110 | 5 | 30 | 42 | 134 | | | | | 0 | 15 | 25 | 35 | | | | |
| 02070912 | 47 | 28.3N | 132.9E | 95 | 11 | 48 | 150 | | | | | | 5 | 15 | 25 | | | | | |
| 02070918 | 48 | 29.5N | 133.6E | 85 | 20 | 72 | 179 | | | | | | 0 | 15 | 25 | | | | | |
| 02071000 | 49 | 30.7N | 134.8E | 75 | 16 | 123 | | | | | | | 0 | 15 | | | | | | |
| 02071006 | 50 | 32.2N | 136.7E | 65 | 47 | 195 | | | | | | | 0 | 10 | | | | | | |
| 02071012 | 51 | 34.0N | 138.8E | 55 | 57 | | | | | | | | 0 | | | | | | | |
| 02071018 | 52 | 36.0N | 141.0E | 45 | 18 | | | | | | | | 0 | | | | | | | |
| | | | AVERAGE | | 13 | 47 | 73 | 95 | 110 | 136 | 166 | 171 | 0 | 7 | 13 | 18 | 22 | 25 | 25 | 22 |
| | | | BIAS | | | | | | | | | | 0 | 1 | 1 | 1 | 1 | -3 | -9 | -13 |
| | | | # CASES | | 52 | 50 | 48 | 46 | 44 | 40 | 36 | 32 | 52 | 50 | 48 | 46 | 44 | 40 | 36 | 32 |

**Statistics for JTWC on TY 09W Rammasun**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02062612 | | 9.6N | 139.2E | 15 | | | | | | | | | | | | | | | | |
| 02062618 | | 10.0N | 138.8E | 15 | | | | | | | | | | | | | | | | |
| 02062700 | | 10.3N | 138.3E | 15 | | | | | | | | | | | | | | | | |
| 02062706 | | 10.3N | 137.8E | 20 | | | | | | | | | | | | | | | | |
| 02062712 | | 10.3N | 137.3E | 20 | | | | | | | | | | | | | | | | |
| 02062718 | | 10.1N | 136.8E | 25 | | | | | | | | | | | | | | | | |
| 02062800 | | 10.0N | 136.2E | 25 | | | | | | | | | | | | | | | | |
| 02062806 | 1 | 9.9N | 135.1E | 25 | 8 | 26 | 149 | 158 | 168 | 177 | 80 | 69 | 0 | 0 | 0 | 0 | 0 | 0 | -50 | -55 |
| 02062812 | 2 | 10.1N | 134.4E | 25 | 21 | 112 | 152 | 142 | 134 | 83 | 25 | 131 | 0 | 0 | -5 | -5 | 0 | -10 | -55 | -55 |
| 02062818 | 3 | 10.7N | 134.5E | 30 | 60 | 177 | 135 | 117 | 111 | 133 | 163 | 184 | 0 | 0 | 0 | 0 | 0 | -20 | -50 | -60 |
| 02062900 | 4 | 10.9N | 135.2E | 30 1 | 18 | 182 | 176 | 169 | 180 | 169 | 222 | 294 | 0 | -5 | -5 | -5 | 0 | -30 | -55 | -60 |
| 02062906 | 5 | 11.4N | 136.0E | 35 | 24 | 48 | 65 | 78 | 99 | 194 | 307 | 330 | 0 | 0 | 5 | 10 | 10 | -20 | -45 | -30 |
| 02062912 | 6 | 11.7N | 135.7E | 40 | 25 | 59 | 53 | 59 | 120 | 222 | 296 | 283 | 0 | 0 | 5 | 15 | 5 | -20 | -40 | -5 |
| 02062918 | 7 | 12.2N | 135.3E | 40 | 26 | 30 | 46 | 96 | 147 | 200 | 224 | 322 | 0 | 0 | 5 | 10 | -5 | -20 | -25 | 0 |
| 02063000 | 8 | 12.7N | 135.0E | 45 | 51 | 56 | 75 | 127 | 168 | 230 | 277 | 377 | 0 | 5 | 10 | 0 | -10 | -25 | -25 | 15 |
| 02063006 | 9 | 13.3N | 134.6E | 45 | 8 | 6 | 21 | 57 | 85 | 132 | 214 | 226 | 0 | 5 | 10 | -5 | -15 | -20 | -25 | 35 |
| 02063012 | 10 | 13.9N | 134.1E | 50 | 13 | 23 | 41 | 74 | 87 | 126 | 191 | 225 | 0 | 5 | 0 | -15 | -25 | -15 | -10 | 50 |
| 02063018 | 11 | 14.6N | 133.6E | 50 | 25 | 54 | 73 | 90 | 138 | 158 | 258 | 308 | 0 | 0 | -10 | -25 | -25 | -15 | 0 | 55 |
| 02070100 | 12 | 15.3N | 133.1E | 50 | 35 | 50 | 74 | 82 | 142 | 225 | 318 | 424 | 0 | -10 | -20 | -35 | -30 | -20 | 15 | 60 |
| 02070106 | 13 | 16.4N | 132.4E | 55 | 16 | 35 | 41 | 77 | 111 | 241 | 328 | 473 | -5 | -20 | -30 | -35 | -30 | -15 | 25 | 65 |
| 02070112 | 14 | 17.5N | 131.6E | 65 | 8 | 16 | 37 | 30 | 61 | 169 | 245 | | 0 | -10 | -20 | -15 | -5 | 15 | 60 | |
| 02070118 | 15 | 18.5N | 130.7E | 75 | 13 | 38 | 13 | 19 | 55 | 127 | 211 | | 0 | -10 | -10 | -10 | -5 | 25 | 65 | |
| 02070200 | 16 | 19.5N | 129.9E | 85 | 6 | 13 | 19 | 36 | 80 | 150 | 233 | | 0 | -10 | -10 | 0 | -5 | 35 | 70 | |
| 02070206 | 17 | 20.2N | 129.0E | 95 | 0 | 30 | 36 | 36 | 85 | 132 | 325 | | -10 | -10 | -10 | -5 | -5 | 35 | 75 | |
| 02070212 | 18 | 21.0N | 128.1E | 105 | 0 | 47 | 48 | 67 | 104 | 143 | | | -15 | -15 | -10 | -15 | 0 | 30 | | |
| 02070218 | 19 | 22.2N | 127.3E | 105 | 0 | 0 | 19 | 66 | 94 | 104 | | | 0 | 0 | 5 | 15 | 25 | 55 | | |
| 02070300 | 20 | 23.2N | 126.3E | 110 | 5 | 20 | 21 | 66 | 55 | 82 | | | 0 | 5 | 10 | 20 | 35 | 50 | | |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02070306 | 21 | 23.8N | 125.8E | 110 | 5 | 36 | 69 | 88 | 79 | 245 | | | 0 | 5 | 15 | 30 | 40 | 55 | | |
| 02070312 | 22 | 24.7N | 125.3E | 110 | 8 | 30 | 68 | 82 | 88 | | | | 0 | 0 | 15 | 35 | 50 | | | |
| 02070318 | 23 | 25.6N | 124.9E | 110 | 12 | 49 | 86 | 90 | 165 | | | | 0 | 0 | 20 | 40 | 50 | | | |
| 02070400 | 24 | 26.9N | 124.3E | 110 | 12 | 26 | 45 | 60 | 155 | | | | 0 | 10 | 20 | 35 | 40 | | | |
| 02070406 | 25 | 28.1N | 124.1E | 105 | 18 | 39 | 42 | 85 | 151 | | | | 0 | 10 | 25 | 35 | 25 | | | |
| 02070412 | 26 | 29.4N | 124.1E | 90 | 8 | 15 | 56 | 124 | | | | | 0 | 10 | 15 | 15 | | | | |
| 02070418 | 27 | 30.7N | 124.1E | 80 | 0 | 24 | 41 | 135 | | | | | 0 | 10 | 15 | 25 | | | | |
| 02070500 | 28 | 32.0N | 123.8E | 65 | 16 | 52 | 54 | | | | | | 5 | 15 | 10 | | | | | |
| 02070506 | 29 | 32.8N | 123.9E | 55 | 11 | 30 | 34 | | | | | | 0 | 0 | 0 | | | | | |
| 02070512 | 30 | 33.9N | 124.5E | 45 | 11 | 24 | | | | | | | 0 | 0 | | | | | | |
| 02070518 | 31 | 35.2N | 125.4E | 40 | 11 | 51 | | | | | | | 0 | 10 | | | | | | |
| 02070600 | 32 | 36.7N | 126.5E | 35 | 25 | | | | | | | | 5 | | | | | | | |
| 02070606 | 33 | 37.9N | 127.9E | 25 | 0 | | | | | | | | -5 | | | | | | | |
| | | | AVERAGE | | 19 | 45 | 62 | 86 | 114 | 164 | 230 | 281 | 1 | 6 | 11 | 17 | 18 | 25 | 41 | 42 |
| | | | BIAS | | | | | | | | | | -1 | 0 | 2 | 4 | 5 | 3 | -4 | 1 |
| | | | # CASES | | 33 | 31 | 29 | 27 | 25 | 21 | 17 | 13 | 33 | 31 | 29 | 27 | 25 | 21 | 17 | 13 |

**Statistics for JTWC on TD 03W**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02031818 | | 4.0N | 138.2E | 25 | | | | | | | | | | | | | | | | |
| 02031900 | | 4.7N | 136.3E | 25 | | | | | | | | | | | | | | | | |
| 02031906 | | 5.6N | 134.5E | 25 | | | | | | | | | | | | | | | | |
| 02031912 | 1 | 6.2N | 133.2E | 25 | 51 | 48 | 68 | 95 | 125 | 125 | 85 | 108 | 0 | 5 | 5 | 10 | 15 | 20 | 20 | 20 |
| 02031918 | 2 | 6.5N | 132.2E | 25 | 32 | 25 | 60 | 91 | 161 | 180 | | | 0 | 0 | 5 | 5 | 10 | 15 | | |
| 02032000 | 3 | 6.5N | 131.1E | 25 | 21 | 38 | 80 | 97 | 129 | 90 | 26 | 137 | 0 | 0 | 5 | 5 | 5 | 15 | 20 | 30 |
| 02032006 | 4 | 6.6N | 130.1E | 30 | 24 | 76 | 94 | 141 | 158 | 80 | 8 | 123 | 0 | 5 | 5 | 10 | 10 | 15 | 20 | 20 |
| 02032012 | 5 | 6.7N | 129.2E | 30 | 36 | 56 | 42 | 85 | 118 | 36 | 34 | | 0 | 5 | 5 | 5 | 10 | 15 | 20 | |
| 02032018 | 6 | 6.7N | 128.5E | 30 | 13 | 13 | 59 | 99 | 92 | 88 | 127 | | 0 | 0 | 0 | 0 | 5 | 10 | 20 | |
| 02032100 | 7 | 7.0N | 127.6E | 30 | 11 | 57 | 60 | 86 | 54 | 66 | 46 | | 0 | 0 | -5 | 0 | 5 | 10 | 20 | |
| 02032106 | 8 | 7.4N | 126.7E | 30 | 16 | 82 | 129 | 148 | 146 | 150 | | | 0 | 0 | -5 | 0 | 5 | 15 | | |
| 02032112 | 9 | 8.2N | 125.9E | 30 | 16 | 72 | 115 | 131 | 138 | 126 | | | 0 | -5 | -5 | 0 | 5 | 15 | | |
| 02032118 | 10 | 9.0N | 125.0E | 25 | 49 | 60 | 65 | 59 | 48 | 18 | | | 0 | -5 | 0 | 5 | 10 | 30 | | |
| 02032200 | 11 | 9.7N | 124.0E | 30 | 6 | 24 | 69 | 97 | 134 | 110 | | | 0 | 5 | 10 | 15 | 30 | 30 | | |
| 02032206 | 12 | 10.3N | 123.0E | 30 | 0 | 45 | 95 | 152 | 176 | 248 | | | 0 | 5 | 10 | 15 | 40 | 40 | | |
| 02032212 | 13 | 10.8N | 121.8E | 30 | 24 | 79 | 135 | 214 | 197 | | | | 0 | 5 | 15 | 25 | 15 | | | |
| 02032218 | 14 | 11.0N | 120.5E | 30 | 0 | 55 | 135 | 159 | 145 | | | | 0 | 5 | 10 | 20 | 20 | | | |
| 02032300 | 15 | 11.1N | 119.3E | 30 | 17 | 97 | 160 | 143 | 148 | | | | 0 | 5 | 10 | 15 | 15 | | | |
| 02032306 | 16 | 11.2N | 118.1E | 30 | 6 | 38 | 64 | 121 | 163 | | | | 0 | 5 | 15 | 20 | 10 | | | |
| 02032312 | 17 | 11.2N | 116.9E | 30 | 6 | 44 | 82 | 155 | | | | | 0 | 10 | 20 | 20 | | | | |
| 02032318 | 18 | 11.2N | 115.8E | 30 | 5 | 38 | 99 | 131 | | | | | 0 | 5 | 5 | 0 | | | | |
| 02032400 | 19 | 11.4N | 114.7E | 30 | 13 | 56 | 108 | | | | | | 0 | 5 | 5 | | | | | |
| 02032406 | 20 | 12.0N | 114.1E | 25 | 8 | 80 | 134 | | | | | | 0 | 10 | 5 | | | | | |
| 02032412 | 21 | 12.8N | 113.8E | 25 | 13 | 26 | | | | | | | 0 | 5 | | | | | | |
| 02032418 | | 13.3N | 113.6E | 20 | | | | | | | | | | | | | | | | |
| 02032500 | | 13.8N | 113.5E | 20 | | | | | | | | | | | | | | | | |
| 02032506 | | 14.2N | 113.3E | 20 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 18 | 53 | 93 | 122 | 133 | 110 | 55 | 123 | 0 | 4 | 7 | 9 | 13 | 19 | 20 | 23 |
| | | | BIAS | | | | | | | | | | 0 | 3 | 6 | 9 | 13 | 19 | 20 | 23 |

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | # CASES | 21 | 21 | 20 | 18 | 16 | 12 | 6 | 3 | 21 | 21 | 20 | 18 | 16 | 12 | 6 | 3 | |

**Statistics for JTWC on TD 04W**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02040512 | | 11.5N | 155.3E | 25 | | | | | | | | | | | | | | | | |
| 02040518 | 1 | 12.8N | 155.9E | 30 | 18 | 24 | 26 | | | | | | 0 | 5 | 10 | | | | | |
| 02040600 | 2 | 14.0N | 156.6E | 30 | 17 | 12 | 59 | | | | | | 0 | 5 | 15 | | | | | |
| 02040606 | 3 | 15.0N | 157.4E | 30 | 6 | 29 | | | | | | | 0 | 5 | | | | | | |
| 02040612 | 4 | 16.0N | 158.5E | 30 | 29 | 65 | | | | | | | 0 | 5 | | | | | | |
| 02040618 | 5 | 17.0N | 159.6E | 30 | 0 | | | | | | | | 0 | | | | | | | |
| 02040700 | 6 | 17.2N | 160.8E | 25 | 0 | | | | | | | | 0 | | | | | | | |
| | | | AVERAGE | | 12 | 32 | 42 | | | | | | 0 | 5 | 13 | | | | | |
| | | | BIAS | | | | | | | | | | 0 | 5 | 13 | | | | | |
| | | | # CASES | | 6 | 4 | 2 | | | | | | 6 | 4 | 2 | | | | | |

**Statistics for JTWC on STY05W Hagibis**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02051306 | | 3.0N | 150.2E | 25 | | | | | | | | | | | | | | | | |
| 02051312 | | 3.5N | 149.9E | 25 | | | | | | | | | | | | | | | | |
| 02051318 | | 4.0N | 149.6E | 25 | | | | | | | | | | | | | | | | |
| 02051400 | | 4.4N | 149.5E | 25 | | | | | | | | | | | | | | | | |
| 02051406 | | 4.7N | 149.5E | 25 | | | | | | | | | | | | | | | | |
| 02051412 | | 5.1N | 149.7E | 25 | | | | | | | | | | | | | | | | |
| 02051418 | | 5.5N | 149.6E | 25 | | | | | | | | | | | | | | | | |
| 02051500 | 1 | 6.3N | 149.3E | 25 | 36 | 80 | 226 | 312 | 424 | 372 | 278 | 326 | 0 | -5 | 0 | 0 | -5 | -10 | -55 | -55 |
| 02051506 | 2 | 7.4N | 148.8E | 30 | 16 | 120 | 241 | 356 | 447 | 424 | 254 | 420 | 0 | 5 | 5 | 5 | -5 | -15 | -60 | -30 |
| 02051512 | 3 | 8.4N | 148.0E | 30 | 26 | 122 | 212 | 336 | 370 | 304 | 192 | 613 | 0 | 0 | 5 | -5 | -5 | -15 | -65 | -30 |
| 02051518 | 4 | 9.4N | 146.8E | 30 | 80 | 194 | 300 | 382 | 372 | 306 | 260 | 833 | 0 | 0 | 0 | -10 | -10 | -25 | -75 | -35 |
| 02051600 | 5 | 10.4N | 145.6E | 35 | 11 | 61 | 183 | 200 | 184 | 133 | 279 | 1008 | 0 | 10 | 0 | -5 | 0 | -50 | -55 | 0 |
| 02051606 | 6 | 11.3N | 144.6E | 35 | 18 | 101 | 164 | 170 | 184 | 145 | 437 | 1077 | 0 | 0 | -10 | -10 | -10 | -60 | -45 | 20 |
| 02051612 | 7 | 12.1N | 143.6E | 35 | 21 | 56 | 48 | 54 | 80 | 141 | 534 | | 0 | -10 | -20 | -20 | -30 | -80 | -45 | |
| 02051618 | 8 | 12.6N | 142.2E | 40 | 25 | 55 | 61 | 25 | 31 | 130 | 685 | | 0 | -10 | -15 | -10 | -15 | -50 | 0 | |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02051700 | 9 | 13.1N | 140.8E | 50 | 5 | 51 | 59 | 47 | 58 | 226 | 876 | | 0 | -5 | -5 | -10 | -40 | -35 | 25 | |
| 02051706 | 10 | 13.5N | 140.0E | 55 | 0 | 25 | 72 | 79 | 113 | 371 | 803 | | 0 | -10 | -10 | -20 | -55 | -35 | 25 | |
| 02051712 | 11 | 14.0N | 139.6E | 60 | 21 | 59 | 102 | 112 | 178 | 526 | | | 0 | 0 | -5 | -45 | -70 | -30 | | |
| 02051718 | 12 | 14.6N | 139.4E | 65 | 13 | 13 | 24 | 42 | 97 | 266 | | | 0 | 0 | -10 | -60 | -80 | -35 | | |
| 02051800 | 13 | 15.4N | 139.4E | 65 | 8 | 8 | 31 | 56 | 83 | 263 | | | 0 | 5 | -45 | -70 | -70 | -20 | | |
| 02051806 | 14 | 16.2N | 139.5E | 75 | 5 | 36 | 67 | 68 | 66 | 108 | | | 0 | 0 | -50 | -70 | -50 | 0 | | |
| 02051812 | 15 | 16.8N | 139.8E | 80 | 8 | 59 | 70 | 66 | 78 | | | | 0 | -30 | -65 | -60 | -40 | | | |
| 02051818 | 16 | 17.2N | 140.0E | 90 | 0 | 21 | 34 | 69 | 63 | | | | 0 | -45 | -65 | -50 | -40 | | | |
| 02051900 | 17 | 17.7N | 140.5E | 120 | 0 | 36 | 41 | 105 | 73 | | | | 0 | -25 | -30 | -25 | -10 | | | |
| 02051906 | 18 | 18.4N | 141.2E | 130 | 0 | 25 | 69 | 96 | 107 | | | | 0 | -15 | -5 | -10 | 10 | | | |
| 02051912 | 19 | 19.3N | 142.2E | 140 | 0 | 26 | 88 | 132 | | | | | 0 | 5 | 10 | 10 | | | | |
| 02051918 | 20 | 20.7N | 143.2E | 140 | 0 | 41 | 77 | 87 | | | | | 0 | 15 | 10 | 15 | | | | |
| 02052000 | 21 | 22.5N | 144.6E | 125 | 0 | 74 | 78 | | | | | | 0 | 15 | 20 | | | | | |
| 02052006 | 22 | 24.9N | 146.9E | 110 | 20 | 88 | 123 | | | | | | 0 | 0 | 15 | | | | | |
| 02052012 | 23 | 27.2N | 149.6E | 95 | 20 | 75 | | | | | | | 0 | 10 | | | | | | |
| 02052018 | 24 | 30.1N | 153.0E | 90 | 51 | 87 | | | | | | | 0 | 25 | | | | | | |
| 02052100 | 25 | 32.9N | 156.3E | 65 | 21 | | | | | | | | 10 | | | | | | | |
| 02052106 | 26 | 35.6N | 159.8E | 50 | 0 | | | | | | | | 10 | | | | | | | |
| | | | AVERAGE | | 16 | 63 | 108 | 140 | 167 | 265 | 460 | 713 | 1 | 10 | 18 | 26 | 30 | 33 | 45 | 28 |
| | | | BIAS | | | | | | | | | | 1 | -3 | -12 | -23 | -29 | -33 | -35 | -22 |
| | | | # CASES | | 26 | 24 | 22 | 20 | 18 | 14 | 10 | 6 | 26 | 24 | 22 | 20 | 18 | 14 | 10 | 6 |

**Statistics for JTWC on TD 06W**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02052606 | | 16.8N | 112.8E | 25 | | | | | | | | | | | | | | | | |
| 02052612 | | 17.1N | 113.0E | 15 | | | | | | | | | | | | | | | | |
| 02052618 | | 17.5N | 113.3E | 15 | | | | | | | | | | | | | | | | |
| 02052700 | | 17.9N | 113.5E | 15 | | | | | | | | | | | | | | | | |
| 02052706 | | 18.3N | 113.8E | 25 | | | | | | | | | | | | | | | | |
| 02052712 | | 18.7N | 114.2E | 25 | | | | | | | | | | | | | | | | |
| 02052718 | | 19.2N | 115.0E | 20 | | | | | | | | | | | | | | | | |
| 02052800 | 1 | 19.5N | 115.8E | 25 | 37 | 26 | 42 | 49 | 106 | | | | -5 | 0 | 0 | 5 | 5 | | | |
| 02052806 | 2 | 19.7N | 116.4E | 25 | 32 | 54 | 87 | 119 | | | | | 0 | 0 | 0 | 5 | | | | |
| 02052812 | 3 | 20.0N | 116.8E | 25 | 37 | 58 | 72 | 98 | | | | | 0 | 0 | 0 | 0 | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02052818 | 4 | 20.5N | 117.4E | 25 | 48 | 86 | 92 | | | 0 | 0 | 0 | | |
| 02052900 | 5 | 21.1N | 118.0E | 25 | 41 | 16 | 36 | | | 0 | 0 | 0 | | |
| 02052906 | 6 | 21.5N | 118.3E | 25 | 5 | 41 | | | | 0 | 0 | | | |
| 02052912 | 7 | 21.9N | 118.8E | 25 | 23 | 66 | | | | 0 | -5 | | | |
| 02052918 | | 22.4N | 119.3E | 25 | | | | | | | | | | |
| 02053000 | | 23.2N | 120.1E | 25 | | | | | | | | | | |
| | | | AVERAGE | | 32 | 50 | 66 | 89 | 106 | 1 | 1 | 0 | 3 | 5 |
| | | | BIAS | | | | | | | -1 | -1 | 0 | 3 | 5 |
| | | | # CASES | | 7 | 7 | 5 | 3 | 1 | 7 | 7 | 5 | 3 | 1 |

**Statistics for JTWC on TC 02S Alex-Andre**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 01102418 | | 7.0S | 97.5E | 25 | | | | | | | | | | | | | | | | |
| 01102500 | | 7.0S | 96.8E | 25 | | | | | | | | | | | | | | | | |
| 01102506 | | 7.0S | 96.2E | 25 | | | | | | | | | | | | | | | | |
| 01102512 | | 7.3S | 95.8E | 25 | | | | | | | | | | | | | | | | |
| 01102518 | | 7.7S | 95.4E | 30 | | | | | | | | | | | | | | | | |
| 01102600 | | 7.9S | 95.0E | 30 | | | | | | | | | | | | | | | | |
| 01102606 | 1 | 8.1S | 94.4E | 35 | 5 | 38 | 85 | 110 | 102 | | | | 0 | 0 | 10 | 0 | -5 | | | |
| 01102618 | 2 | 8.0S | 93.1E | 35 | 13 | 32 | 36 | 24 | 25 | | | | 0 | 0 | -5 | -5 | -5 | | | |
| 01102706 | 3 | 7.7S | 91.7E | 35 | 24 | 17 | 19 | 13 | 18 | 86 | | | 0 | -15 | -10 | -5 | -5 | 5 | | |
| 01102718 | 4 | 7.7S | 90.3E | 50 | 13 | 25 | 19 | 30 | 19 | | | | 0 | 0 | 0 | 10 | 20 | | | |
| 01102806 | 5 | 8.1S | 89.0E | 55 | 17 | 30 | 66 | 83 | 93 | | | | 0 | 0 | 5 | 20 | 20 | | | |
| 01102818 | 6 | 8.4S | 87.4E | 55 | 34 | 86 | 101 | 119 | 173 | | | | 0 | 0 | 15 | 15 | 25 | | | |
| 01102906 | 7 | 8.8S | 85.2E | 55 | 8 | 51 | 158 | 252 | 278 | | | | 0 | 10 | 15 | 30 | 30 | | | |
| 01102918 | 8 | 8.7S | 83.5E | 45 | 18 | 118 | 213 | 237 | 204 | | | | 0 | 0 | 10 | 0 | 5 | | | |
| 01103006 | 9 | 7.8S | 82.8E | 45 | 21 | 32 | 62 | 118 | 171 | | | | 0 | 10 | 10 | 5 | 5 | | | |
| 01103012 | 10 | 7.5S | 82.6E | 45 | 5 | 32 | 48 | 109 | 153 | | | | 0 | 10 | 0 | 5 | 10 | | | |
| 01103018 | 11 | 7.3S | 82.3E | 35 | 88 | 123 | 195 | 236 | | | | | 0 | 0 | 0 | 0 | | | | |
| 01103100 | 12 | 7.5S | 82.0E | 35 | 59 | 60 | 97 | 147 | | | | | 0 | 0 | 0 | 5 | | | | |
| 01103106 | 13 | 8.0S | 81.5E | 35 | 21 | 75 | 102 | | | | | | 0 | 5 | 0 | | | | | |
| 01103112 | 14 | 8.7S | 80.8E | 35 | 13 | 17 | 32 | | | | | | 0 | 5 | 5 | | | | | |
| 01103118 | 15 | 9.8S | 80.0E | 30 | 18 | 56 | | | | | | | 0 | -5 | | | | | | |
| 01110100 | | 10.5S | 79.5E | 30 | | | | | | | | | | | | | | | | |
| 01110106 | | 11.4S | 79.0E | 30 | | | | | | | | | | | | | | | | |
| 01110112 | | 12.3S | 78.6E | 25 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 24 | 53 | 88 | 123 | 124 | 86 | | | 0 | 4 | 6 | 8 | 13 | 5 | | |
| | | | BIAS | | | | | | | | | | 0 | 1 | 4 | 7 | 10 | 5 | | |
| | | | # CASES | | 15 | 15 | 14 | 12 | 10 | 1 | | | 15 | 15 | 14 | 12 | 10 | 1 | | |

**Statistics for JTWC on TC 03S**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 01111600 | | 10.5S | 145.5E | 15 | | | | | | | | | | | | | | | | |
| 01111606 | | 10.2S | 144.5E | 15 | | | | | | | | | | | | | | | | |
| 01111612 | | 9.8S | 143.7E | 15 | | | | | | | | | | | | | | | | |
| 01111618 | | 9.3S | 143.1E | 20 | | | | | | | | | | | | | | | | |
| 01111700 | | 8.8S | 142.6E | 25 | | | | | | | | | | | | | | | | |
| 01111706 | | 8.6S | 141.9E | 25 | | | | | | | | | | | | | | | | |
| 01111712 | | 8.6S | 140.7E | 25 | | | | | | | | | | | | | | | | |
| 01111718 | | 8.5S | 140.3E | 25 | | | | | | | | | | | | | | | | |
| 01111800 | | 7.7S | 139.7E | 25 | | | | | | | | | | | | | | | | |
| 01111806 | | 7.2S | 139.0E | 25 | | | | | | | | | | | | | | | | |
| 01111812 | | 6.9S | 138.3E | 25 | | | | | | | | | | | | | | | | |
| 01111818 | | 6.6S | 137.8E | 25 | | | | | | | | | | | | | | | | |
| 01111900 | | 6.6S | 137.4E | 25 | | | | | | | | | | | | | | | | |
| 01111906 | | 6.6S | 136.9E | 25 | | | | | | | | | | | | | | | | |
| 01111912 | | 6.6S | 136.1E | 25 | | | | | | | | | | | | | | | | |
| 01111918 | | 6.5S | 135.2E | 25 | | | | | | | | | | | | | | | | |
| 01112000 | | 6.4S | 134.3E | 25 | | | | | | | | | | | | | | | | |
| 01112006 | | 6.5S | 133.2E | 25 | | | | | | | | | | | | | | | | |
| 01112012 | | 6.4S | 132.4E | 25 | | | | | | | | | | | | | | | | |
| 01112018 | | 6.4S | 131.3E | 25 | | | | | | | | | | | | | | | | |
| 01112100 | | 6.5S | 130.3E | 30 | | | | | | | | | | | | | | | | |
| 01112106 | 1 | 6.7S | 129.3E | 35 | 26 | 60 | 128 | 211 | | | | | 0 | 0 | 0 | 0 | | | | |
| 01112118 | 2 | 6.6S | 127.6E | 35 | 96 | 184 | | | | | | | -10 | -15 | | | | | | |
| 01112200 | | 6.5S | 127.0E | 35 | | | | | | | | | | | | | | | | |
| 01112206 | | 6.3S | 126.5E | 35 | | | | | | | | | | | | | | | | |
| 01112212 | | 6.1S | 126.2E | 35 | | | | | | | | | | | | | | | | |
| 01112218 | | 6.0S | 126.0E | 35 | | | | | | | | | | | | | | | | |
| 01112300 | | 5.9S | 125.9E | 35 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 61 | 122 | 128 | 211 | | | | | 5 | 8 | 0 | 0 | | | | |
| | | | BIAS | | | | | | | | | | -5 | -8 | 0 | 0 | | | | |
| | | | # CASES | | 2 | 2 | 1 | 1 | | | | | 2 | 2 | 1 | 1 | | | | |

TC 10S Dina
TC 11S Eddy
TC 12S Francesca
TC 13S Chris
TC 14P Claudia
TC 15S Guillaume
TC 16P
TC 17P Des
TC 18S Hary
TC 19P
TC 20S Ikala
TC 21S Dianne-Jery
TC 22S Bonnie
TC 23S Kesiny
TC 24S Errol
TC 25P Upia

**Statistics for JTWC on TC 04S**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 01112006 | | 11.5S | 81.1E | 25 | | | | | | | | | | | | | | | | |
| 01112012 | | 11.6S | 81.7E | 25 | | | | | | | | | | | | | | | | |
| 01112018 | | 11.6S | 82.1E | 25 | | | | | | | | | | | | | | | | |
| 01112100 | | 11.5S | 82.4E | 30 | | | | | | | | | | | | | | | | |
| 01112106 | 1 | 11.4S | 82.7E | 30 | 48 | 109 | 185 | 224 | 273 | | | | 0 | 0 | 5 | 15 | 20 | | | |
| 01112118 | 2 | 11.5S | 82.9E | 35 1 | 04 | 102 | 109 | 138 | 176 | | | | 0 | 0 | 0 | 5 | 0 | | | |
| 01112206 | 3 | 12.0S | 83.1E | 35 | 11 | 39 | 80 | 99 | 133 | | | | 0 | 5 | 10 | 15 | 15 | | | |
| 01112218 | 4 | 12.5S | 81.6E | 30 | 17 | 29 | 45 | 34 | | | | | 0 | 5 | 5 | 5 | | | | |
| 01112306 | 5 | 12.8S | 80.0E | 25 | 5 | 13 | 80 | | | | | | 0 | 0 | 0 | | | | | |
| 01112312 | | 12.9S | 79.2E | 25 | | | | | | | | | | | | | | | | |
| 01112318 | | 12.9S | 78.4E | 25 | | | | | | | | | | | | | | | | |
| 01112400 | | 12.9S | 77.8E | 25 | | | | | | | | | | | | | | | | |
| 01112406 | | 12.9S | 77.4E | 25 | | | | | | | | | | | | | | | | |
| 01112412 | | 12.9S | 76.9E | 25 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 38 | 59 | 100 | 124 | 194 | | | | 0 | 2 | 4 | 10 | 12 | | | |
| | | | BIAS | | | | | | | | | | 0 | 2 | 4 | 10 | 12 | | | |
| | | | # CASES | | 5 | 5 | 5 | 4 | 3 | | | | 5 | 5 | 5 | 4 | 3 | | | |

**Statistics for JTWC on TC 05S Bessi-Bako**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 01112500 | | 6.5S | 95.3E | 25 | | | | | | | | | | | | | | | | |
| 01112506 | | 6.7S | 95.3E | 20 | | | | | | | | | | | | | | | | |
| 01112512 | | 6.9S | 95.3E | 25 | | | | | | | | | | | | | | | | |
| 01112518 | | 7.1S | 95.3E | 25 | | | | | | | | | | | | | | | | |
| 01112600 | | 7.3S | 95.3E | 25 | | | | | | | | | | | | | | | | |
| 01112606 | | 7.5S | 95.1E | 25 | | | | | | | | | | | | | | | | |
| 01112612 | | 7.7S | 94.9E | 25 | | | | | | | | | | | | | | | | |
| 01112618 | | 8.0S | 94.4E | 25 | | | | | | | | | | | | | | | | |
| 01112700 | | 8.2S | 93.9E | 25 | | | | | | | | | | | | | | | | |
| 01112706 | 1 | 8.3S | 93.4E | 30 | 6 | 19 | 30 | 36 | 71 | | | | 0 | -10 | -15 | -15 | -15 | | | |
| 01112718 | 2 | 8.7S | 92.4E | 45 | 42 | 32 | 38 | 86 | 137 | | | | 0 | 5 | 10 | 10 | 15 | | | |
| 01112806 | 3 | 9.3S | 91.6E | 50 | 5 | 56 | 98 | 138 | 75 | | | | -5 | 0 | 10 | 20 | 15 | | | |
| 01112818 | 4 | 10.7S | 91.6E | 55 | 13 | 37 | 75 | 55 | 43 | | | | 0 | -5 | 0 | -5 | -15 | | | |
| 01112906 | 5 | 12.2S | 91.4E | 55 | 46 | 6 | 76 | 105 | 55 | | | | 0 | 10 | 5 | -10 | -15 | | | |
| 01112918 | 6 | 13.8S | 90.6E | 45 | 41 | 157 | 212 | 200 | 143 | | | | 0 | 0 | -10 | -15 | -30 | | | |
| 01113006 | 7 | 14.4S | 88.4E | 45 | 0 | 21 | 25 | 31 | 112 | | | | 0 | -10 | -10 | -25 | -25 | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01113018 | 8 | 14.6S | 86.8E | 55 | 5 | 30 | 88 | 154 | 228 | 0 | 0 | -10 | -20 | -35 |
| 01120106 | 9 | 14.9S | 85.8E | 55 | 8 | 30 | 71 | 128 | 175 | 0 | -10 | -10 | -30 | -30 |
| 01120118 | 10 | 15.5S | 85.4E | 65 | 8 | 25 | 73 | 120 | 168 | -5 | -5 | -20 | -25 | -25 |
| 01120206 | 11 | 16.2S | 85.4E | 65 | 13 | 46 | 85 | 117 | 133 | 0 | -15 | -15 | -20 | -5 |
| 01120218 | 12 | 17.0S | 85.8E | 75 | 13 | 49 | 77 | 115 | 187 | 0 | 5 | 0 | 15 | 15 |
| 01120306 | 13 | 17.4S | 86.2E | 70 | 21 | 36 | 66 | 131 | 202 | 0 | 0 | 15 | 20 | 25 |
| 01120318 | 14 | 17.7S | 86.5E | 65 | 53 | 62 | 96 | 130 | | 0 | 15 | 20 | 25 | |
| 01120406 | 15 | 18.0S | 86.5E | 45 | 8 | 42 | 92 | | | 0 | 5 | 10 | | |
| 01120506 | 16 | 18.2S | 86.0E | 25 | 0 | | | | | 5 | | | | |
| | | | AVERAGE | | 18 | 43 | 80 | 110 | 133 | 1 | 6 | 11 | 18 | 20 |
| | | | BIAS | | | | | | | 0 | -1 | -1 | -5 | -10 |
| | | | # CASES | | 16 | 15 | 15 | 14 | 13 | 16 | 15 | 15 | 14 | 13 |

**Statistics for JTWC on TC 06P Trina**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 01113000 | | 21.1S | 159.9W | 25 | | | | | | | | | | | | | | | | |
| 01113006 | | 21.2S | 159.8W | 30 | | | | | | | | | | | | | | | | |
| 01113012 | 1 | 21.4S | 159.8W | 35 | 48 | 58 | 102 | 151 | 219 | | | | 0 | 5 | 5 | 0 | 0 | | | |
| 01120100 | 2 | 21.8S | 159.7W | 30 | 61 | 87 | | | | | | | 0 | -5 | | | | | | |
| 01120106 | | 21.8S | 159.4W | 25 | | | | | | | | | | | | | | | | |
| 01120112 | | 21.7S | 159.3W | 30 | | | | | | | | | | | | | | | | |
| 01120118 | | 21.5S | 159.2W | 30 | | | | | | | | | | | | | | | | |
| 01120200 | | 21.4S | 159.1W | 30 | | | | | | | | | | | | | | | | |
| 01120206 | | 21.2S | 159.0W | 30 | | | | | | | | | | | | | | | | |
| 01120212 | | 21.0S | 158.9W | 30 | | | | | | | | | | | | | | | | |
| 01120218 | | 20.8S | 158.8W | 30 | | | | | | | | | | | | | | | | |
| 01120300 | | 20.8S | 159.2W | 30 | | | | | | | | | | | | | | | | |
| 01120306 | | 20.8S | 159.7W | 30 | | | | | | | | | | | | | | | | |
| 01120312 | | 21.0S | 160.5W | 25 | | | | | | | | | | | | | | | | |
| 01120318 | | 21.0S | 161.2W | 25 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 55 | 72 | 102 | 151 | 219 | | | | 0 | 5 | 5 | 0 | 0 | | | |
| | | | BIAS | | | | | | | | | | 0 | 0 | 5 | 0 | 0 | | | |
| | | | # CASES | | 2 | 2 | 1 | 1 | 1 | | | | 2 | 2 | 1 | 1 | 1 | | | |

**Statistics for JTWC on TC 07P Waka**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 01122812 | | 10.4S | 175.1W | 25 | | | | | | | | | | | | | | | | |
| 01122818 | | 10.4S | 174.7W | 30 | | | | | | | | | | | | | | | | |
| 01122900 | 1 | 10.8S | 174.5W | 30 | 23 | 67 | 111 | 114 | 87 | | | | 0 | 0 | -20 | -40 | -45 | | | |
| 01122912 | 2 | 12.0S | 175.0W | 35 | 13 | 41 | 41 | 40 | 82 | | | | 0 | -25 | -45 | -50 | -45 | | | |
| 01123000 | 3 | 13.0S | 175.8W | 65 | 13 | 44 | 64 | 136 | 249 | | | | 0 | 0 | 0 | 0 | 0 | | | |
| 01123012 | 4 | 14.3S | 175.8W | 90 | 6 | 46 | 133 | 250 | 373 | | | | 0 | -5 | 0 | 10 | 25 | | | |
| 01123100 | 5 | 16.3S | 175.3W | 100 | 13 | 62 | 155 | 215 | 254 | | | | 0 | 0 | 5 | 25 | 30 | | | |
| 01123112 | 6 | 18.8S | 173.9W | 100 | 34 | 123 | 214 | 269 | | | | | 0 | 10 | 30 | 45 | | | | |
| 02010100 | 7 | 22.0S | 171.6W | 90 | 28 | 30 | 85 | | | | | | 0 | 15 | 25 | | | | | |
| 02010112 | 8 | 25.6S | 169.2W | 65 | 0 | 51 | | | | | | | 0 | 15 | | | | | | |
| 02010200 | 9 | 29.3S | 167.6W | 45 | 15 | | | | | | | | 5 | | | | | | | |
| | | | AVERAGE | | 16 | 58 | 115 | 171 | 209 | | | | 1 | 9 | 18 | 28 | 29 | | | |
| | | | BIAS | | | | | | | | | | 1 | 1 | -1 | -2 | -7 | | | |
| | | | # CASES | | 9 | 8 | 7 | 6 | 5 | | | | 9 | 8 | 7 | 6 | 5 | | | |

**Statistics for JTWC on TC 08S Cyprien**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 01123000 | | 19.3S | 35.8E | 25 | | | | | | | | | | | | | | | | |
| 01123006 | | 19.4S | 36.3E | 25 | | | | | | | | | | | | | | | | |
| 01123012 | | 19.4S | 36.9E | 25 | | | | | | | | | | | | | | | | |
| 01123018 | | 19.4S | 37.4E | 25 | | | | | | | | | | | | | | | | |
| 01123100 | | 19.5S | 37.9E | 25 | | | | | | | | | | | | | | | | |
| 01123106 | | 19.6S | 38.4E | 25 | | | | | | | | | | | | | | | | |
| 01123112 | | 19.7S | 38.9E | 25 | | | | | | | | | | | | | | | | |
| 01123118 | | 19.9S | 39.6E | 30 | | | | | | | | | | | | | | | | |
| 02010100 | | 20.1S | 40.3E | 35 | | | | | | | | | | | | | | | | |
| 02010106 | 1 | 20.4S | 41.0E | 45 | 11 | 32 | 72 | 96 | 78 | | | | 0 | 5 | 15 | 5 | 5 | | | |
| 02010118 | 2 | 21.0S | 42.4E | 50 | 8 | 29 | 62 | 113 | | | | | 0 | -5 | -5 | 5 | | | | |
| 02010206 | 3 | 22.1S | 43.3E | 45 | 18 | 40 | 23 | | | | | | 0 | 0 | 0 | | | | | |
| 02010218 | 4 | 22.9S | 43.7E | 35 | 6 | 55 | | | | | | | 0 | 5 | | | | | | |
| 02010300 | | 23.1S | 43.9E | 30 | | | | | | | | | | | | | | | | |
| 02010306 | | 22.8S | 44.2E | 25 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 11 | 39 | 52 | 104 | 78 | | | | 0 | 4 | 7 | 5 | 5 | | | |
| | | | BIAS | | | | | | | | | | 0 | 1 | 3 | 5 | 5 | | | |
| | | | # CASES | | 4 | 4 | 3 | 2 | 1 | | | | 4 | 4 | 3 | 2 | 1 | | | |

**Statistics for JTWC on TC 09P Bernie**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02010300 | | 14.4S | 139.0E | 30 | | | | | | | | | | | | | | | | |
| 02010306 | 1 | 14.6S | 139.0E | 30 | 18 | 42 | 99 | 134 | | | | | 0 | -10 | 0 | 15 | | | | |
| 02010318 | 2 | 15.0S | 139.1E | 45 | 29 | 31 | 40 | | | | | | 0 | 15 | 35 | | | | | |
| 02010406 | 3 | 16.1S | 139.1E | 40 | 8 | 36 | | | | | | | 0 | 10 | | | | | | |
| 02010412 | | 16.6S | 138.8E | 35 | | | | | | | | | | | | | | | | |
| 02010418 | | 17.0S | 138.2E | 25 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 19 | 36 | 69 | 134 | | | | | 0 | 12 | 18 | 15 | | | | |
| | | | BIAS | | | | | | | | | | 0 | 5 | 18 | 15 | | | | |
| | | | # CASES | | 3 | 3 | 2 | 1 | | | | | 3 | 3 | 2 | 1 | | | | |

**Statistics for JTWC on TC 10S Dina**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02011612 | | 6.8S | 77.9E | 25 | | | | | | | | | | | | | | | | |
| 02011618 | | 7.3S | 76.7E | 25 | | | | | | | | | | | | | | | | |
| 02011700 | | 8.2S | 75.9E | 25 | | | | | | | | | | | | | | | | |
| 02011706 | | 9.6S | 74.9E | 25 | | | | | | | | | | | | | | | | |
| 02011712 | | 10.6S | 73.5E | 30 | | | | | | | | | | | | | | | | |
| 02011718 | 1 | 11.5S | 72.1E | 55 | 17 | 90 | 146 | 130 | 109 | | | | 0 | -5 | -10 | -5 | -15 | | | |
| 02011806 | 2 | 13.4S | 69.7E | 70 | 16 | 8 | 47 | 73 | 75 | | | | 0 | -5 | 0 | -10 | -35 | | | |
| 02011818 | 3 | 15.4S | 67.9E | 85 | 0 | 24 | 52 | 58 | 66 | | | | 0 | 0 | -10 | -35 | -35 | | | |
| 02011906 | 4 | 16.5S | 66.9E | 90 | 0 | 6 | 29 | 26 | 12 | | | | 0 | -10 | -25 | -15 | 0 | | | |
| 02011918 | 5 | 17.3S | 65.7E | 105 | 5 | 19 | 21 | 24 | 36 | | | | 0 | -15 | -15 | -5 | 0 | | | |
| 02012006 | 6 | 18.0S | 64.2E | 130 | 0 | 0 | 8 | 13 | 18 | | | | 0 | 10 | 25 | 30 | 30 | | | |
| 02012018 | 7 | 18.5S | 62.5E | 130 | 8 | 45 | 67 | 82 | 87 | | | | 0 | 10 | 20 | 20 | 25 | | | |
| 02012106 | 8 | 18.9S | 60.5E | 120 | 0 | 8 | 13 | 36 | 73 | | | | 0 | 10 | 20 | 25 | 30 | | | |
| 02012118 | 9 | 19.3S | 58.6E | 120 | 5 | 8 | 31 | 61 | 96 | | | | 0 | 10 | 20 | 25 | 40 | | | |
| 02012206 | 10 | 19.7S | 56.6E | 120 | 16 | 33 | 51 | 86 | 152 | | | | 0 | 15 | 20 | 40 | 60 | | | |
| 02012218 | 11 | 20.3S | 54.9E | 115 | 0 | 13 | 42 | 102 | 193 | | | | 0 | 0 | 15 | 30 | 50 | | | |
| 02012306 | 12 | 21.3S | 53.7E | 115 | 13 | 38 | 96 | 192 | 224 | | | | 0 | 15 | 35 | 55 | 70 | | | |
| 02012318 | 13 | 22.8S | 52.9E | 100 | 11 | 83 | 192 | 208 | | | | | 0 | 15 | 35 | 50 | | | | |
| 02012406 | 14 | 25.0S | 52.3E | 80 | 28 | 24 | 36 | | | | | | 0 | 10 | 25 | | | | | |
| 02012418 | 15 | 27.7S | 52.4E | 55 | 5 | 87 | | | | | | | 0 | 10 | | | | | | |
| 02012500 | | 28.7S | 53.0E | 45 | | | | | | | | | | | | | | | | |
| 02012506 | | 29.3S | 53.0E | 35 | | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02012512 | 30.0S | 53.2E | 35 | | | | | | | | | | | | |
| | | | | AVERAGE | 9 | 32 | 59 | 84 | 95 | | 0 | 9 | 20 | 27 | 33 |
| | | | | BIAS | | | | | | | 0 | 5 | 11 | 16 | 18 |
| | | | | # CASES | 15 | 15 | 14 | 13 | 12 | | 15 | 15 | 14 | 13 | 12 |

Print Friendly (PDF)



**Statistics for JTWC on TC 11S Eddy**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02012306 | | 11.7S | 89.5E | 25 | | | | | | | | | | | | | | | | |
| 02012312 | | 11.7S | 89.4E | 25 | | | | | | | | | | | | | | | | |
| 02012318 | | 11.7S | 89.1E | 30 | | | | | | | | | | | | | | | | |
| 02012400 | | 11.7S | 88.8E | 30 | | | | | | | | | | | | | | | | |
| 02012406 | 1 | 12.1S | 88.4E | 30 | 5 | 42 | 39 | 59 | 131 | | | | 0 | -5 | -10 | -20 | -15 | | | |
| 02012418 | 2 | 13.4S | 88.6E | 35 | 24 | 54 | 96 | 179 | 239 | | | | -5 | -10 | -20 | -25 | -25 | | | |
| 02012506 | 3 | 14.8S | 88.7E | 45 | 8 | 29 | 98 | 135 | 120 | | | | 0 | -5 | -5 | -10 | 10 | | | |
| 02012518 | 4 | 16.3S | 89.0E | 60 | 23 | 87 | 157 | 193 | 171 | | | | -5 | -10 | -20 | -15 | 0 | | | |
| 02012606 | 5 | 18.3S | 89.7E | 65 | 5 | 18 | 37 | 159 | 254 | | | | 0 | -10 | 0 | 10 | 15 | | | |
| 02012618 | 6 | 20.1S | 89.7E | 75 | 6 | 45 | 78 | 72 | | | | | -10 | 0 | 10 | 15 | | | | |
| 02012706 | 7 | 21.5S | 88.6E | 65 | 8 | 74 | 73 | | | | | | -5 | 10 | 15 | | | | | |
| 02012718 | 8 | 22.0S | 86.4E | 45 | 8 | 78 | | | | | | | -5 | 0 | | | | | | |
| 02012806 | 9 | 22.5S | 84.5E | 35 | 8 | | | | | | | | -5 | | | | | | | |
| 02012812 | | 23.0S | 83.4E | 30 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 11 | 53 | 82 | 133 | 183 | | | | 4 | 6 | 11 | 16 | 13 | | | |
| | | | BIAS | | | | | | | | | | -4 | -4 | -4 | -8 | -3 | | | |
| | | | # CASES | | 9 | 8 | 7 | 6 | 5 | | | | 9 | 8 | 7 | 6 | 5 | | | |

**Statistics for JTWC on TC 12S Francesca**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02013112 | | 12.2S | 89.7E | 20 | | | | | | | | | | | | | | | | |
| 02013118 | | 12.4S | 88.7E | 25 | | | | | | | | | | | | | | | | |
| 02020100 | | 12.7S | 87.9E | 25 | | | | | | | | | | | | | | | | |
| 02020106 | | 13.2S | 87.2E | 25 | | | | | | | | | | | | | | | | |
| 02020112 | | 13.5S | 86.1E | 25 | | | | | | | | | | | | | | | | |
| 02020118 | 1 | 13.8S | 85.3E | 30 | 18 | 51 | 74 | 79 | 93 | | | | 0 | -5 | -10 | -15 | -25 | | | |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02020206 | 2 | 14.2S | 83.1E | 35 | 5 | 48 | 58 | 119 | 146 | | | | 0 | -10 | -15 | -25 | -40 | | | |
| 02020212 | 3 | 14.2S | 81.7E | 40 | 0 | 8 | 13 | 57 | 63 | | | | -5 | -10 | -15 | -20 | -40 | | | |
| 02020218 | 4 | 14.1S | 80.9E | 45 | 5 | 18 | 19 | 6 | 53 | | | | 0 | -5 | -10 | -25 | -35 | | | |
| 02020306 | 5 | 14.4S | 79.6E | 55 | 6 | 41 | 53 | 21 | 13 | | | | 5 | 0 | -15 | -25 | -15 | | | |
| 02020318 | 6 | 14.8S | 78.2E | 70 | 0 | 30 | 68 | 111 | 155 | | | | 0 | -15 | -30 | -25 | -20 | | | |
| 02020406 | 7 | 14.9S | 77.5E | 90 | 5 | 55 | 101 | 112 | 99 | | | | -5 | -20 | -15 | -5 | 10 | | | |
| 02020418 | 8 | 15.4S | 78.0E | 110 | 6 | 25 | 54 | 71 | 75 | | | | 5 | 10 | 25 | 45 | 50 | | | |
| 02020506 | 9 | 16.1S | 78.7E | 110 | 0 | 27 | 35 | 37 | 51 | | | | 0 | 5 | 20 | 15 | 10 | | | |
| 02020518 | 10 | 16.8S | 79.4E | 105 | 5 | 13 | 8 | 52 | 80 | | | | -5 | 10 | 15 | 5 | 0 | | | |
| 02020606 | 11 | 17.3S | 80.0E | 90 | 8 | 21 | 50 | 74 | 87 | | | | -5 | 0 | -5 | -5 | -15 | | | |
| 02020618 | 12 | 17.7S | 80.8E | 85 | 5 | 41 | 59 | 69 | 95 | | | | 0 | -5 | -10 | -20 | -15 | | | |
| 02020706 | 13 | 18.0S | 82.0E | 90 | 6 | 13 | 32 | 37 | 49 | | | | -5 | -10 | -15 | -20 | -20 | | | |
| 02020806 | 14 | 19.6S | 83.7E | 95 | 8 | 31 | 36 | 30 | 45 | | | | 0 | -5 | -5 | 5 | 5 | | | |
| 02020818 | 15 | 20.3S | 84.4E | 90 | 0 | 25 | 48 | 78 | 111 | | | | -10 | -10 | 0 | 5 | 15 | | | |
| 02020906 | 16 | 21.3S | 84.8E | 85 | 18 | 21 | 33 | 69 | 99 | | | | -5 | 0 | -5 | 5 | 10 | | | |
| 02020918 | 17 | 22.2S | 84.9E | 70 | 6 | 13 | 53 | 81 | 129 | | | | 0 | 5 | 10 | 15 | 25 | | | |
| 02021006 | 18 | 23.0S | 85.1E | 65 | 5 | 50 | 82 | 140 | | | | | 0 | 10 | 15 | 25 | | | | |
| 02021106 | 19 | 24.7S | 85.7E | 40 | 35 | 80 | | | | | | | 0 | 10 | | | | | | |
| 02021118 | 20 | 26.4S | 86.7E | 25 | 20 | | | | | | | | 10 | | | | | | | |
| | | | AVERAGE | | 8 | 32 | 49 | 69 | 85 | | | | 3 | 8 | 13 | 17 | 21 | | | |
| | | | BIAS | | | | | | | | | | -1 | -2 | -4 | -4 | -6 | | | |
| | | | # CASES | | 20 | 19 | 18 | 18 | 17 | | | | 20 | 19 | 18 | 18 | 17 | | | |

**Statistics for JTWC on TC 13S Chris**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02020218 | | 14.8S | 121.4E | 25 | | | | | | | | | | | | | | | | |
| 02020300 | | 15.3S | 121.5E | 30 | | | | | | | | | | | | | | | | |
| 02020306 | 1 | 15.7S | 121.1E | 45 | 11 | 31 | 52 | 62 | 98 | | | | 0 | 5 | 0 | -15 | -30 | | | |
| 02020318 | 2 | 16.3S | 120.8E | 55 | 0 | 42 | 41 | 42 | 69 | | | | 0 | -15 | -30 | -40 | -50 | | | |
| 02020406 | 3 | 17.2S | 121.1E | 75 | 8 | 25 | 34 | 23 | 66 | | | | -10 | -30 | -40 | -50 | -15 | | | |
| 02020418 | 4 | 18.1S | 120.5E | 100 | 8 | 36 | 59 | 31 | | | | | 0 | -10 | -35 | -15 | | | | |
| 02020506 | 5 | 18.7S | 120.2E | 115 | 5 | 33 | 61 | | | | | | 0 | -10 | 15 | | | | | |
| 02020518 | 6 | 19.8S | 120.1E | 125 | 0 | 37 | | | | | | | 0 | 0 | | | | | | |
| 02020606 | 7 | 21.2S | 119.5E | 75 | 11 | | | | | | | | 20 | | | | | | | |
| 02020612 | | 22.2S | 119.5E | 55 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 6 | 34 | 49 | 39 | 77 | | | | 4 | 12 | 24 | 30 | 32 | | | |
| | | | BIAS | | | | | | | | | | 1 | -10 | -18 | -30 | -32 | | | |
| | | | # CASES | | 7 | 6 | 5 | 4 | 3 | | | | 7 | 6 | 5 | 4 | 3 | | | |

**TC 10S Dina**

**TC 11S Eddy**

**TC 12S Francesca**

**TC 13S Chris**

**TC 14P Claudia**

**TC 15S Guillaume**

**TC 16P**

**TC 17P Des**

**TC 18S Hary**

**TC 19P**

**TC 20S Ikala**

**TC 21S Dianne-Jery**

**TC 22S Bonnie**

**TC 23S Kesiny**

**TC 24S Errol**

**TC 25P Upia**

**Statistics for JTWC on TC 14P Claudia**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02021018 | | 18.7S | 156.0E | 25 | | | | | | | | | | | | | | | | |
| 02021100 | | 19.7S | 156.2E | 30 | | | | | | | | | | | | | | | | |
| 02021106 | 1 | 20.8S | 156.5E | 45 | 0 | 54 | 183 | 338 | 488 | | | | -10 | -20 | -20 | 0 | 5 | | | |
| 02021118 | 2 | 22.5S | 157.6E | 65 | 8 | 93 | 161 | 246 | 304 | | | | 0 | 0 | 15 | 30 | 45 | | | |
| 02021200 | 3 | 23.3S | 158.7E | 70 | 22 | 87 | 153 | 222 | | | | | 0 | 0 | 20 | 30 | | | | |
| 02021206 | 4 | 24.2S | 160.1E | 75 | 20 | 97 | 197 | 284 | | | | | 0 | 10 | 20 | 35 | | | | |
| 02021218 | 5 | 25.9S | 163.5E | 65 | 6 | 61 | 109 | | | | | | 0 | 5 | 15 | | | | | |
| 02021306 | 6 | 27.2S | 167.7E | 50 | 5 | 56 | | | | | | | 0 | 5 | | | | | | |
| 02021312 | | 27.4S | 169.8E | 45 | | | | | | | | | | | | | | | | |
| 02021318 | | 27.4S | 171.7E | 30 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 11 | 75 | 161 | 273 | 396 | | | | 2 | 7 | 18 | 24 | 25 | | | |
| | | | BIAS | | | | | | | | | | -2 | 0 | 10 | 24 | 25 | | | |
| | | | # CASES | | 6 | 6 | 5 | 4 | 2 | | | | 6 | 6 | 5 | 4 | 2 | | | |

**Statistics for JTWC on TC 15S Guillaume**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02021412 | | 17.0S | 50.7E | 25 | | | | | | | | | | | | | | | | |
| 02021418 | | 16.5S | 51.0E | 25 | | | | | | | | | | | | | | | | |
| 02021500 | | 16.2S | 51.2E | 30 | | | | | | | | | | | | | | | | |
| 02021506 | | 15.9S | 51.4E | 30 | | | | | | | | | | | | | | | | |
| 02021512 | | 15.8S | 51.7E | 30 | | | | | | | | | | | | | | | | |
| 02021518 | 1 | 15.6S | 51.9E | 30 | 11 | 18 | 59 | 124 | 183 | | | | 0 | 0 | -5 | -35 | -30 | | | |
| 02021606 | 2 | 14.9S | 52.8E | 35 | 8 | 17 | 61 | 107 | 121 | | | | 0 | -10 | -45 | -40 | -45 | | | |
| 02021618 | 3 | 14.4S | 54.4E | 50 | 13 | 37 | 81 | 104 | 117 | | | | 0 | -25 | -15 | -25 | -35 | | | |
| 02021706 | 4 | 14.5S | 56.3E | 90 | 0 | 30 | 17 | 27 | 136 | | | | 0 | 10 | 5 | -15 | -15 | | | |
| 02021718 | 5 | 15.5S | 58.1E | 90 | 0 | 6 | 18 | 29 | 51 | | | | 0 | -10 | -20 | -15 | -25 | | | |
| 02021806 | 6 | 16.7S | 59.2E | 105 | 0 | 24 | 59 | 95 | 151 | | | | -5 | -15 | -5 | -15 | -30 | | | |
| 02021818 | 7 | 18.2S | 59.5E | 120 | 5 | 23 | 46 | 69 | 75 | | | | 0 | 0 | -15 | -40 | -40 | | | |
| 02021900 | 8 | 18.9S | 59.4E | 120 | 6 | 26 | 49 | 91 | 103 | | | | 0 | -10 | -30 | -45 | -30 | | | |
| 02021906 | 9 | 19.4S | 59.2E | 115 | 6 | 13 | 36 | 63 | 74 | | | | 0 | -10 | -30 | -30 | -15 | | | |
| 02021912 | 10 | 20.0S | 58.9E | 115 | 8 | 43 | 87 | 100 | 116 | | | | 0 | -15 | -30 | -15 | -10 | | | |
| 02021918 | 11 | 20.4S | 58.9E | 115 | 12 | 32 | 69 | 98 | 122 | | | | 0 | -5 | 0 | 15 | 5 | | | |
| 02022006 | 12 | 21.1S | 59.0E | 120 | 12 | 60 | 105 | 128 | 136 | | | | 0 | 10 | 30 | 30 | 30 | | | |
| 02022018 | 13 | 22.4S | 59.8E | 105 | 5 | 33 | 77 | 196 | 283 | | | | 0 | 20 | 25 | 30 | 35 | | | |
| 02022106 | 14 | 23.8S | 60.6E | 75 | 18 | 105 | 233 | 327 | | | | | 0 | 0 | 0 | 5 | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02022118 | 15 | 24.7S | 61.5E | 60 | 95 | 173 | 241 | | | 0 | 5 | 10 | | |
| 02022206 | 16 | 25.5S | 62.3E | 45 | 36 | 12 | | | | 0 | 5 | | | |
| 02022212 | | 26.0S | 63.0E | 35 | | | | | | | | | | |
| 02022218 | | 26.4S | 63.6E | 30 | | | | | | | | | | |
| | | | AVERAGE | | 15 | 41 | 83 | 111 | 128 | 0 | 9 | 18 | 25 | 27 |
| | | | BIAS | | | | | | | 0 | -3 | -8 | -14 | -16 |
| | | | # CASES | | 16 | 16 | 15 | 14 | 13 | 16 | 16 | 15 | 14 | 13 |

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**Statistics for JTWC on TC 16P**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02022306 | | 16.5S | 175.5E | 20 | | | | | | | | | | | | | | | | |
| 02022312 | | 17.1S | 175.2E | 20 | | | | | | | | | | | | | | | | |
| 02022318 | | 17.9S | 175.0E | 20 | | | | | | | | | | | | | | | | |
| 02022400 | | 18.7S | 175.1E | 25 | | | | | | | | | | | | | | | | |
| 02022406 | | 19.6S | 175.3E | 30 | | | | | | | | | | | | | | | | |
| 02022412 | | 20.4S | 175.6E | 35 | | | | | | | | | | | | | | | | |
| 02022418 | | 21.2S | 175.8E | 35 | | | | | | | | | | | | | | | | |
| 02022500 | 1 | 21.9S | 176.0E | 35 | 18 | 96 | 197 | | | | | | 0 | 0 | 0 | | | | | |
| 02022512 | 2 | 22.7S | 176.4E | 35 | 13 | 54 | | | | | | | 0 | 0 | | | | | | |
| 02022600 | 3 | 23.0S | 176.8E | 30 | 13 | | | | | | | | 0 | | | | | | | |
| | | | AVERAGE | | 15 | 75 | 197 | | | | | | 0 | 0 | 0 | | | | | |
| | | | BIAS | | | | | | | | | | 0 | 0 | 0 | | | | | |
| | | | # CASES | | 3 | 2 | 1 | | | | | | 3 | 2 | 1 | | | | | |

**Statistics for JTWC on TC 17P Des**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02030418 | | 19.0S | 157.5E | 25 | | | | | | | | | | | | | | | | |
| 02030500 | | 19.0S | 158.5E | 30 | | | | | | | | | | | | | | | | |
| 02030506 | 1 | 19.0S | 159.6E | 35 | 29 | 78 | 111 | 153 | 208 | | | | 0 | 0 | 5 | 15 | 10 | | | |
| 02030518 | 2 | 19.7S | 161.5E | 45 | 46 | 90 | 172 | 258 | | | | | 0 | 5 | 20 | 20 | | | | |
| 02030606 | 3 | 21.0S | 163.2E | 45 | 27 | 61 | 116 | | | | | | 0 | 0 | 0 | | | | | |
| 02030618 | 4 | 22.7S | 165.3E | 35 | 51 | 128 | | | | | | | 0 | -5 | | | | | | |
| 02030706 | 5 | 24.2S | 168.3E | 35 | 12 | | | | | | | | 0 | | | | | | | |
| | | | AVERAGE | | 34 | 89 | 133 | 206 | 208 | | | | 0 | 3 | 8 | 18 | 10 | | | |
| | | | BIAS | | | | | | | | | | 0 | 0 | 8 | 18 | 10 | | | |
| | | | # CASES | | 5 | 4 | 3 | 2 | 1 | | | | 5 | 4 | 3 | 2 | 1 | | | |

**TD 17W**

**TS 18W**

**STY19W Phanfone**

**TS 20W Vongfong**

**TY 21W Rusa**

**TY 22W Sinlaku**

**TS 23W Hagupit**

**TS 24W Mekkhala**

**STY25W Higos**

**TY 26W Bavi**

**TD 27W**

**TD 28W**

**TS 29W Maysak**

**TY 30W Haishen**

**STY31W Pongsona**

**HUR02C Ele**

**HUR03C Huko**

**TC 01A**

**TC 02B**

**TC 03B**

**TC 04B**

**TC 05B**

**5.3 SOUTHERN HEMISPHERE VERIFICATION TABLES**

**TC 01S**

**TC 02S Alex-Andre**

**TC 03S**

**TC 04S**

**TC 05S Bessi-Bako**

**TC 06P Trina**

**TC 07P Waka**

**TC 08S Cyprien**

**Statistics for JTWC on TC 18S Hary**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02030500 | | 10.1S | 66.6E | 25 | | | | | | | | | | | | | | | | |
| 02030506 | | 10.4S | 66.1E | 25 | | | | | | | | | | | | | | | | |
| 02030512 | | 10.7S | 65.6E | 30 | | | | | | | | | | | | | | | | |
| 02030518 | | 11.0S | 64.9E | 30 | | | | | | | | | | | | | | | | |
| 02030600 | 1 | 11.2S | 64.1E | 35 | 47 | 103 | 109 | 101 | 114 | | | | 0 | 5 | -5 | -10 | -40 | | | |
| 02030612 | 2 | 11.6S | 61.9E | 40 | 17 | 34 | 55 | 76 | 110 | | | | 0 | -5 | -10 | -40 | -45 | | | |
| 02030700 | 3 | 11.5S | 59.6E | 55 | 13 | 44 | 64 | 97 | 132 | 108 | | | 0 | 0 | -30 | -40 | -40 | -50 | | |
| 02030712 | 4 | 11.3S | 57.4E | 65 | 0 | 13 | 32 | 87 | 108 | 131 | | | 0 | -30 | -35 | -40 | -35 | -45 | | |
| 02030800 | 5 | 11.4S | 55.2E | 105 | 8 | 46 | 67 | 55 | 66 | 85 | | | 0 | -5 | -5 | 5 | -20 | 0 | | |
| 02030812 | 6 | 11.3S | 53.5E | 120 | 0 | 37 | 43 | 26 | 21 | 102 | | | 0 | 5 | 15 | 0 | -25 | -10 | | |
| 02030900 | 7 | 11.8S | 52.6E | 125 | 13 | 40 | 38 | 29 | 23 | | | | 0 | -5 | -25 | -20 | -5 | | | |
| 02030912 | 8 | 13.2S | 51.7E | 125 | 21 | 38 | 35 | 29 | 21 | | | | 0 | -15 | -20 | 0 | 0 | | | |
| 02031000 | 9 | 14.7S | 50.8E | 140 | 5 | 44 | 51 | 62 | 95 | | | | 0 | 5 | 20 | 15 | 15 | | | |
| 02031012 | 10 | 16.1S | 50.4E | 135 | 0 | 29 | 87 | 153 | 190 | | | | 0 | 20 | 25 | 35 | 45 | | | |
| 02031100 | 11 | 18.2S | 50.6E | 115 | 13 | 54 | 102 | 130 | 88 | | | | 0 | 10 | 20 | 20 | 35 | | | |
| 02031112 | 12 | 20.8S | 51.5E | 110 | 0 | 23 | 32 | 24 | 97 | | | | 5 | 15 | 25 | 35 | 55 | | | |
| 02031200 | 13 | 23.5S | 53.0E | 100 | 5 | 40 | 48 | 98 | 162 | | | | 0 | 15 | 30 | 50 | 50 | | | |
| 02031212 | 14 | 26.3S | 54.5E | 90 | 6 | 53 | 126 | 177 | | | | | 5 | 25 | 45 | 50 | | | | |
| 02031218 | 15 | 27.4S | 55.2E | 80 | 12 | 67 | 124 | | | | | | 0 | 15 | 25 | | | | | |
| 02031300 | 16 | 28.2S | 55.8E | 70 | 8 | 21 | 60 | | | | | | 0 | 15 | 10 | | | | | |
| 02031312 | 17 | 29.6S | 56.9E | 45 | 11 | 52 | | | | | | | 0 | -5 | | | | | | |
| 02031318 | | 30.1S | 57.7E | 40 | | | | | | | | | | | | | | | | |
| 02031400 | | 30.4S | 58.7E | 40 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 11 | 43 | 67 | 82 | 94 | 106 | | | 1 | 11 | 22 | 26 | 32 | 26 | | |
| | | | BIAS | | | | | | | | | | 1 | 4 | 5 | 4 | -1 | -26 | | |
| | | | # CASES | | 17 | 17 | 16 | 14 | 13 | 4 | | | 17 | 17 | 16 | 14 | 13 | 4 | | |

**TC 09P Bernie**

**TC 10S Dina**

**TC 11S Eddy**

**TC 12S Francesca**

**TC 13S Chris**

**TC 14P Claudia**

**TC 15S Guillaume**

**TC 16P**

**TC 17P Des**

**TC 18S Hary**

**TC 19P**

**TC 20S Ikala**

**TC 21S Dianne-Jery**

**TC 22S Bonnie**

**TC 23S Kesiny**

**TC 24S Errol**

**TC 25P Upia**

**Statistics for JTWC on TC 19P**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02031318 | | 16.1S | 160.8E | 25 | | | | | | | | | | | | | | | | |
| 02031400 | | 16.9S | 161.6E | 25 | | | | | | | | | | | | | | | | |
| 02031406 | | 17.7S | 162.7E | 25 | | | | | | | | | | | | | | | | |
| 02031412 | | 18.6S | 163.9E | 25 | | | | | | | | | | | | | | | | |
| 02031418 | 1 | 19.9S | 165.4E | 35 | 61 | 130 | 196 | 269 | | | | | 0 | 5 | 10 | 25 | | | | |
| 02031506 | 2 | 21.5S | 169.2E | 35 | 6 | 31 | 70 | | | | | | 0 | 0 | 5 | | | | | |
| 02031518 | 3 | 22.3S | 173.1E | 35 | 18 | 50 | | | | | | | 0 | 5 | | | | | | |
| 02031606 | 4 | 23.2S | 177.1E | 30 | 22 | | | | | | | | 0 | | | | | | | |
| | | | AVERAGE | | 27 | 70 | 133 | 269 | | | | | 0 | 3 | 8 | 25 | | | | |
| | | | BIAS | | | | | | | | | | 0 | 3 | 8 | 25 | | | | |
| | | | # CASES | | 4 | 3 | 2 | 1 | | | | | 4 | 3 | 2 | 1 | | | | |

**Statistics for JTWC on TC 20S Ikala**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02032212 | | 8.2S | 81.4E | 25 | | | | | | | | | | | | | | | | |
| 02032218 | | 8.2S | 80.5E | 25 | | | | | | | | | | | | | | | | |
| 02032300 | | 7.9S | 79.5E | 30 | | | | | | | | | | | | | | | | |
| 02032306 | | 8.4S | 78.6E | 30 | | | | | | | | | | | | | | | | |
| 02032312 | | 9.1S | 78.1E | 30 | | | | | | | | | | | | | | | | |
| 02032318 | | 9.8S | 77.5E | 25 | | | | | | | | | | | | | | | | |
| 02032400 | | 10.2S | 76.9E | 30 | | | | | | | | | | | | | | | | |
| 02032406 | 1 | 10.6S | 76.1E | 30 | 16 | 13 | 48 | 101 | 159 | | | | 0 | 0 | 5 | 0 | 5 | | | |
| 02032418 | 2 | 11.1S | 74.6E | 40 | 13 | 57 | 101 | 174 | 290 | | | | 0 | 5 | 0 | 5 | -20 | | | |
| 02032506 | 3 | 11.5S | 73.2E | 40 | 29 | 95 | 170 | 245 | 296 | | | | 0 | -5 | -5 | -25 | -25 | | | |
| 02032518 | 4 | 12.2S | 73.0E | 55 | 26 | 84 | 180 | 251 | 332 | | | | 0 | -5 | -25 | -20 | -10 | | | |
| 02032606 | 5 | 13.5S | 73.7E | 65 | 0 | 24 | 68 | 150 | 247 | | | | 0 | -20 | -15 | -10 | 35 | | | |
| 02032618 | 6 | 15.1S | 74.6E | 95 | 8 | 42 | 117 | 205 | 315 | | | | -20 | -15 | 5 | 60 | 70 | | | |
| 02032706 | 7 | 16.3S | 75.5E | 105 | 5 | 42 | 110 | 203 | 358 | | | | 0 | 10 | 50 | 55 | 65 | | | |
| 02032718 | 8 | 17.7S | 76.8E | 105 | 24 | 93 | 182 | 309 | | | | | 0 | 25 | 15 | 15 | | | | |
| 02032806 | 9 | 18.9S | 78.4E | 60 | 28 | 102 | 259 | | | | | | 0 | 10 | 20 | | | | | |
| 02032818 | 10 | 20.2S | 80.3E | 45 | 5 | 74 | | | | | | | 0 | 5 | | | | | | |
| 02032900 | | 20.8S | 81.4E | 35 | | | | | | | | | | | | | | | | |
| 02032906 | | 21.3S | 82.7E | 25 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 16 | 63 | 137 | 205 | 285 | | | | 2 | 10 | 16 | 24 | 33 | | | |
| | | | BIAS | | | | | | | | | | -2 | 1 | 6 | 10 | 17 | | | |
| | | | # CASES | | 10 | 10 | 9 | 8 | 7 | | | | 10 | 10 | 9 | 8 | 7 | | | |

**Statistics for JTWC on TC 21S Dianne-Jery**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02040518 | | 10.3S | 102.6E | 25 | | | | | | | | | | | | | | | | |
| 02040600 | | 10.7S | 101.9E | 25 | | | | | | | | | | | | | | | | |
| 02040606 | | 11.2S | 100.9E | 25 | | | | | | | | | | | | | | | | |
| 02040612 | | 11.7S | 99.9E | 25 | | | | | | | | | | | | | | | | |
| 02040618 | | 12.2S | 98.9E | 30 | | | | | | | | | | | | | | | | |
| 02040700 | 1 | 12.2S | 97.9E | 35 | 21 | 24 | 76 | 74 | 50 | | | | 0 | -10 | -10 | -15 | -10 | | | |
| 02040712 | 2 | 13.2S | 95.8E | 55 | 0 | 29 | 18 | 25 | 44 | | | | 0 | 10 | 10 | 10 | 0 | | | |
| 02040800 | 3 | 14.4S | 93.1E | 65 | 8 | 35 | 47 | 63 | 115 | | | | 0 | -5 | 0 | 0 | 15 | | | |
| 02040812 | 4 | 15.2S | 91.0E | 80 | 13 | 48 | 89 | 167 | 186 | | | | 0 | 10 | 10 | 20 | 45 | | | |
| 02040900 | 5 | 16.5S | 89.3E | 90 | 17 | 11 | 58 | 84 | 135 | | | | 0 | -5 | 20 | 45 | 45 | | | |
| 02040912 | 6 | 17.7S | 88.1E | 105 | 8 | 77 | 115 | 160 | 172 | | | | 0 | 15 | 40 | 35 | 55 | | | |
| 02041000 | 7 | 18.9S | 88.2E | 95 | 12 | 45 | 114 | 139 | | | | | 0 | 20 | 20 | 35 | | | | |
| 02041100 | 8 | 21.2S | 88.7E | 60 | 5 | 61 | | | | | | | 0 | 10 | | | | | | |
| 02041112 | 9 | 22.7S | 89.1E | 35 | 5 | | | | | | | | 0 | | | | | | | |
| 02041118 | | 23.5S | 89.8E | 30 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 10 | 41 | 74 | 102 | 117 | | | | 0 | 11 | 16 | 23 | 28 | | | |
| | | | BIAS | | | | | | | | | | 0 | 6 | 13 | 19 | 25 | | | |
| | | | # CASES | | 9 | 8 | 7 | 7 | 6 | | | | 9 | 8 | 7 | 7 | 6 | | | |

**TS 18W**

**STY19W Phanfone**

**TS 20W Vongfong**

**TY 21W Rusa**

**TY 22W Sinlaku**

**TS 23W Hagupit**

**TS 24W Mekkhala**

**STY25W Higos**

**TY 26W Bavi**

**TD 27W**

**TD 28W**

**TS 29W Maysak**

**TY 30W Haishen**

**STY31W Pongsona**

**HUR02C Ele**

**HUR03C Huko**

**TC 01A**

**TC 02B**

**TC 03B**

**TC 04B**

**TC 05B**

**5.3 SOUTHERN HEMISPHERE VERIFICATION TABLES**

**TC 01S**

**TC 02S Alex-Andre**

**TC 03S**

**TC 04S**

**TC 05S Bessi-Bako**

**TC 06P Trina**

**TC 07P Waka**

**TC 08S Cyprien**

**TC 09P Bernie**

**Statistics for JTWC on TC 22S Bonnie**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02040906 | | 7.8S | 129.2E | 25 | | | | | | | | | | | | | | | | |
| 02040912 | | 8.2S | 128.7E | 25 | | | | | | | | | | | | | | | | |
| 02040918 | | 8.8S | 128.1E | 25 | | | | | | | | | | | | | | | | |
| 02041000 | 1 | 9.2S | 126.9E | 30 | 13 | 36 | 68 | 105 | 144 | | | | 0 | 5 | 0 | 10 | 20 | | | |
| 02041012 | 2 | 10.0S | 124.4E | 30 | 18 | 53 | 90 | 110 | 119 | | | | 0 | -5 | 0 | 10 | 20 | | | |
| 02041100 | 3 | 10.1S | 122.0E | 40 | 13 | 0 | 24 | 43 | 81 | | | | 0 | 0 | 15 | 30 | 45 | | | |
| 02041112 | 4 | 10.1S | 119.6E | 45 | 18 | 30 | 40 | 72 | 71 | | | | 0 | 0 | 10 | 20 | 45 | | | |
| 02041200 | 5 | 10.2S | 117.0E | 45 | 11 | 8 | 27 | 31 | 38 | | | | 5 | 10 | 20 | 40 | 50 | | | |
| 02041212 | 6 | 10.6S | 114.5E | 45 | 24 | 34 | 21 | 24 | 63 | | | | 0 | 5 | 20 | 25 | 35 | | | |
| 02041300 | 7 | 11.3S | 111.7E | 45 | 30 | 54 | 100 | 107 | 58 | | | | 0 | 15 | 25 | 35 | 45 | | | |
| 02041312 | 8 | 11.9S | 109.2E | 40 | 6 | 34 | 54 | 51 | 84 | | | | 0 | 5 | 15 | 30 | 45 | | | |
| 02041400 | 9 | 12.4S | 107.1E | 40 | 0 | 38 | 84 | 169 | | | | | 0 | 10 | 15 | 35 | | | | |
| 02041412 | 10 | 13.9S | 104.8E | 35 | 26 | 105 | 190 | | | | | | 0 | 0 | 5 | | | | | |
| 02041500 | 11 | 15.4S | 101.5E | 35 | 8 | 91 | | | | | | | 0 | 5 | | | | | | |
| 02041512 | 12 | 16.1S | 98.0E | 30 | 11 | | | | | | | | 0 | | | | | | | |
| | | | AVERAGE | | 15 | 44 | 70 | 79 | 82 | | | | 0 | 5 | 13 | 26 | 38 | | | |
| | | | BIAS | | | | | | | | | | 0 | 5 | 13 | 26 | 38 | | | |
| | | | # CASES | | 12 | 11 | 10 | 9 | 8 | | | | 12 | 11 | 10 | 9 | 8 | | | |

**Statistics for JTWC on TC 23S Kesiny**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02050206 | | 7.3S | 62.0E | 25 | | | | | | | | | | | | | | | | |
| 02050212 | | 7.7S | 62.4E | 25 | | | | | | | | | | | | | | | | |
| 02050218 | | 8.2S | 63.5E | 25 | | | | | | | | | | | | | | | | |
| 02050300 | | 8.5S | 65.0E | 25 | | | | | | | | | | | | | | | | |
| 02050306 | 1 | 8.9S | 65.5E | 35 | 13 | 6 | 63 | 99 | 121 | | | | -5 | 5 | 5 | 10 | 20 | | | |
| 02050318 | 2 | 9.5S | 66.1E | 35 | 21 | 32 | 63 | 92 | 108 | | | | 0 | 0 | 0 | 10 | 0 | | | |
| 02050406 | 3 | 9.8S | 66.2E | 40 | 21 | 49 | 94 | 123 | 132 | | | | 0 | 0 | 10 | 0 | -5 | | | |
| 02050418 | 4 | 10.0S | 65.8E | 45 | 6 | 30 | 56 | 55 | 40 | | | | -5 | 0 | 0 | -5 | -5 | | | |
| 02050506 | 5 | 10.1S | 64.3E | 45 | 0 | 42 | 43 | 38 | 36 | | | | 0 | -10 | -15 | -10 | 0 | | | |
| 02050518 | 6 | 10.4S | 62.4E | 55 | 5 | 34 | 48 | 60 | 65 | | | | 0 | -5 | -5 | 10 | 15 | | | |
| 02050606 | 7 | 10.5S | 61.1E | 65 | 8 | 41 | 77 | 102 | 88 | | | | 0 | 5 | 20 | 25 | 25 | | | |
| 02050618 | 8 | 10.7S | 60.1E | 65 | 11 | 8 | 19 | 25 | 59 | | | | 0 | 10 | 25 | 30 | 25 | | | |
| 02050706 | 9 | 11.0S | 59.0E | 55 | 13 | 32 | 32 | 60 | 64 | | | | 0 | 5 | 15 | 15 | 5 | | | |
| 02050718 | 10 | 11.4S | 57.6E | 50 | 18 | 56 | 86 | 77 | 129 | | | | -5 | 0 | 0 | -10 | -15 | | | |
| 02050806 | 11 | 11.6S | 55.5E | 45 | 11 | 45 | 56 | 71 | 63 | | | | -5 | 0 | -15 | -15 | -10 | | | |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02050906 | 12 | 12.4S | 51.2E | 60 | 0 | 39 | 76 | 168 | 227 | | | | 0 | 10 | 15 | 20 | 20 | | | |
| 02050918 | 13 | 12.8S | 49.0E | 55 | 0 | 43 | 133 | 173 | 236 | | | | 0 | 15 | 20 | 25 | 20 | | | |
| 02051006 | 14 | 13.6S | 47.3E | 40 | 11 | 95 | 123 | 172 | | | | | 0 | 5 | 10 | 10 | | | | |
| 02051018 | 15 | 15.3S | 46.9E | 30 | 6 | 50 | 104 | | | | | | 0 | 0 | 0 | | | | | |
| 02051106 | 16 | 15.7S | 46.9E | 25 | 6 | 17 | | | | | | | 0 | 0 | | | | | | |
| 02051118 | 17 | 15.9S | 46.9E | 25 | 0 | | | | | | | | 0 | | | | | | | |
| | | | AVERAGE | | 9 | 39 | 71 | 94 | 105 | | | | 1 | 4 | 10 | 14 | 13 | | | |
| | | | BIAS | | | | | | | | | | -1 | 3 | 6 | 8 | 7 | | | |
| | | | # CASES | | 17 | 16 | 15 | 14 | 13 | | | | 17 | 16 | 15 | 14 | 13 | | | |

**Statistics for JTWC on TC 24S Errol**

| | WRN | BEST TRACK | | | POSITION ERRORS | | | | | | | | WIND ERRORS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02050906 | | 6.6S | 97.4E | 30 | | | | | | | | | | | | | | | | |
| 02050912 | | 6.9S | 97.1E | 30 | | | | | | | | | | | | | | | | |
| 02050918 | 1 | 6.9S | 96.8E | 30 | 8 | 128 | 169 | 191 | 189 | | | | 0 | 0 | 0 | -5 | 0 | | | |
| 02051006 | 2 | 6.3S | 97.6E | 35 | 13 | 22 | 55 | 64 | 42 | | | | 0 | 0 | -5 | 0 | 5 | | | |
| 02051018 | 3 | 6.1S | 97.2E | 35 | 8 | 55 | 78 | 40 | 51 | | | | 0 | -10 | -5 | 0 | 0 | | | |
| 02051106 | 4 | 5.8S | 96.3E | 45 | 40 | 73 | 42 | 35 | 128 | | | | 0 | 5 | 15 | 20 | 30 | | | |
| 02051118 | 5 | 6.2S | 95.3E | 45 | 8 | 61 | 86 | 181 | 265 | | | | 0 | 10 | 15 | 25 | 30 | | | |
| 02051206 | 6 | 6.5S | 95.3E | 40 | 21 | 49 | 139 | 216 | 326 | | | | 0 | 5 | 15 | 20 | 40 | | | |
| 02051218 | 7 | 7.5S | 94.6E | 40 | 13 | 103 | 167 | 263 | | | | | 0 | 10 | 15 | 30 | | | | |
| 02051306 | 8 | 8.4S | 95.5E | 35 | 18 | 63 | 141 | | | | | | 0 | 0 | 10 | | | | | |
| 02051318 | 9 | 9.0S | 96.0E | 35 | 13 | 51 | | | | | | | 0 | 10 | | | | | | |
| 02051406 | 10 | 10.0S | 96.8E | 25 | 0 | | | | | | | | 0 | | | | | | | |
| 02051412 | | 10.8S | 97.3E | 25 | | | | | | | | | | | | | | | | |
| | | | AVERAGE | | 14 | 67 | 110 | 141 | 167 | | | | 0 | 6 | 10 | 14 | 18 | | | |
| | | | BIAS | | | | | | | | | | 0 | 3 | 8 | 13 | 18 | | | |
| | | | # CASES | | 10 | 9 | 8 | 7 | 6 | | | | 10 | 9 | 8 | 7 | 6 | | | |

**Statistics for JTWC on TC 25P Upia**

| | **WRN** | **BEST TRACK** | | | **POSITION ERRORS** | | | | | | | | **WIND ERRORS** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DTG | NO. | LAT | LONG | wind | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 | 00 | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| 02052306 | | 6.6S | 157.3E | 25 | | | | | | | | | | | | | | | | |
| 02052312 | | 7.0S | 156.9E | 25 | | | | | | | | | | | | | | | | |
| 02052318 | | 7.3S | 156.3E | 25 | | | | | | | | | | | | | | | | |
| 02052400 | | 7.4S | 155.5E | 25 | | | | | | | | | | | | | | | | |
| 02052406 | | 7.4S | 154.9E | 25 | | | | | | | | | | | | | | | | |
| 02052412 | | 7.4S | 154.6E | 25 | | | | | | | | | | | | | | | | |
| 02052418 | | 7.5S | 154.3E | 25 | | | | | | | | | | | | | | | | |
| 02052500 | | 7.7S | 154.0E | 25 | | | | | | | | | | | | | | | | |
| 02052506 | | 7.9S | 153.7E | 35 | | | | | | | | | | | | | | | | |
| 02052512 | 1 | 8.1S | 153.6E | 35 | 8 | 36 | 62 | 86 | 109 | | | | 0 | 5 | 10 | 15 | 20 | | | |
| 02052518 | 2 | 8.3S | 153.6E | 35 | 0 | 54 | 83 | 83 | 106 | | | | 0 | 5 | 10 | 15 | 20 | | | |
| 02052600 | 3 | 8.6S | 153.7E | 35 | 13 | 43 | 60 | 72 | 83 | | | | 0 | 5 | 10 | 15 | 25 | | | |
| 02052606 | 4 | 8.8S | 153.8E | 35 | 18 | 54 | 93 | 119 | 129 | | | | 0 | 5 | 10 | 15 | 25 | | | |
| 02052612 | 5 | 8.9S | 153.8E | 35 | 36 | 60 | 79 | 96 | | | | | 0 | 5 | 10 | 5 | | | | |
| 02052618 | 6 | 9.0S | 153.9E | 35 | 53 | 84 | 102 | 90 | | | | | 0 | 0 | 0 | 0 | | | | |
| 02052700 | 7 | 9.0S | 153.9E | 35 | 0 | 12 | 31 | | | | | | 0 | 0 | 5 | | | | | |
| 02052706 | 8 | 9.1S | 153.9E | 35 | 18 | 19 | 27 | | | | | | 0 | 0 | 0 | | | | | |
| 02052712 | 9 | 9.2S | 154.0E | 35 | 26 | 13 | | | | | | | 0 | 5 | | | | | | |
| 02052718 | 10 | 9.3S | 154.1E | 35 | 40 | 54 | | | | | | | 0 | 5 | | | | | | |
| 02052800 | 11 | 9.4S | 154.1E | 30 | 13 | | | | | | | | 5 | | | | | | | |
| 02052806 | 12 | 9.8S | 154.3E | 30 | 0 | | | | | | | | 0 | | | | | | | |
| | | | AVERAGE | | 19 | 43 | 67 | 91 | 107 | | | | 0 | 4 | 7 | 11 | 23 | | | |
| | | | BIAS | | | | | | | | | | 0 | 4 | 7 | 11 | 23 | | | |
| | | | # CASES | | 12 | 10 | 8 | 6 | 4 | | | | 12 | 10 | 8 | 6 | 4 | | | |

Print Friendly (PDF)



## 2.3 SUMMARY OF SOUTH PACIFIC AND SOUTH INDIAN OCEAN TROPICAL CYCLONES

# Tropical Cyclone (TC) 01S

Verification Statistics

First Poor : 1800Z 01 Oct 01
First Fair : 1800Z 03 Oct 01
First TCFA : 2330Z 05 Oct 01
First Warning : 0600Z 06 Oct 01
Last Warning : 0600Z 08 Oct 01
Max Intensity : 35 kts, gusts to 45 kts
Landfall : None
Total Warnings : 5
Remarks : None

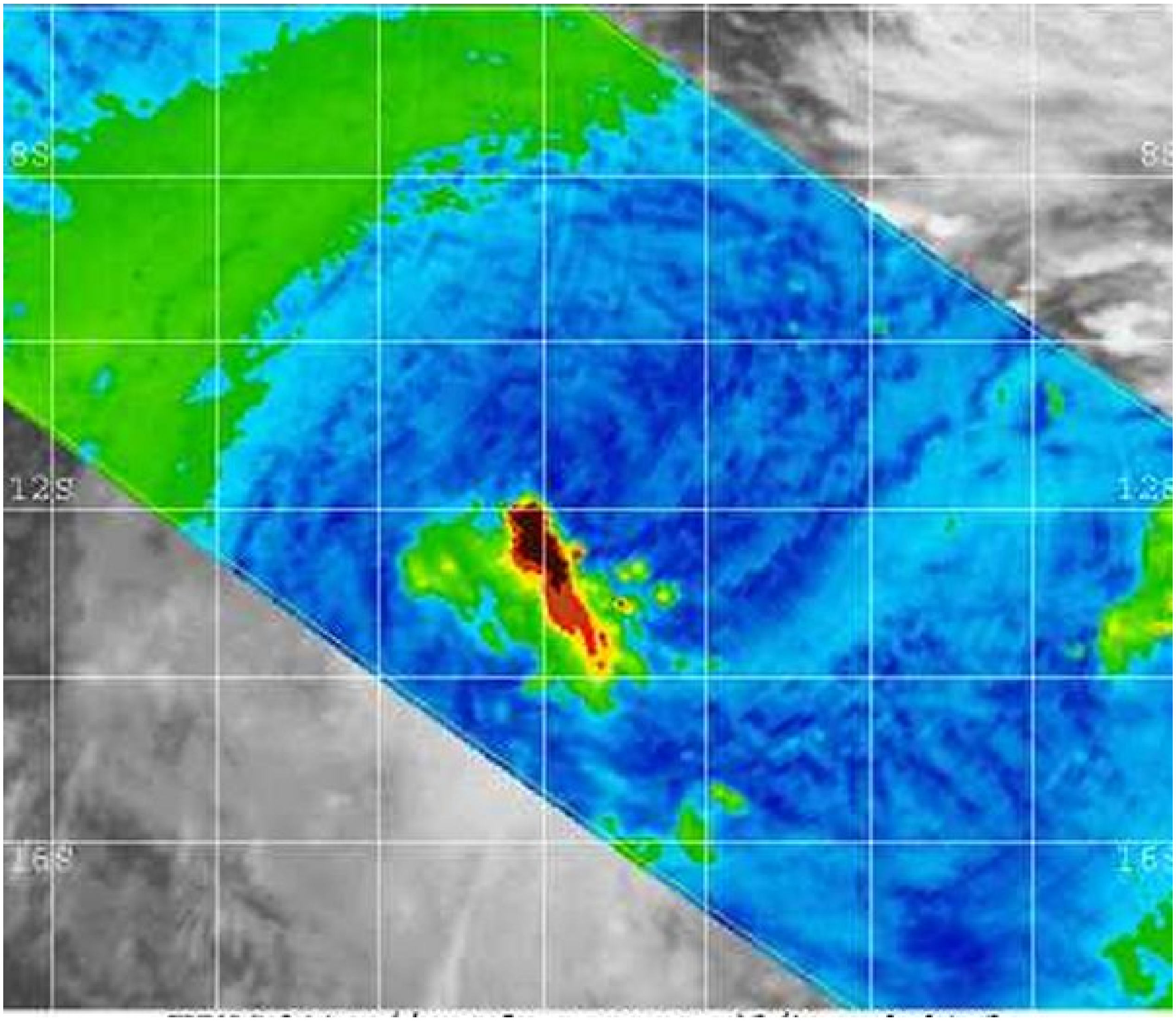
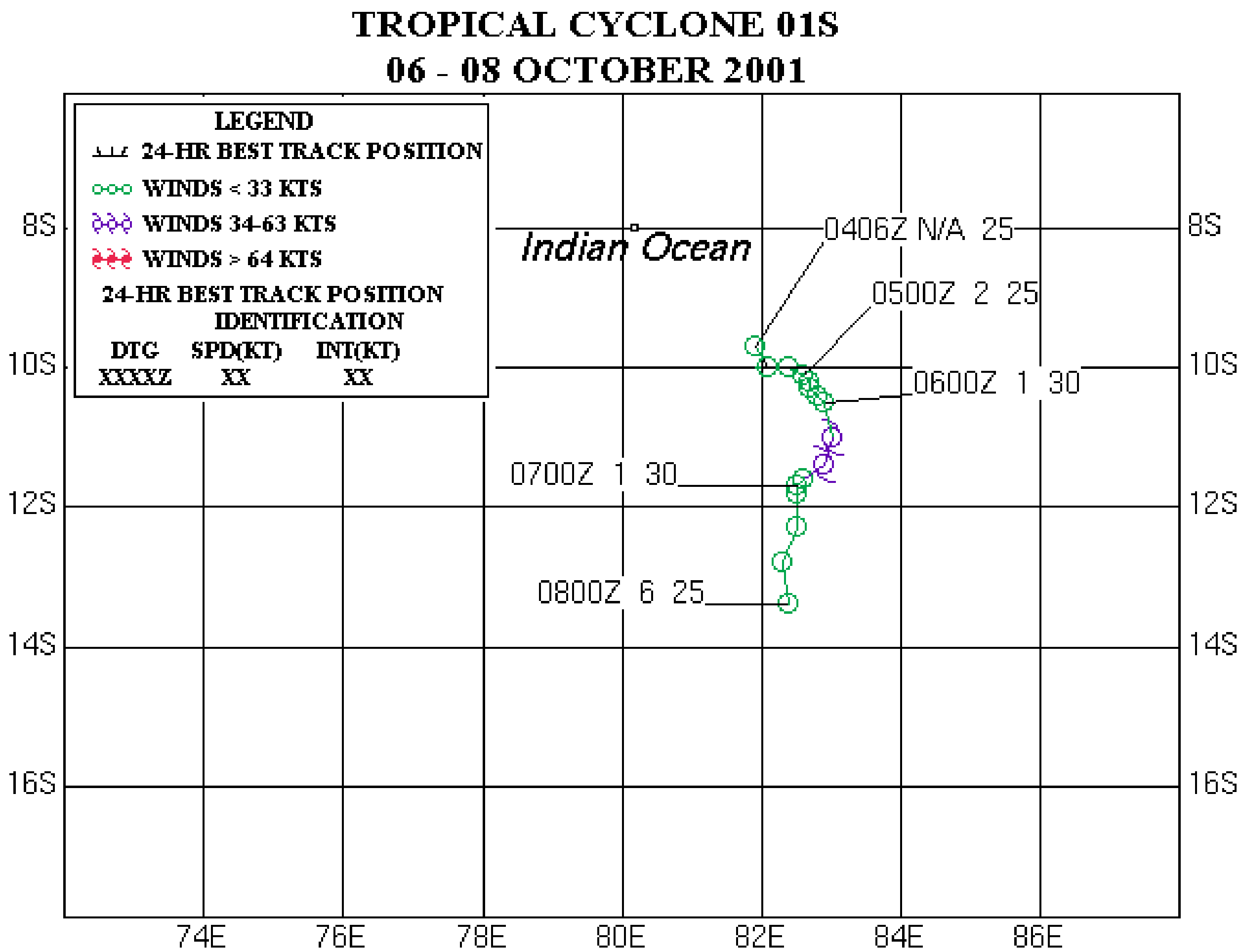


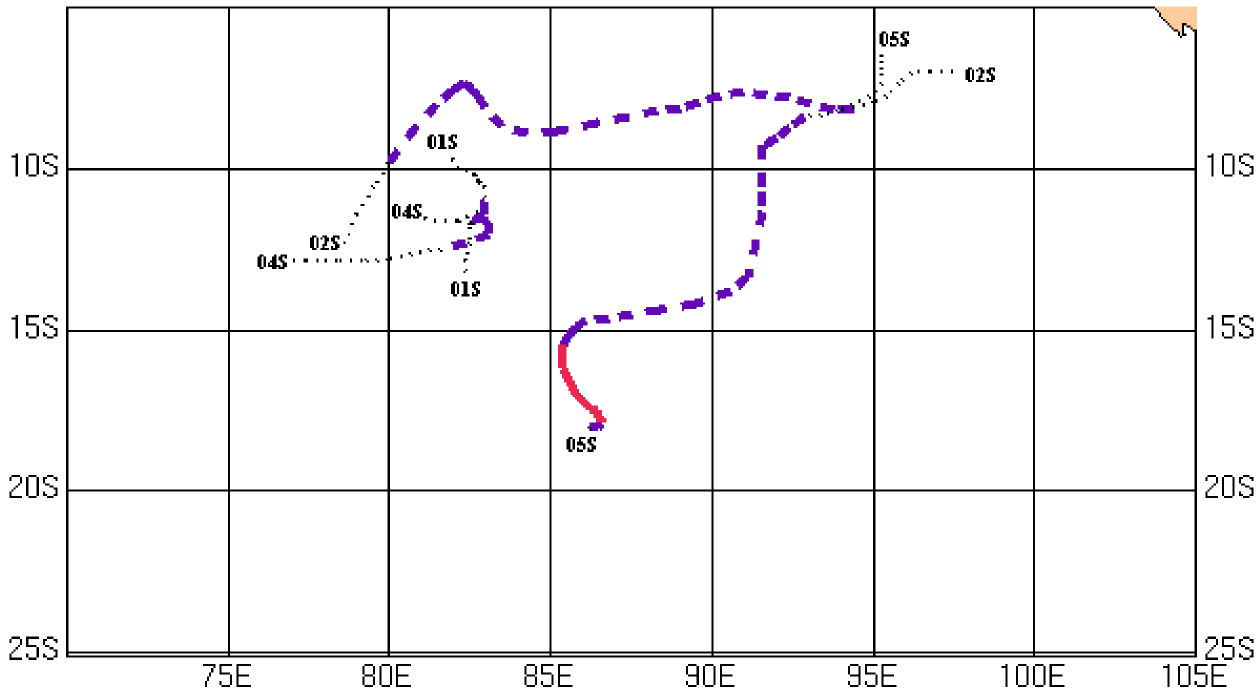

Figure 2-01S-1. 062016Z October 2001 85 GHz TRMM imagery of TC 01S in the South Indian Ocean with an estimated intensity of 35 knots.


TROPICAL CYCLONE 01S
06 - 08 OCTOBER 2001
LEGEND
24-HR BEST TRACK POSITION
WINDS < 33 KTS
WINDS 34-63 KTS
WINDS > 64 KTS
24-HR BEST TRACK POSITION IDENTIFICATION
DTG SPD(KT) INT(KT)
XXXXZ XX XX
Indian Ocean
0406Z N/A 25
0500Z 2 25
0600Z 1 30
0700Z 1 30
0800Z 6 25
8S
10S
12S
14S
16S
74E
76E
78E
80E
82E
84E
86E

Contents | Summary | Chap 1 | Chap 2 | Chap 3 | Chap 4 | Chap 5 | Chap 6

Print Friendly (PDF)

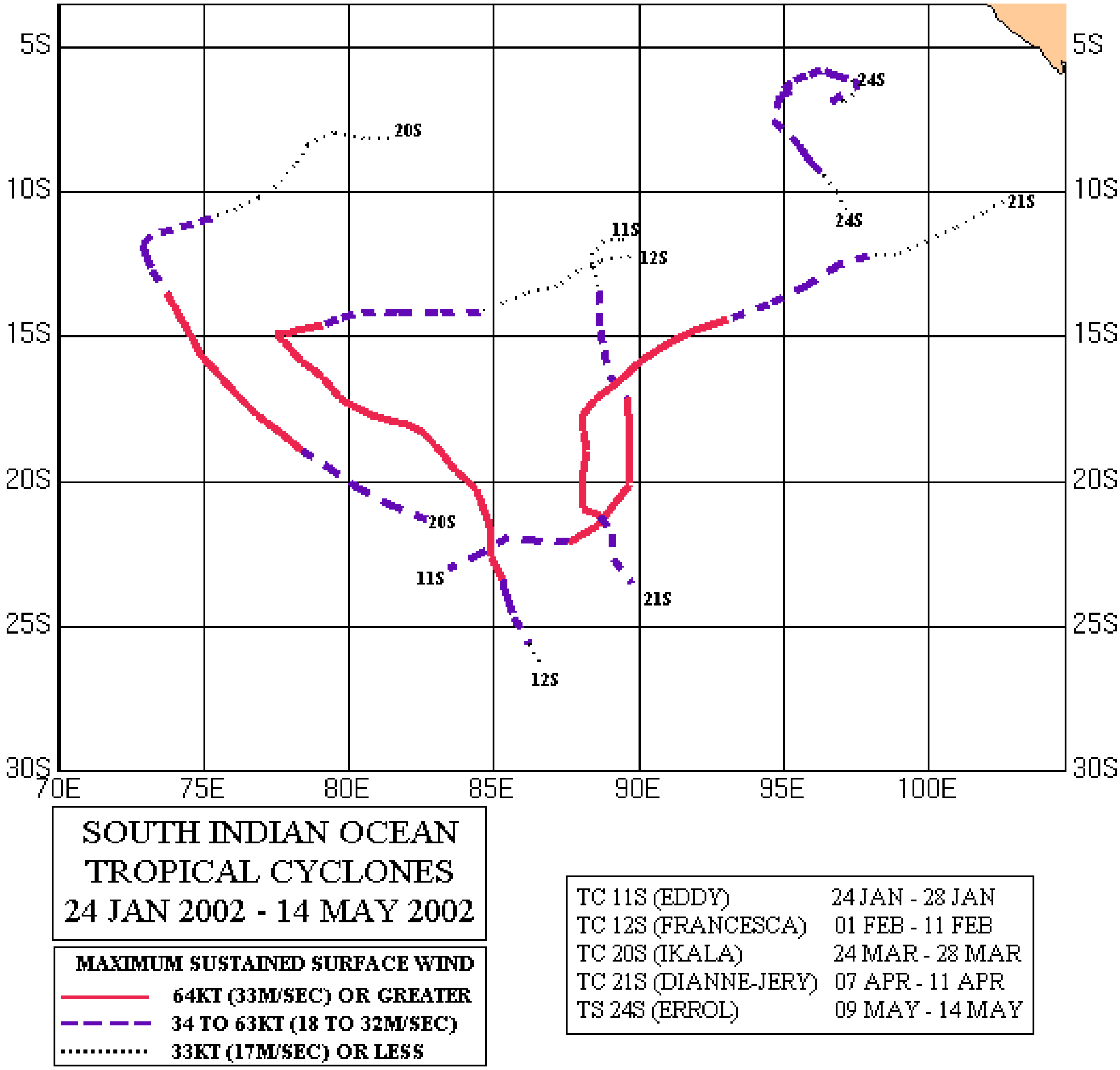


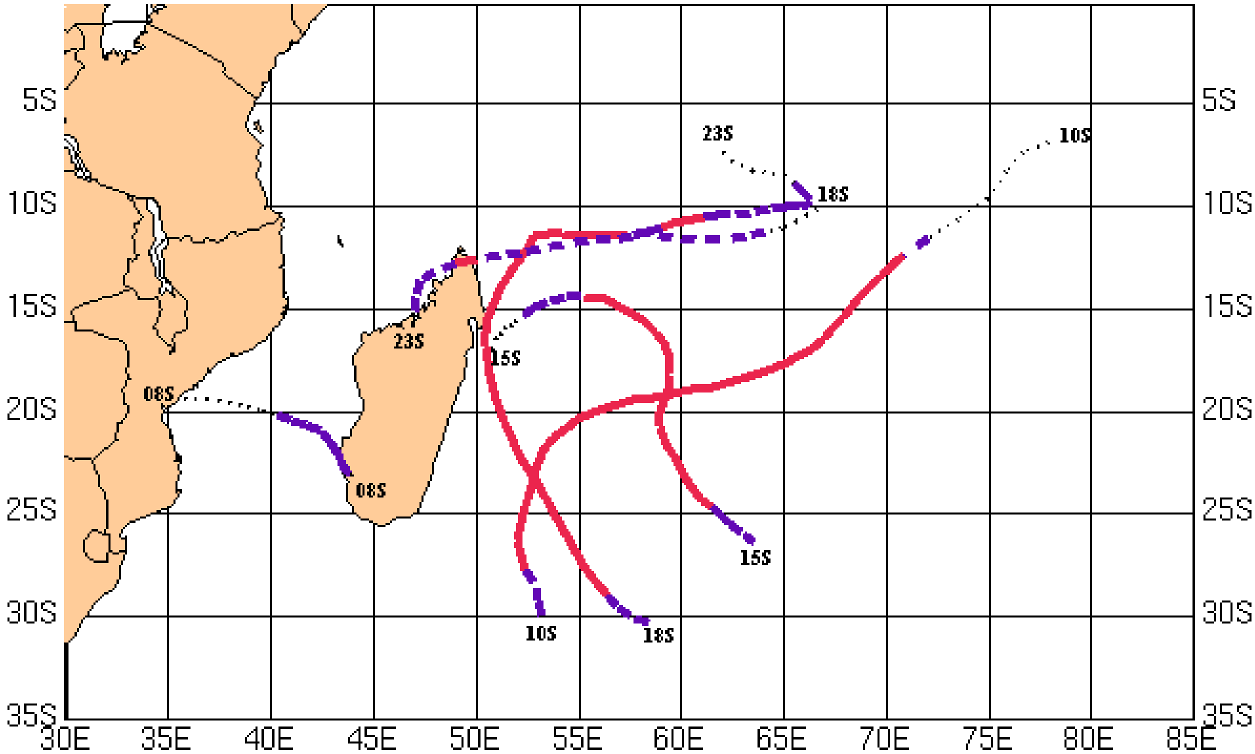



SOUTH INDIAN OCEAN TROPICAL CYCLONES
06 OCT 2001 - 05 DEC 2001

| | |
|---|---|
| TC 01S | 06 OCT - 08 OCT |
| TC 02S (ALEX-ANDRE) | 26 OCT - 31 OCT |
| TC 04S | 21 NOV - 23 NOV |
| TC 05S (BESSI-BAKO) | 27 NOV - 05 DEC |

MAXIMUM SUSTAINED SURFACE WIND
- 64KT (33M/SEC) OR GREATER
- 34 TO 63KT (18 TO 32M/SEC)
- 33KT (17M/SEC) OR LESS


5S
10S
15S
20S
25S
30S
70E
75E
80E
85E
90E
95E
100E
11S
12S
20S
21S
24S
SOUTH INDIAN OCEAN
TROPICAL CYCLONES
24 JAN 2002 - 14 MAY 2002
MAXIMUM SUSTAINED SURFACE WIND
64KT (33M/SEC) OR GREATER
34 TO 63KT (18 TO 32M/SEC)
33KT (17M/SEC) OR LESS
TC 11S (EDDY) 24 JAN - 28 JAN
TC 12S (FRANCESCA) 01 FEB - 11 FEB
TC 20S (IKALA) 24 MAR - 28 MAR
TC 21S (DIANNE-JERY) 07 APR - 11 APR
TS 24S (ERROL) 09 MAY - 14 MAY




SOUTH INDIAN OCEAN
TROPICAL CYCLONES
01 JAN 2002 - 11 MAY 2002

**MAXIMUM SUSTAINED SURFACE WIND**

**64KT (33M/SEC) OR GREATER**

**34 TO 63KT (18 TO 32M/SEC)**

**33KT (17M/SEC) OR LESS**

| | |
|---|---|
| TC 08S (CYPRIEN) | 01 JAN - 02 JAN |
| TC 10S (DINA) | 17 JAN - 24 JAN |
| TC 15S (GUILLAUME) | 15 FEB - 22 FEB |
| TC 18S (HARY) | 06 MAR - 13 MAR |
| TC 23S (KESINY) | 03 MAY - 11 MAY |

**Table 2-3**

**ANNUAL VARIATION OF SOUTHERN HEMISPHERE TROPICAL CYCLONES**

**BY OCEAN BASIN**

| YEAR | SOUTH INDIAN | AUSTRALIAN | SOUTH PACIFIC | |
|---|---|---|---|---|
| | (WEST OF 105°E) | (105°E - 165°E) | (EAST OF 165°E) | TOTAL |
| **1958-1977 AVERAGE*** | 8.4 | 10.3 | 5.9 | 24.6 |
| | | | | |
| 1981 | 13 | 8 | 3 | 24 |
| 1982 | 12 | 11 | 2 | 25 |
| 1983 | 7 | 6 | 12 | 25 |
| 1984 | 14 | 14 | 2 | 30 |
| 1985 | 14 | 15 | 6 | 35 |
| 1986 | 14 | 16 | 3 | 33 |
| 1987 | 9 | 8 | 11 | 28 |
| 1988 | 14 | 2 | 5 | 21 |
| 1989 | 12 | 9 | 7 | 28 |
| 1990 | 18 | 8 | 3 | 29 |
| 1991 | 11 | 10 | 1 | 22 |
| 1992 | 11 | 6 | 13 | 30 |
| 1993 | 10 | 16 | 1 | 27 |
| 1994 | 16 | 10 | 4 | 30 |
| 1995 | 11 | 7 | 4 | 22 |
| 1996 | 13 | 11 | 4 | 28 |
| 1997 | 17 | 5 | 16 | 38 |
| 1998 | 12 | 10 | 15 | 37 |
| 1999 | 13 | 16 | 4 | 33 |
| 2000 | 10 | 12 | 5 | 27 |
| 2001 | 10 | 8 | 3 | 21 |
| 2002 | 14 | 7 | 4 | 25 |
| (1981-2002) | | | | |
| TOTAL | 275 | 215 | 128 | 618 |
| AVERAGE | 12.5 | 9.8 | 5.8 | 28.1 |

* (Gray,1978)

TC 18S Hary

TC 19P

TC 20S Ikala

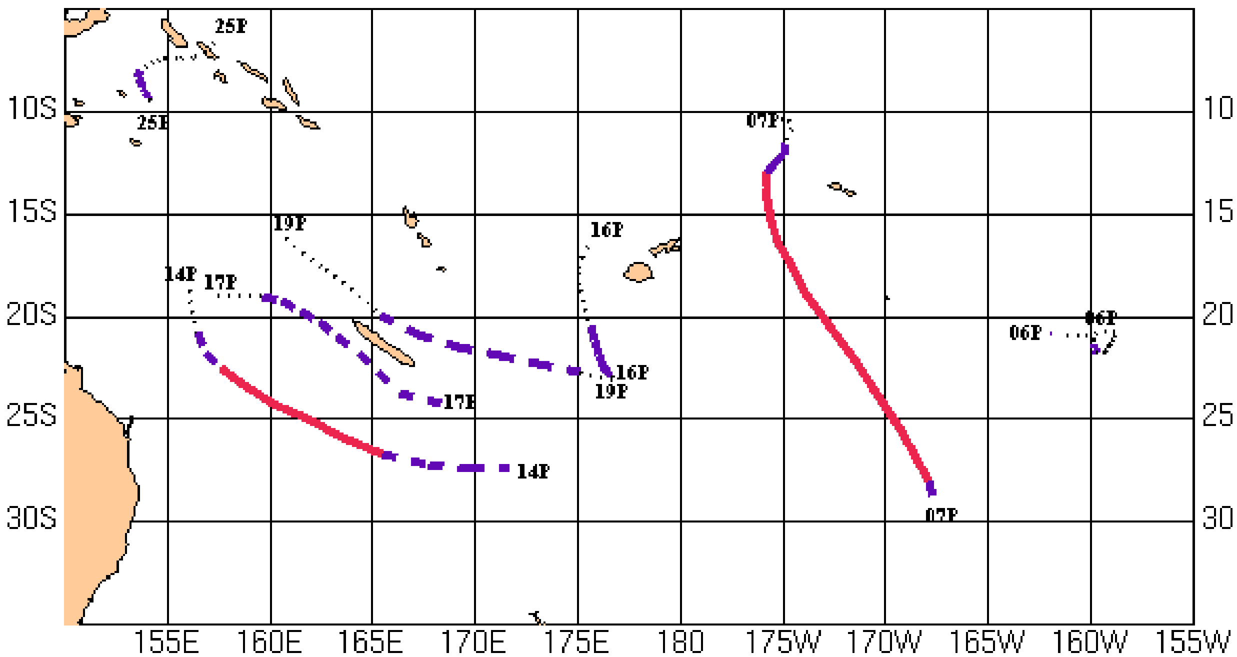
TC 21S Dianne-Jery

TC 22S Bonnie

TC 23S Kesiny

TC 24S Errol

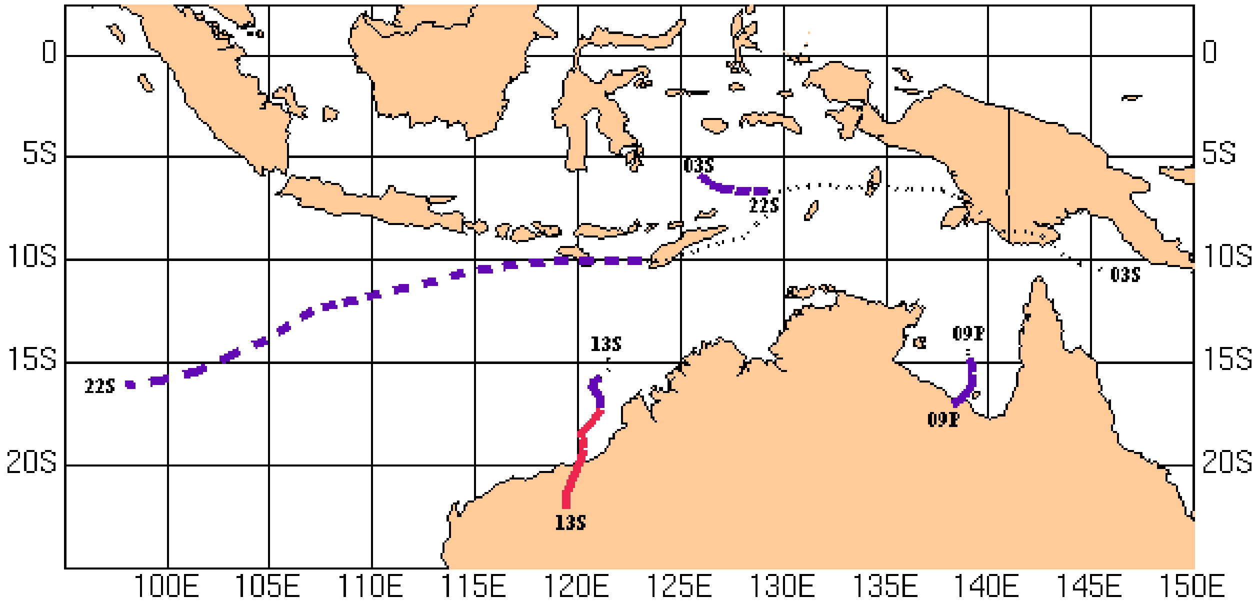
TC 25P Upia




AUSTRALIA REGION
TROPICAL CYCLONES
30 NOV 2001 - 28 MAY 2002

MAXIMUM SUSTAINED SURFACE WIND
64KT (33M/SEC) OR GREATER
34 TO 63KT (18 TO 32M/SEC)
33KT (17M/SEC) OR LESS

| | |
|---|---|
| TC 06P (TRINA) | 30 NOV - 01 DEC |
| TC 07P (WAKA) | 29 DEC - 02 JAN |
| TC 14P (CLAUDIA) | 11 FEB - 13 FEB |
| TC 16P | 24 FEB - 26 FEB |
| TC 17P (DES) | 05 MAR - 07 MAR |
| TC 19P | 14 MAR - 16 MAR |
| TC 25P (UPIA) | 25 MAY - 28 MAY |




AUSTRALIA REGION
TROPICAL CYCLONES
21 NOV 2001 - 15 APR 2002

**MAXIMUM SUSTAINED SURFACE WIND**

- 64KT (33M/SEC) OR GREATER
- 34 TO 63KT (18 TO 32M/SEC)
- 33KT (17M/SEC) OR LESS

| | |
|---|---|
| TC 03S | 21 NOV - 21 NOV |
| TC 09P (BERNIE) | 03 JAN - 04 JAN |
| TC 13S (CHRIS) | 03 FEB - 06 FEB |
| TC 22S (BONNIE) | 10 APR - 15 APR |

# Tropical Cyclone (TC) 02S (Alex-Andre*)

Verification Statistics

First Poor : 1800Z 23 Oct 01
First Fair : 1000Z 25 Oct 01
First TCFA : 1630Z 25 Oct 01
First Warning : 0600Z 26 Oct 01
Last Warning : 1800Z 31 Oct 01
Max Intensity : 55 kts, gusts to 70 kts
Landfall : None
Total Warnings : 15
Remarks : None

*Names assigned by Perth TCWC and RSMC La Reunion

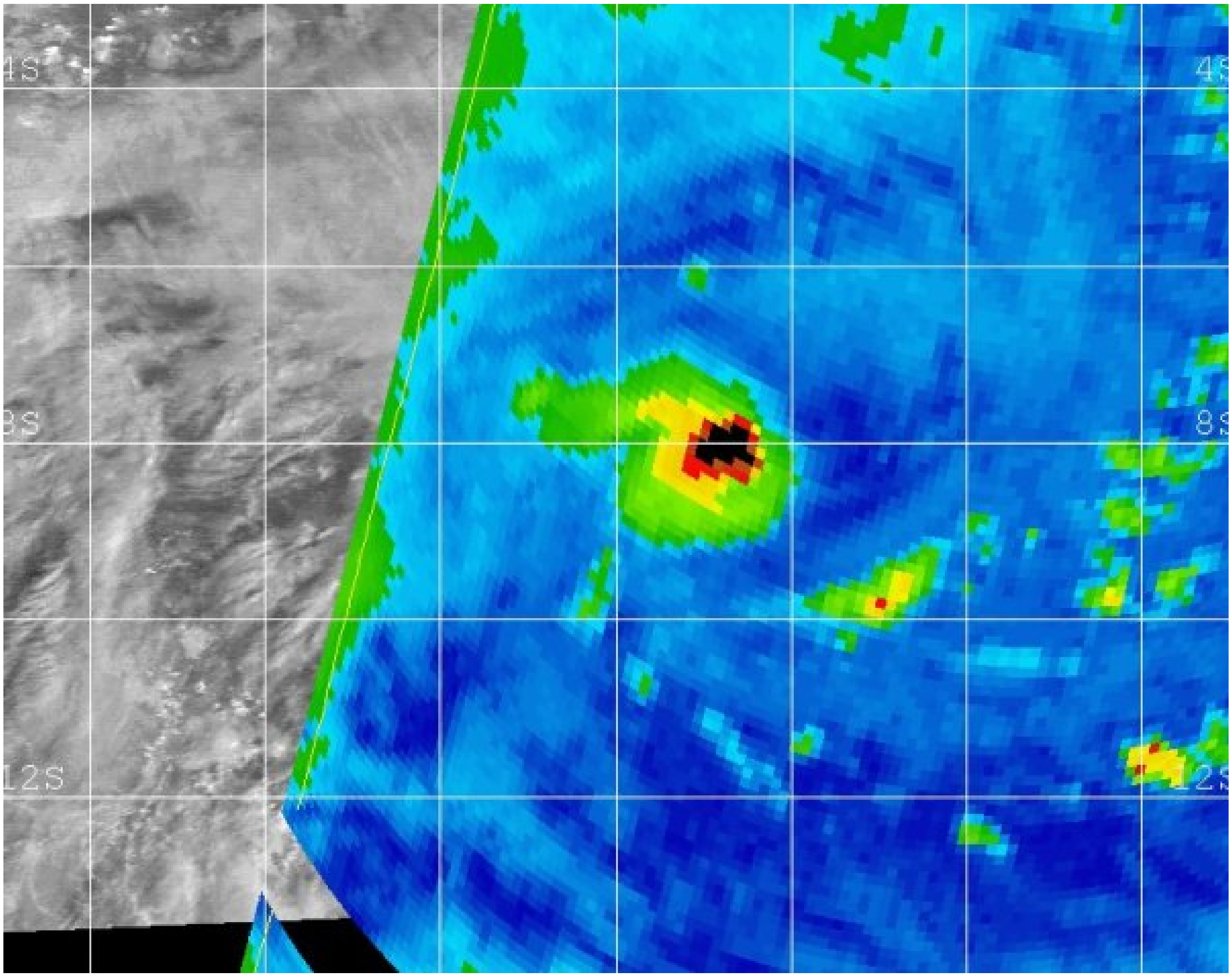
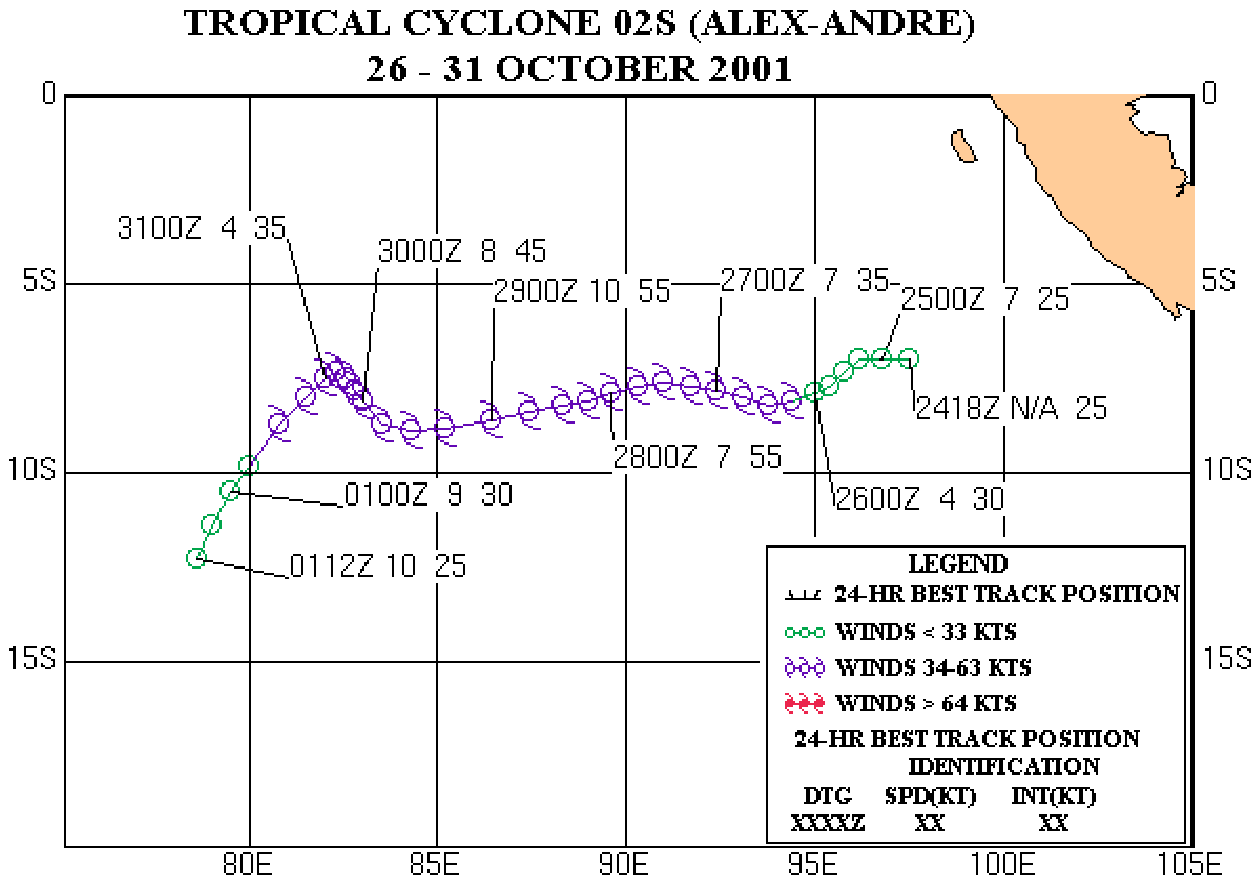



Figure 2-02S-1. 272358Z October 2001 85 GHz SSM/I imagery of TC 02S (Alex) southwest of Sumatra in the South Indian Ocean with an estimated intensity of 55 knots.


TROPICAL CYCLONE 02S (ALEX-ANDRE)
26 - 31 OCTOBER 2001
3100Z 4 35
3000Z 8 45
2900Z 10 55
2700Z 7 35
2500Z 7 25
2418Z N/A 25
2800Z 7 55
2600Z 4 30
0100Z 9 30
0112Z 10 25
LEGEND
24-HR BEST TRACK POSITION
WINDS < 33 KTS
WINDS 34-63 KTS
WINDS > 64 KTS
24-HR BEST TRACK POSITION IDENTIFICATION
DTG SPD(KT) INT(KT)
XXXXZ XX XX
0
5S
10S
15S
80E
85E
90E
95E
100E
105E

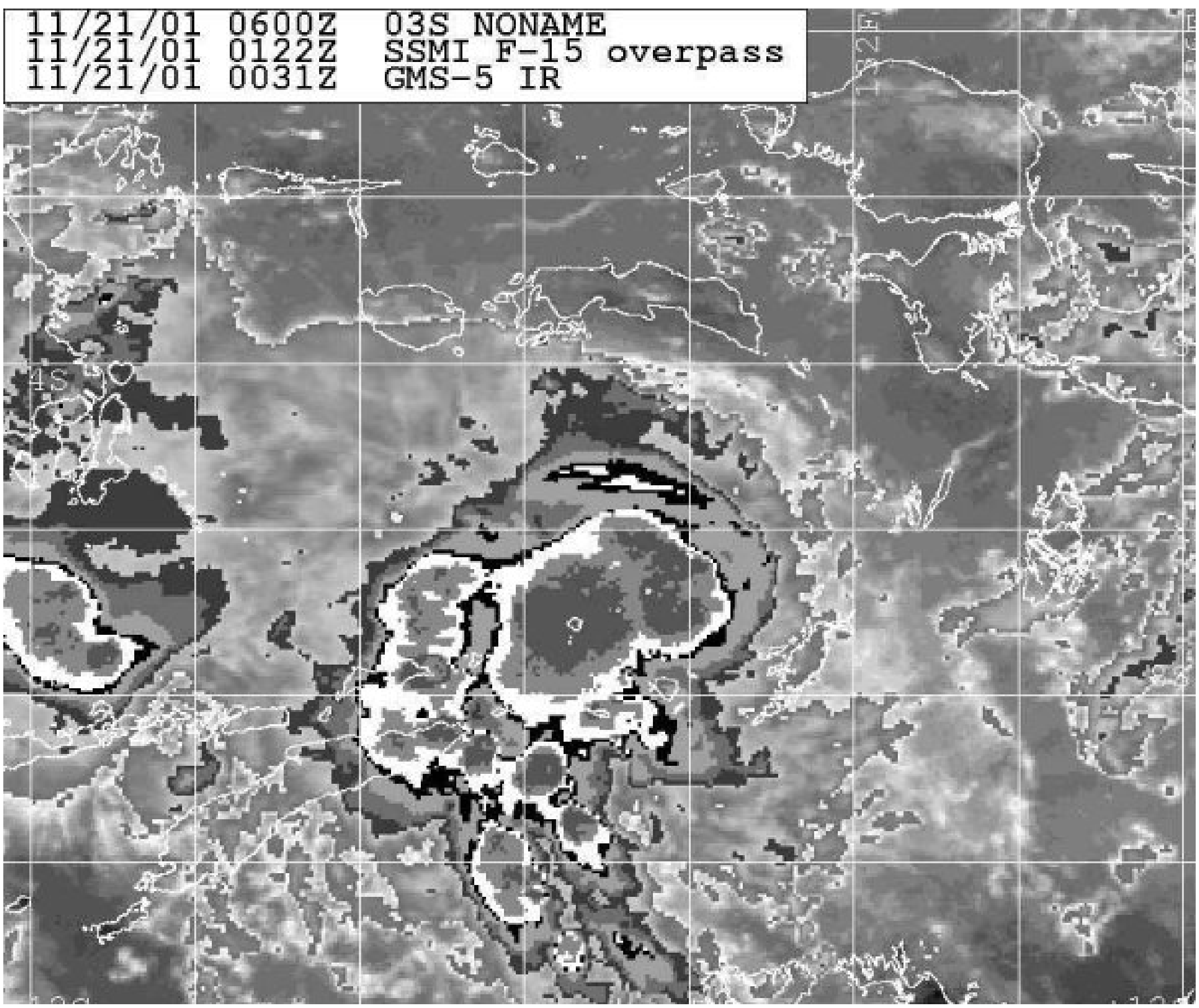
Print Friendly (PDF)



# Tropical Cyclone (TC) 03S

Verification Statistics

First Poor : 1800Z 14 Nov 01
First Fair : 1100Z 20 Nov 01
First TCFA : 0030Z 21 Nov 01
First Warning : 0600Z 21 Nov 01
Last Warning : 1800Z 21 Nov 01
Max Intensity : 35 kts, gusts to 45 kts
Landfall : None
Total Warnings : 2
Remarks : None



TC 18S Hary

TC 19P

TC 20S Ikala

TC 21S Dianne-Jery

TC 22S Bonnie

TC 23S Kesiny

TC 24S Errol

TC 25P Upia

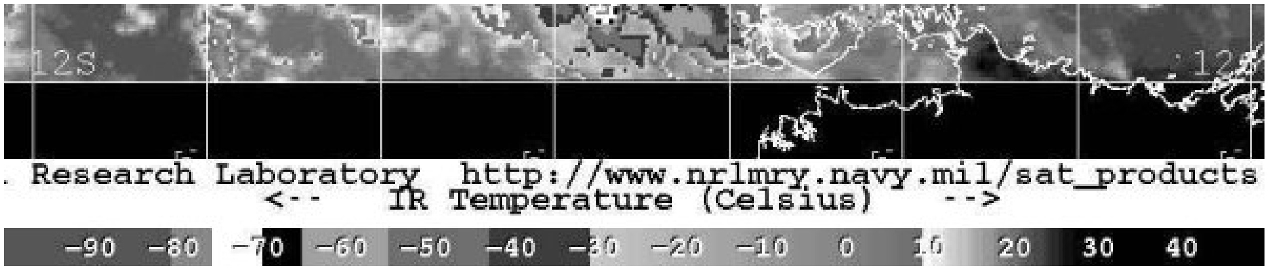
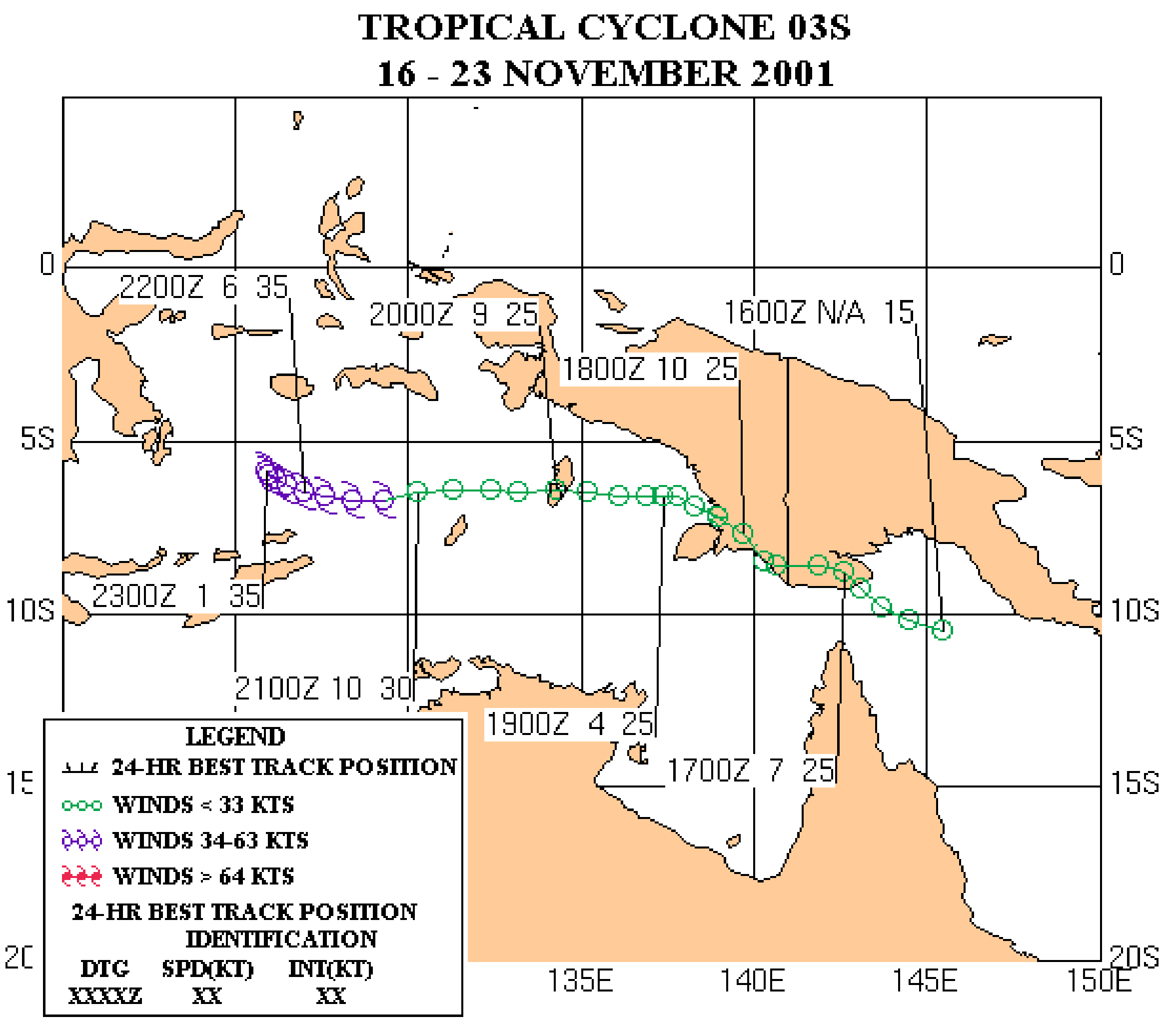


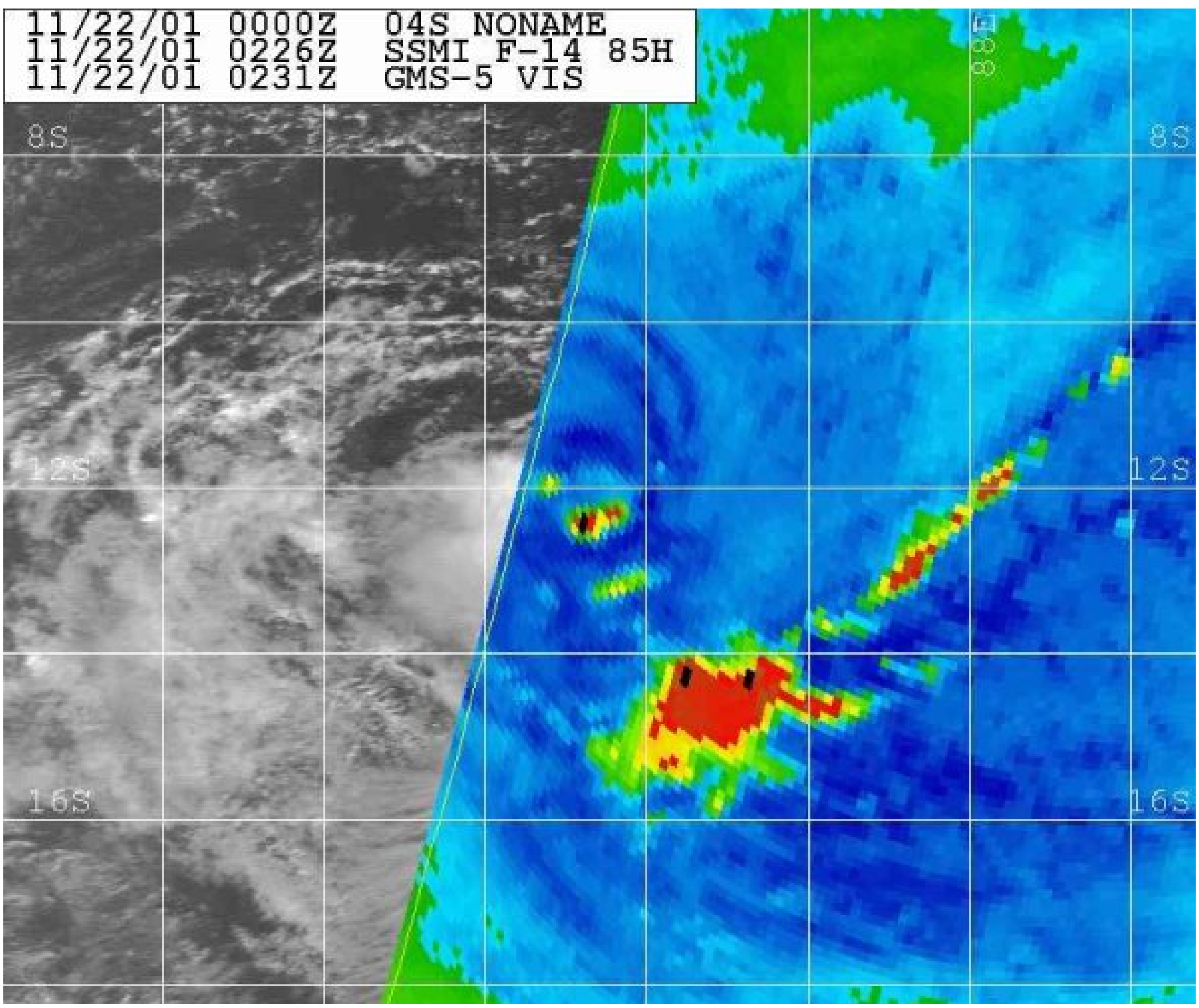

Figure 2-03S-1. 210031Z November enhanced infrared imagery of TC 03S in the Banda sea with an estimated intensity of 35 knots.



# Tropical Cyclone (TC) 04S

Verification Statistics

First Poor : 0230Z 16 Nov 01
First Fair : 0600Z 17 Nov 01
First TCFA : 0300Z 21 Nov 01
First Warning : 0600Z 21 Nov 01
Last Warning : 0600Z 23 Nov 01
Max Intensity : 35 kts, gusts to 45 kts
Landfall : None
Total Warnings : 5
Remarks : None



TC 18S Hary

TC 19P

TC 20S Ikala

TC 21S Dianne-Jery

TC 22S Bonnie

TC 23S Kesiny

TC 24S Errol

TC 25P Upia

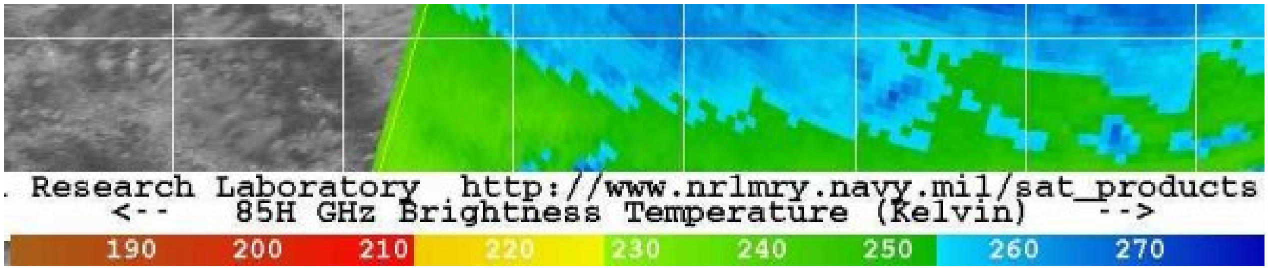
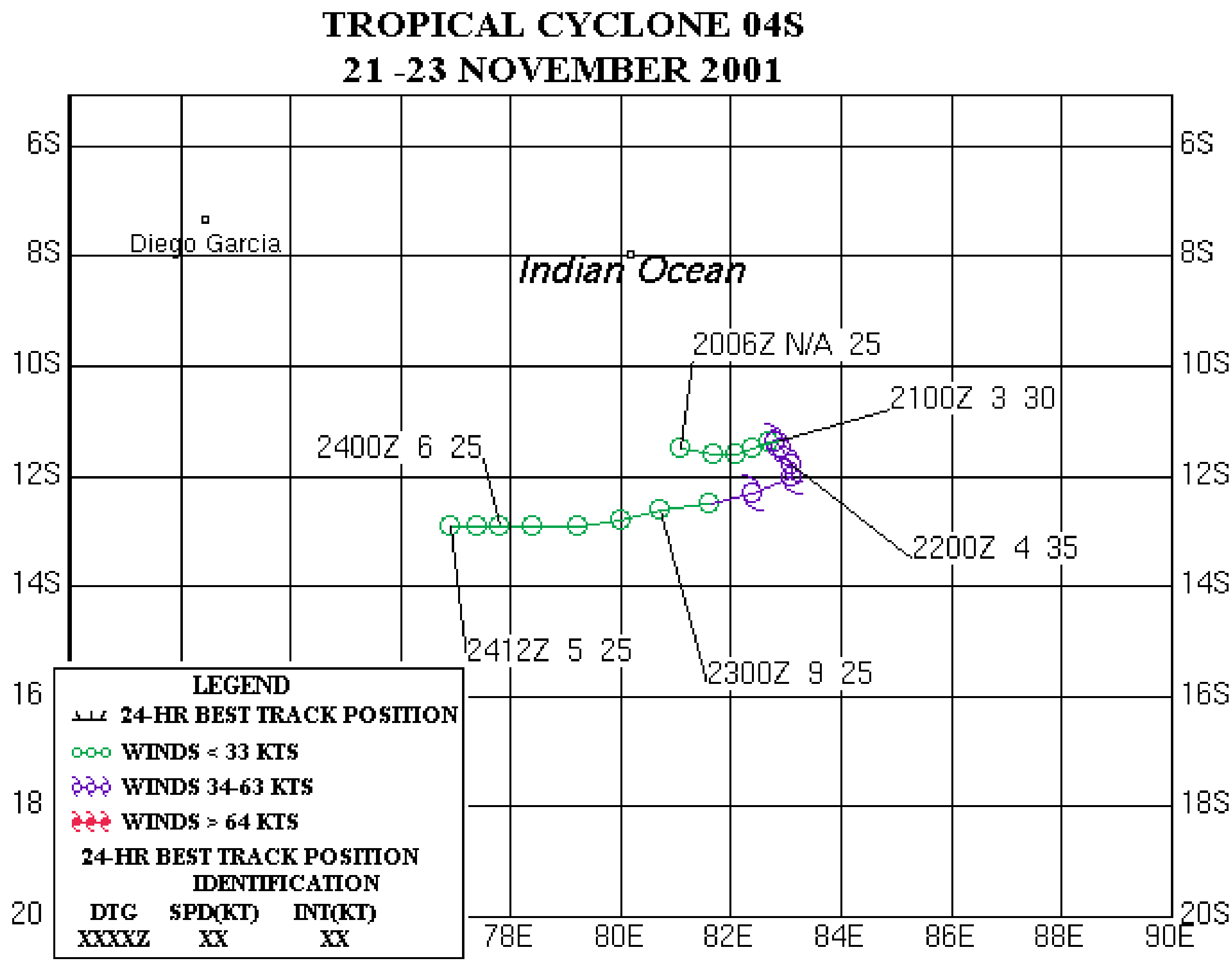



Figure 2-04S-1. 220226Z November 2001 85 GHz SSM/I imagery of TC 04S in the South Indian Ocean with an estimated intensity of 35 knots.



# Tropical Cyclone (TC) 05S (Bessi-Bako*)

Verification Statistics

First Poor : 0900Z 25 Nov 01
First Fair : 1800Z 25 Nov 01
First TCFA : 0330Z 26 Nov 01
First Warning : 0600Z 27 Nov 01
Last Warning : 0600Z 05 Dec 01
Max Intensity : 75 kts, gusts to 90 kts
Landfall : None
Total Warnings : 17
Remarks : None

* Names assigned by Perth TCWC and RSMC La Reunion

**TC 18S Hary**

**TC 19P**

**TC 20S Ikala**

**TC 21S Dianne-Jery**

**TC 22S Bonnie**

**TC 23S Kesiny**

**TC 24S Errol**

**TC 25P Upia**

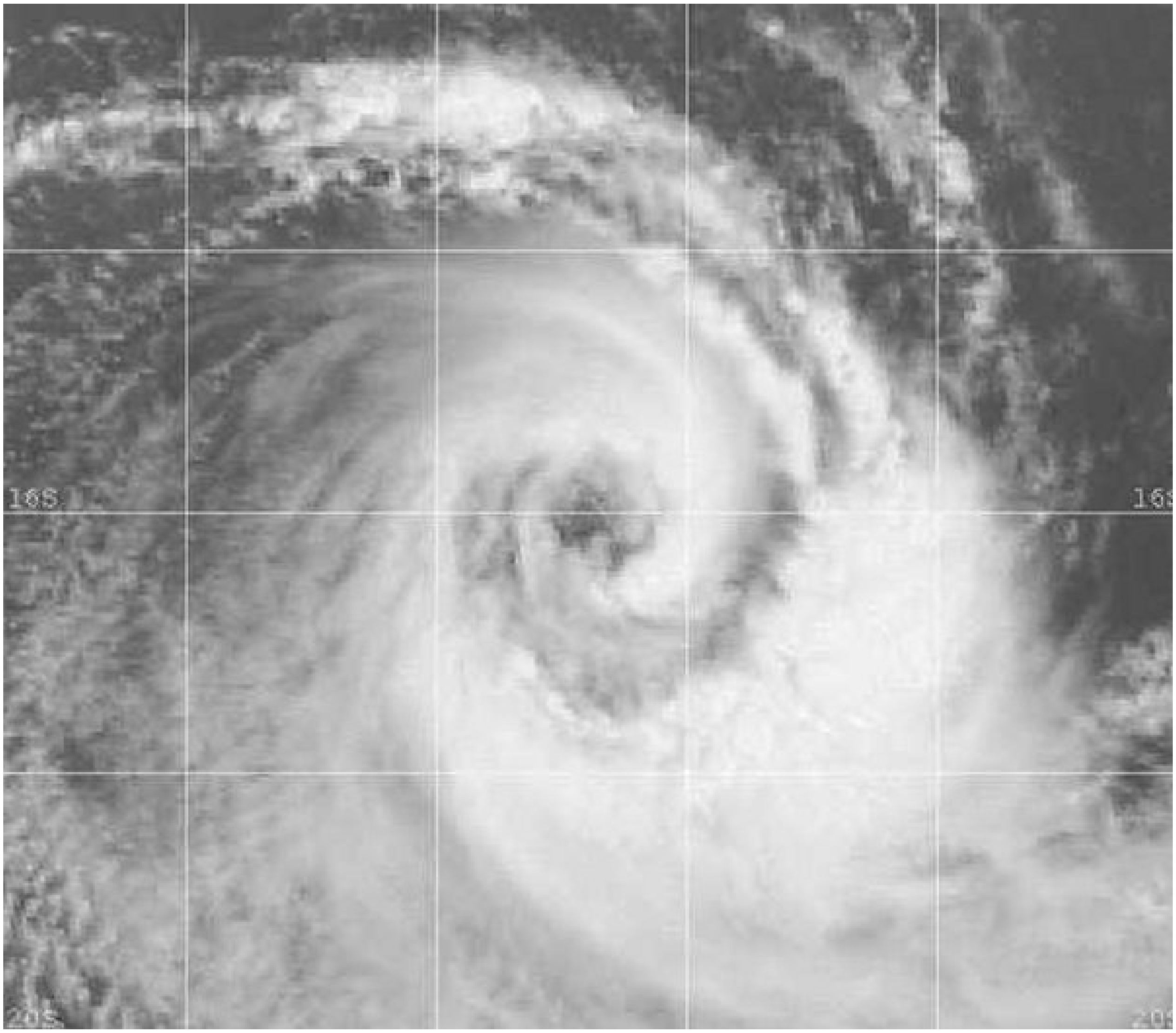



Figure 2-05S-1. 020500Z December 2001 Visible imagery of TC 05S (Bessi) in the South Indian Ocean with an estimated intensity of 65 knots.

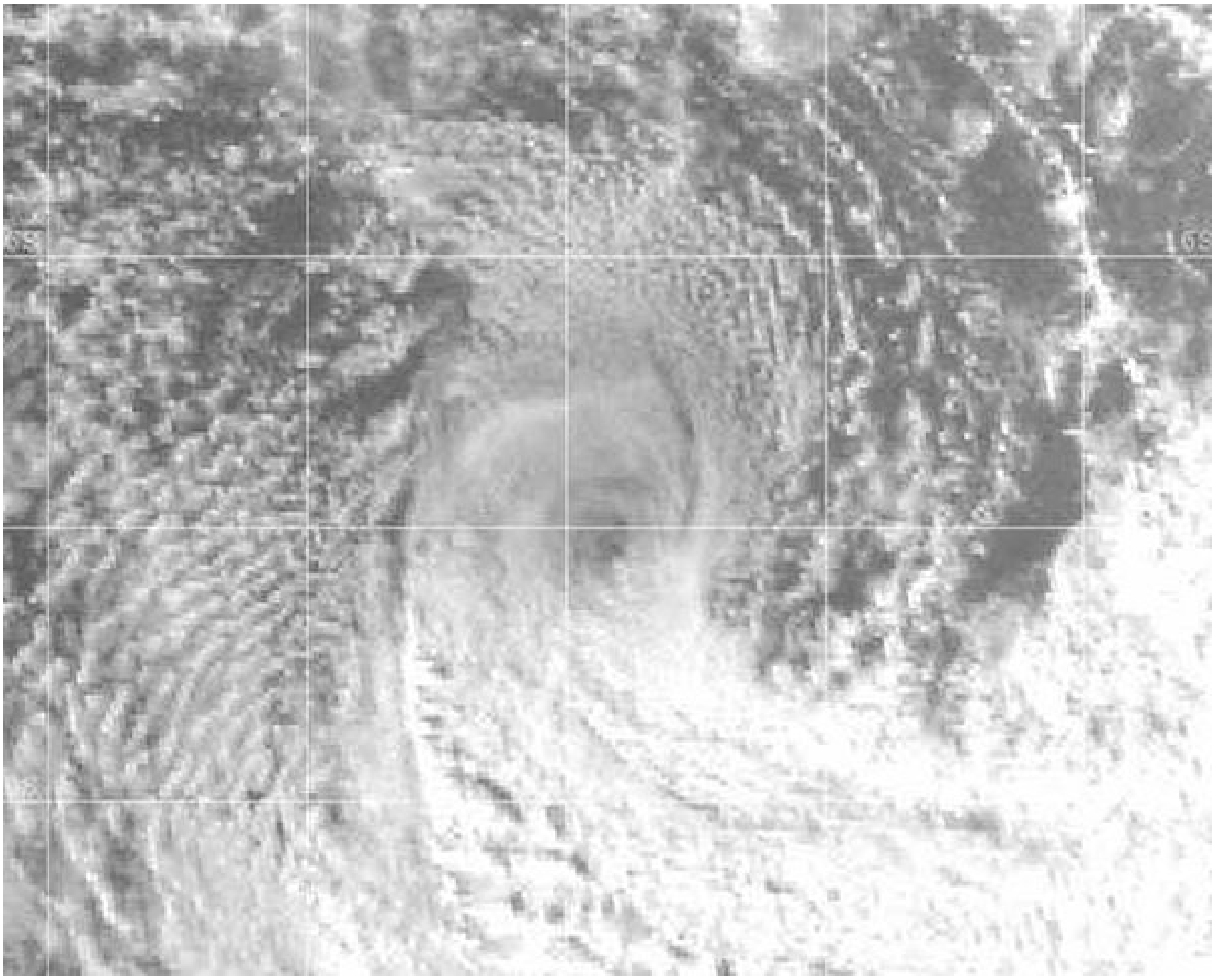
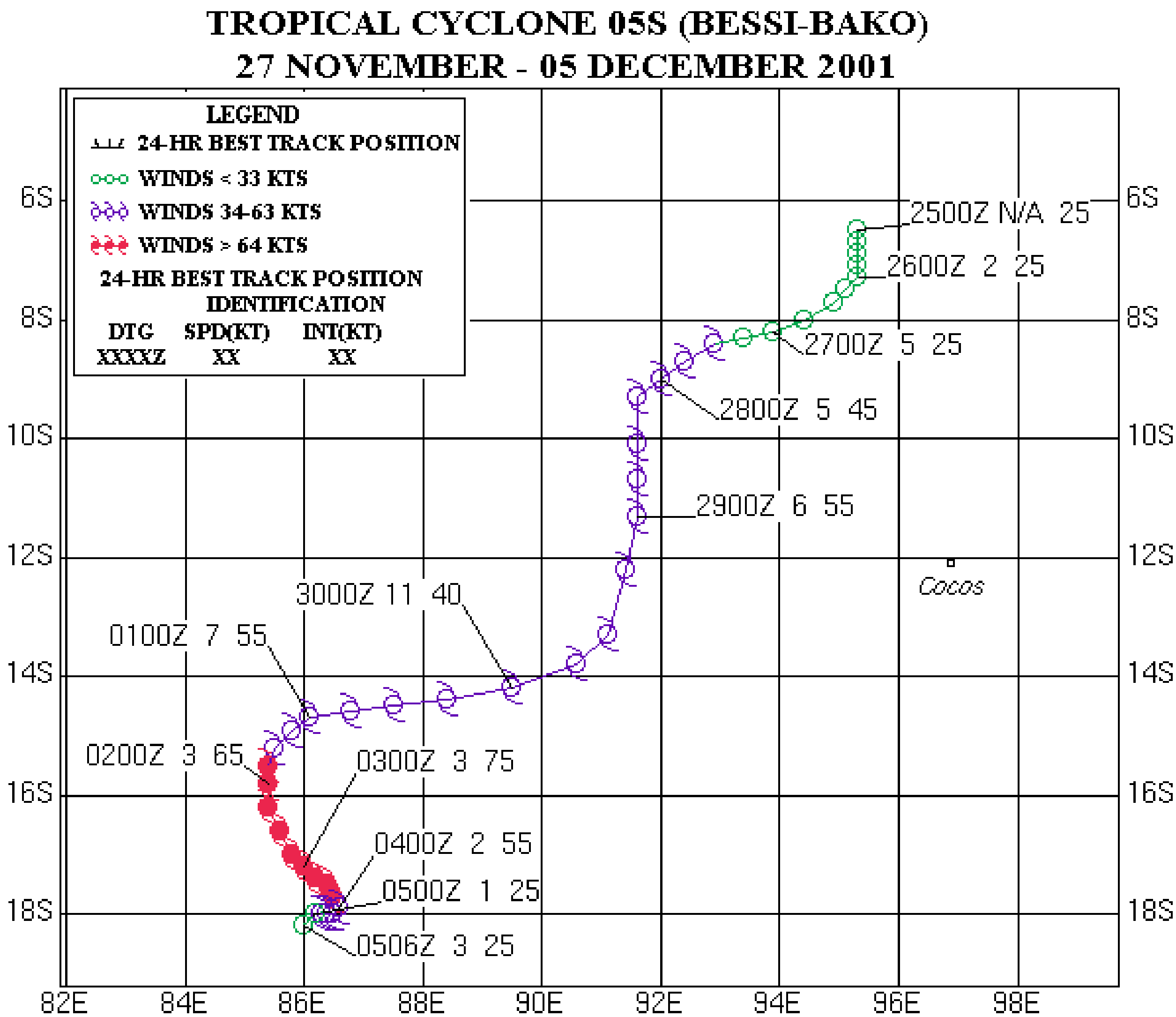


Figure 2-05S-2. 051130Z December 2001 visible imagery of TC 05S (Bessi) in the South Indian Ocean. At this time, the system was extratropical with an estimated intensity of 25 knots.


TROPICAL CYCLONE 05S (BESSI-BAKO)
27 NOVEMBER - 05 DECEMBER 2001
LEGEND
24-HR BEST TRACK POSITION
WINDS < 33 KTS
WINDS 34-63 KTS
WINDS > 64 KTS
24-HR BEST TRACK POSITION IDENTIFICATION
DTG SPD(KT) INT(KT)
XXXXZ XX XX
2500Z N/A 25
2600Z 2 25
2700Z 5 25
2800Z 5 45
2900Z 6 55
3000Z 11 40
0100Z 7 55
0200Z 3 65
0300Z 3 75
0400Z 2 55
0500Z 1 25
0506Z 3 25
Cocos
6S
8S
10S
12S
14S
16S
18S
82E
84E
86E
88E
90E
92E
94E
96E
98E

# Tropical Cyclone (TC) 06P (Trina*)

Verification Statistics

First Poor : None
First Fair : None
First TCFA : 1100Z 30 Nov 01
First Warning : 1200Z 30 Nov 01
Last Warning : 0000Z 01 Dec 01
Max Intensity : 35 kts, gusts to 45 kts
Landfall : None
Total Warnings : 2
Remarks : None

* Name assigned by RSMC Nadi

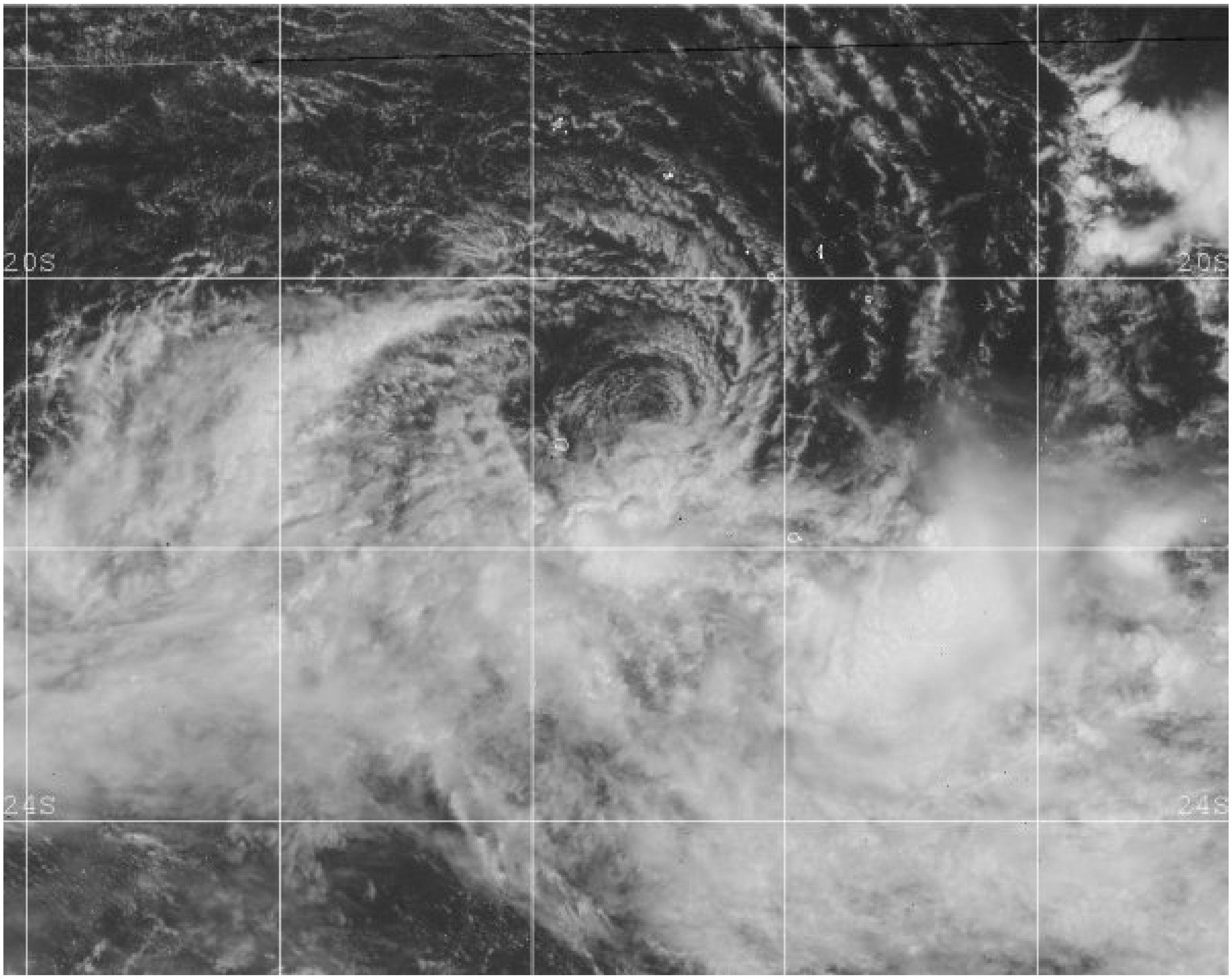
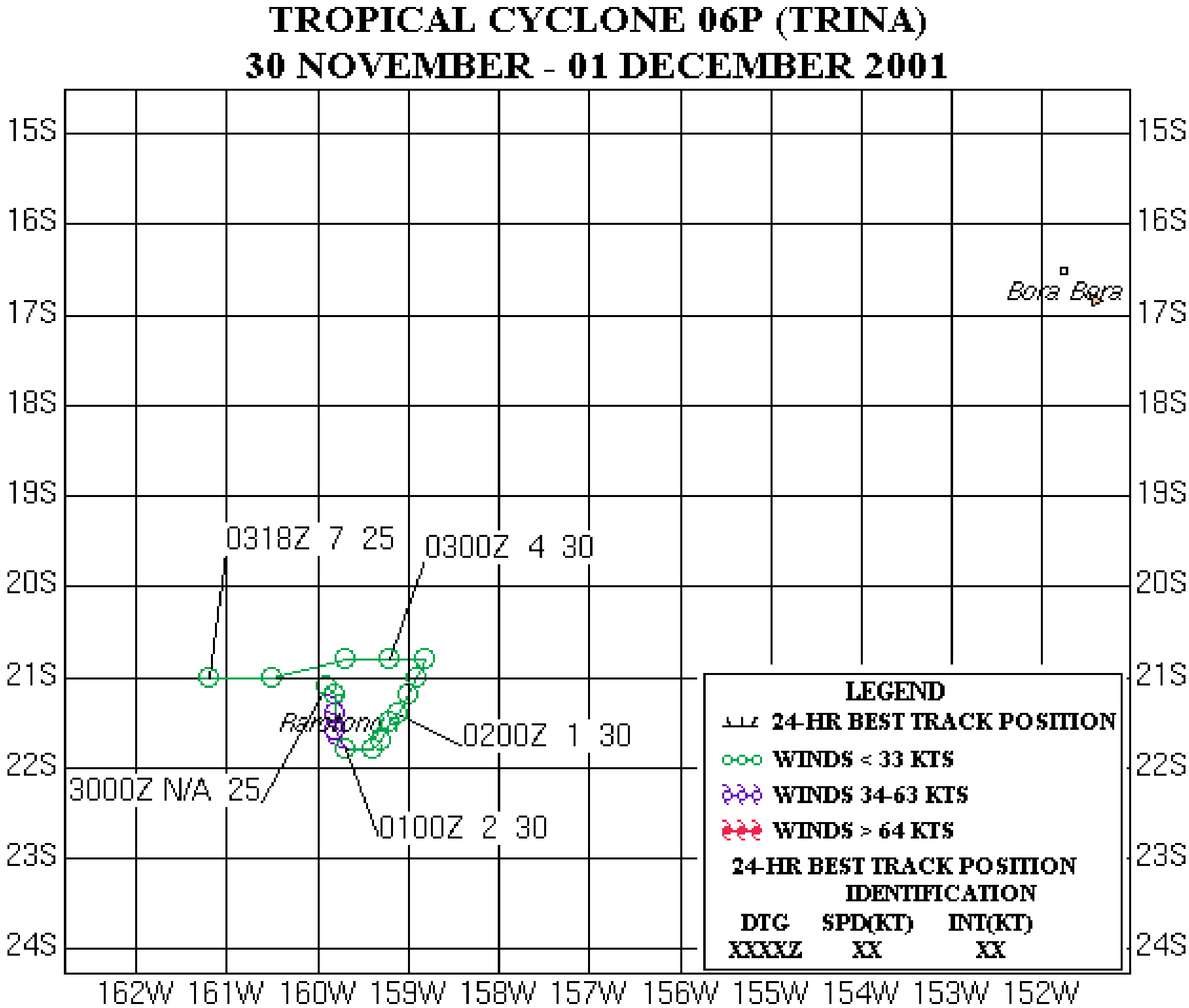



Figure 2-06P-1. 302052Z November 2001 GOES 10 visible imagery of TC 06P (Trina) east of Australia with an estimated intensity of 35 knots.


TROPICAL CYCLONE 06P (TRINA)
30 NOVEMBER - 01 DECEMBER 2001
15S
16S
17S
18S
19S
20S
21S
22S
23S
24S
Bora Bora
0318Z 7 25
0300Z 4 30
0200Z 1 30
3000Z N/A 25
0100Z 2 30
Rarotonga
LEGEND
24-HR BEST TRACK POSITION
WINDS < 33 KTS
WINDS 34-63 KTS
WINDS > 64 KTS
24-HR BEST TRACK POSITION IDENTIFICATION
DTG SPD(KT) INT(KT)
XXXXZ XX XX
162W 161W 160W 159W 158W 157W 156W 155W 154W 153W 152W

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# Tropical Cyclone (TC) 07P (Waka*)

Verification Statistics

First Poor : None
First Fair : None
First TCFA : 1430Z 28 Dec 01
First Warning : 0000Z 29 Dec 01
Last Warning : 0000Z 02 Jan 02
Max Intensity : 100 kts, gusts to 125 kts
Landfall : None
Total Warnings : 9
Remarks : None

*Name assigned by RSMC Nadi

**TC 18S Hary**

**TC 19P**

**TC 20S Ikala**

**TC 21S Dianne-Jery**

**TC 22S Bonnie**

**TC 23S Kesiny**

**TC 24S Errol**

**TC 25P Upia**

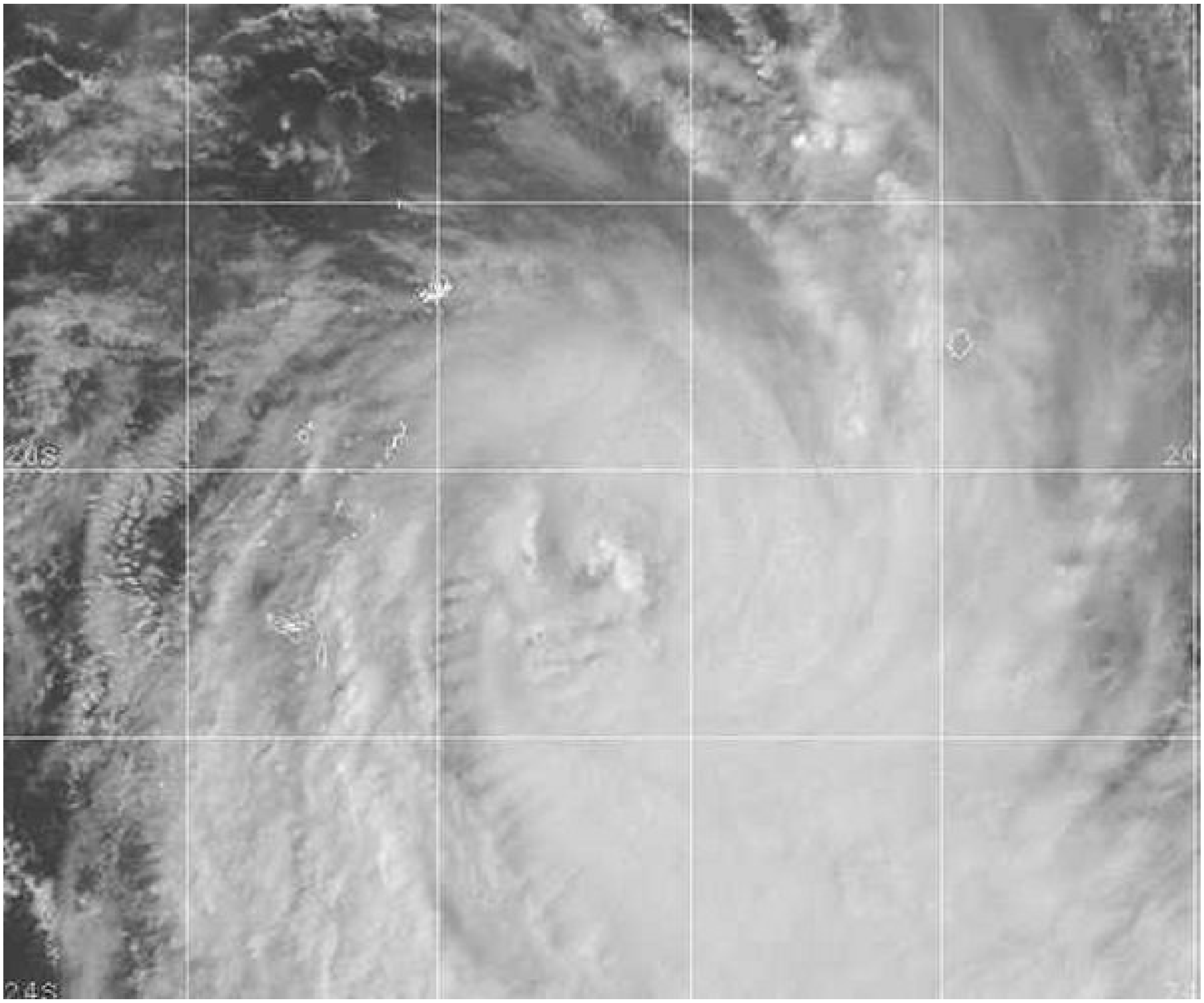



Figure 2-07P-1. 311952Z December 2001 GOES 10 visible imagery of TC 07P (Waka) southeast of the Fiji islands with an estimated intensity of 100 knots.

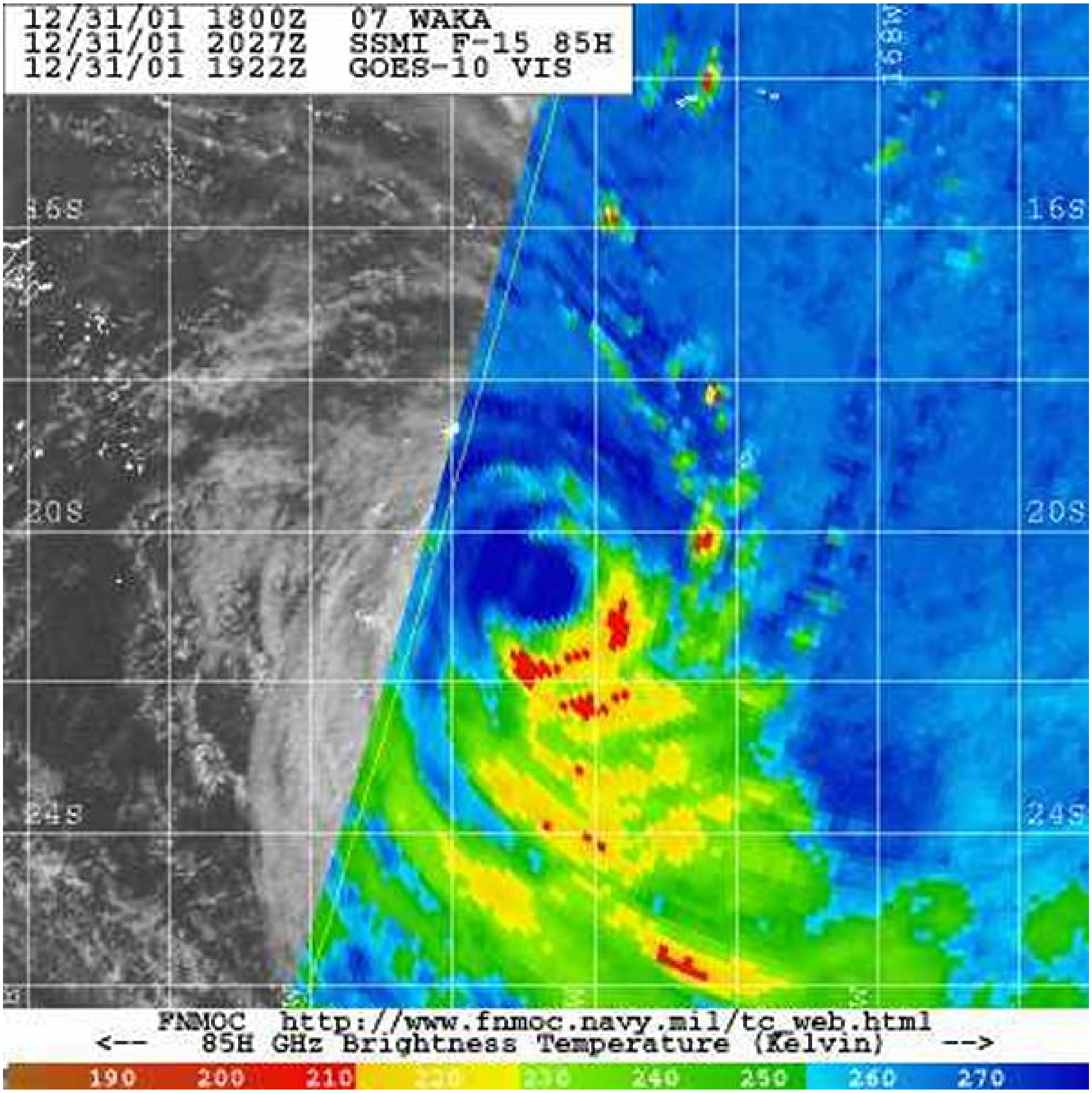
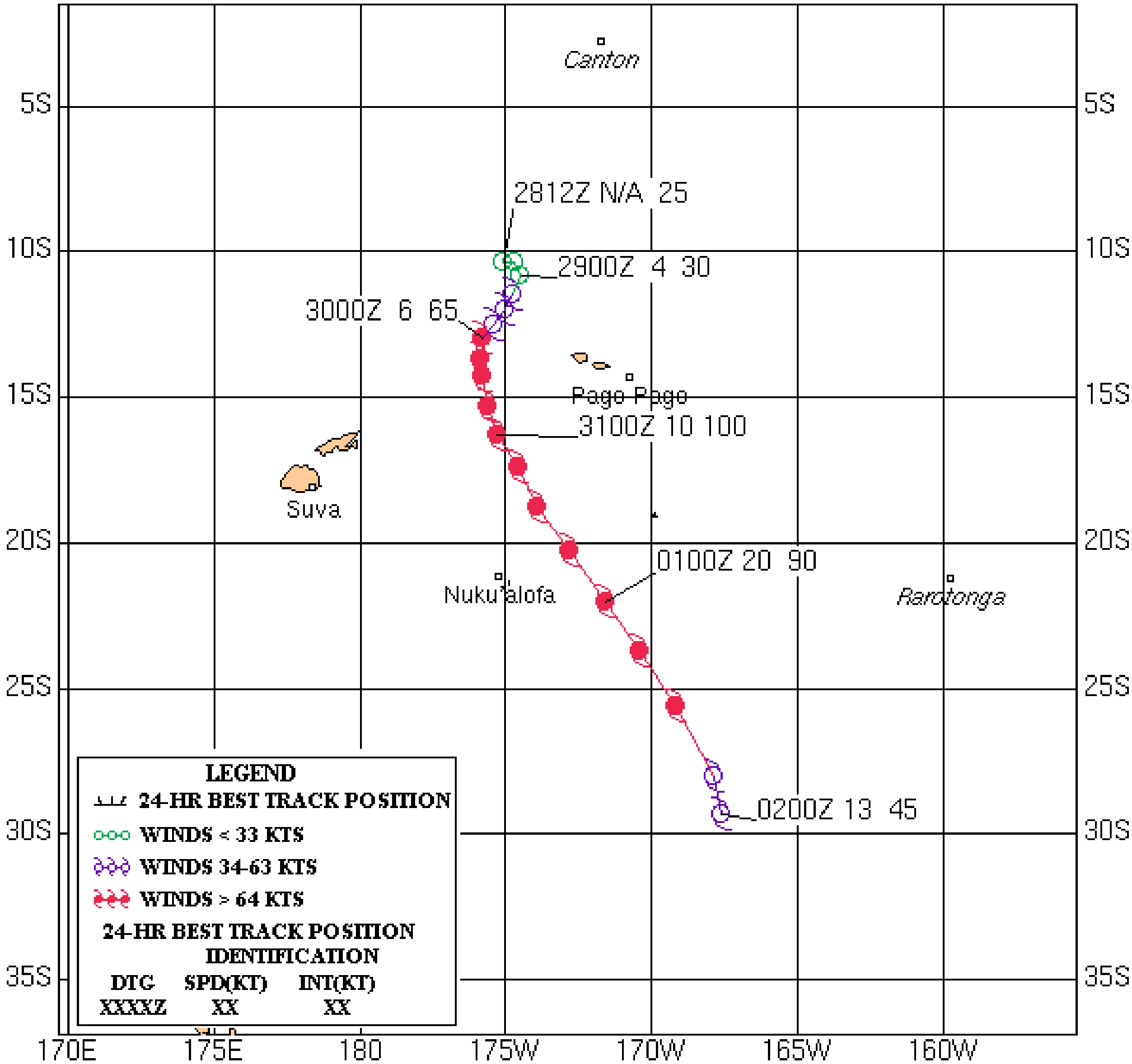



Figure 2-07P-2. 312127Z December 2001 85 GHz SSM/I imagery of TC 07P (Waka) depicting a partial eyewall. Note that this feature is not as evident in Figure 2-07P-01 which was at nearly the same time.

TROPICAL CYCLONE 07P (WAKA)
29 DECEMBER 2001 - 02 JANUARY 2002



# Tropical Cyclone (TC) 08S (Cyprien*)

Verification Statistics

First Poor : 2230Z 29 Dec 01
First Fair : None
First TCFA : 0900Z 31 Dec 01
First Warning : 0600Z 01 Jan 02
Last Warning : 1800Z 02 Jan 02
Max Intensity : 50 kts, gusts to 65 kts
Landfall : north of Toliara, Madagascar
Total Warnings : 4
Remarks :
(1) Tropical Cyclone 08S initially tracked eastward as a weak tropical disturbance as it emerged from Mozambique. The disturbance slowly developed to moderate tropical cyclone strength over the warm waters of the Mozambique Channel before making landfall north of Toliara, Madagascar.
(2) Tropical Cyclone 08S caused significant damage and flooding in Southwest Madagascar. The United Nations Integrated Regional Information Network reported that approximately two thousand residents were affected and damage was estimated at 181,000 dollars.

*Name assigned by RSMC La Reunion

TC 18S Hary

TC 19P

TC 20S Ikala

TC 21S Dianne-Jery

TC 22S Bonnie

TC 23S Kesiny

TC 24S Errol

TC 25P Upia

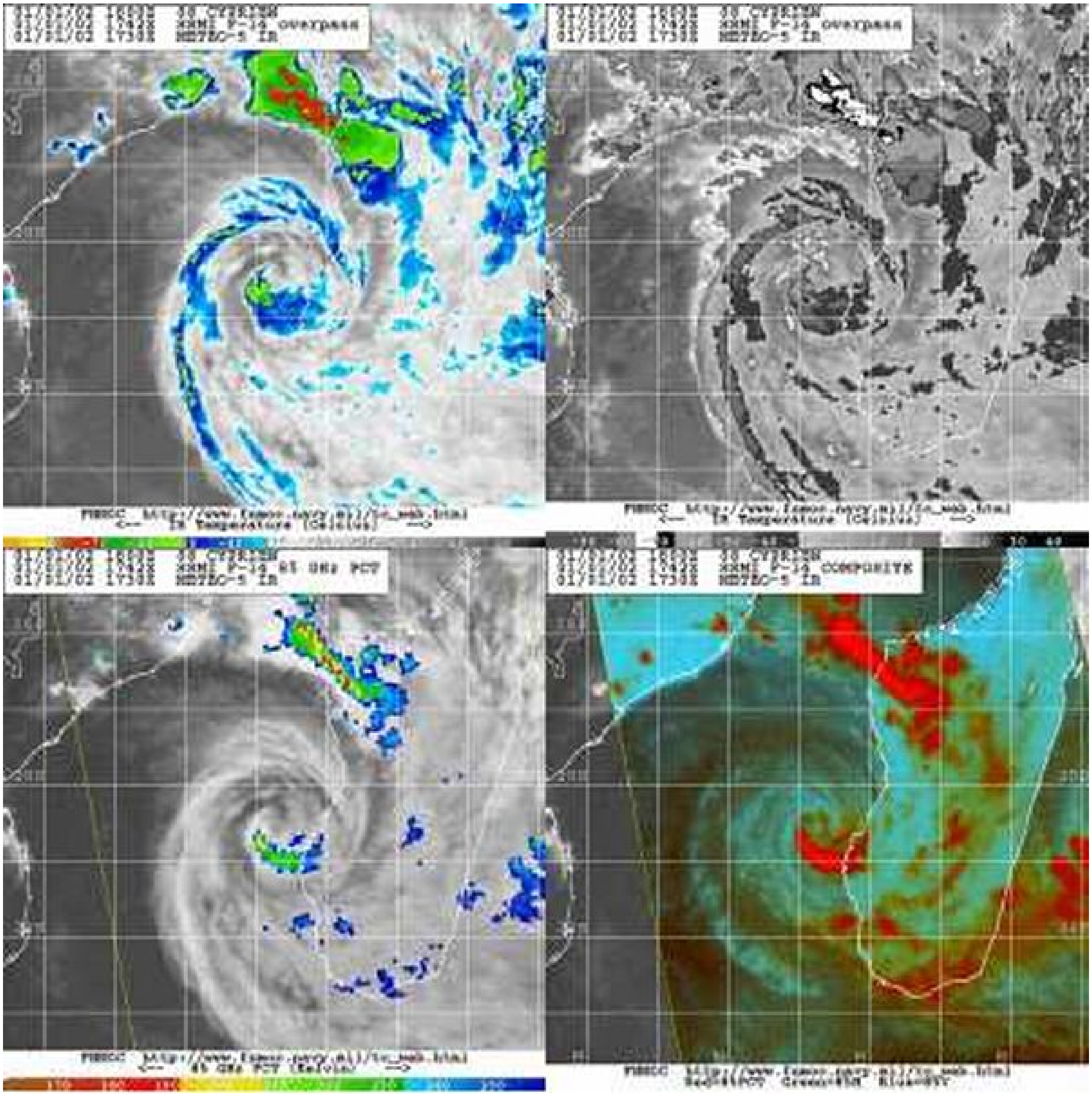
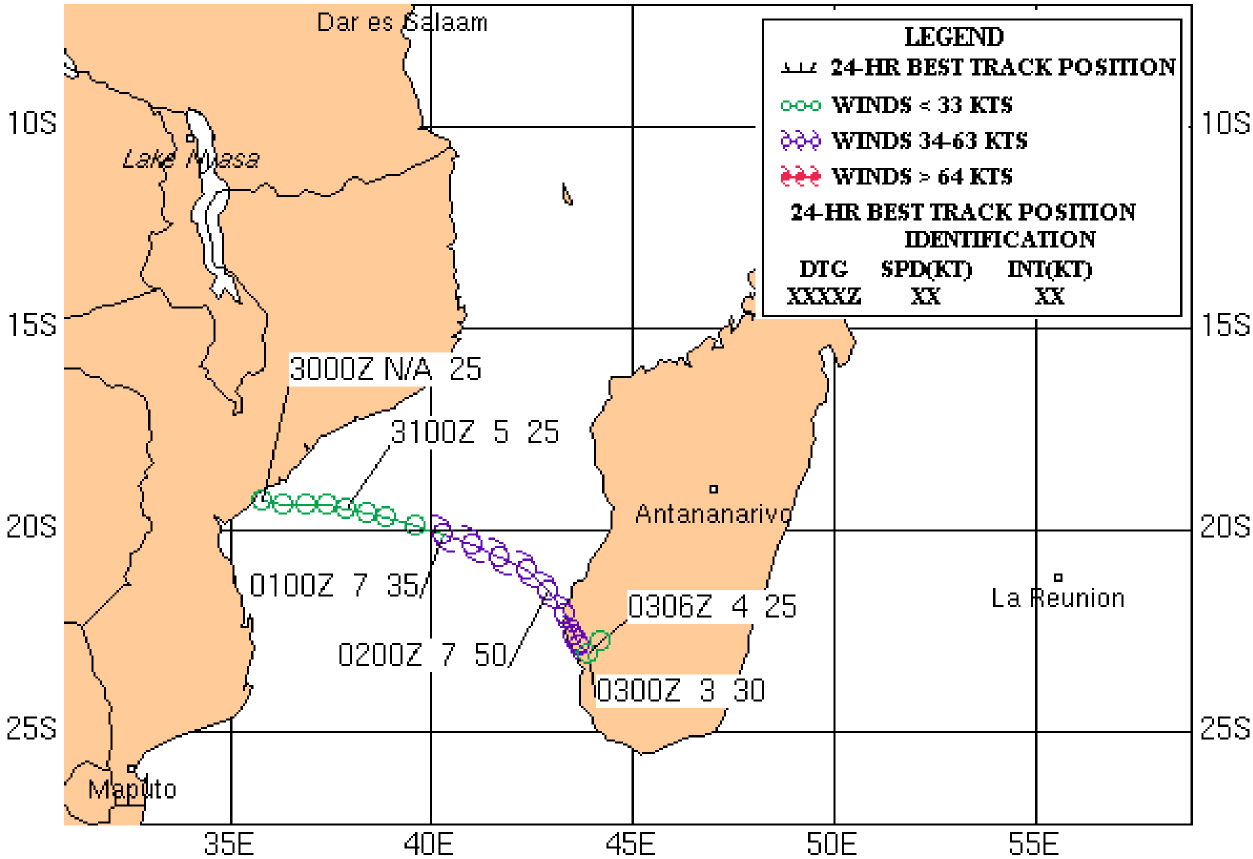


Figure 2-08S-1. 011743Z January 2002 multi-sensor imagery of TC 08S (Cyprien) west of Madagascar with an estimated intensity of 50 knots.

# TROPICAL CYCLONE 08S (CYPRIEN)
## 01 - 02 JANUARY 2002



# Tropical Cyclone (TC) 09P (Bernie*)

Verification Statistics

First Poor : 1700Z 30 Dec 01
First Fair : 0600Z 31 Dec 01
First TCFA : 0800Z 02 Jan 02
First Warning : 0600Z 03 Jan 02
Last Warning : 0600Z 04 Jan 02
Max Intensity : 45 kts, gusts to 55 kts
Landfall : Massacre Inlet, Queensland, Australia
Total Warnings : 3
Remarks :
(1) TC 09P developed as a weak tropical disturbance in central Gulf of Carpenteria in a moderate vertical wind shear environment. It slowly tracked southward attaining maximum intensity before making landfall near Massacre Inlet, Queensland.

*Name assigned by Brisbane TCWC

TC 18S Hary

TC 19P

TC 20S Ikala

TC 21S Dianne-Jery

TC 22S Bonnie

TC 23S Kesiny

TC 24S Errol

TC 25P Upia

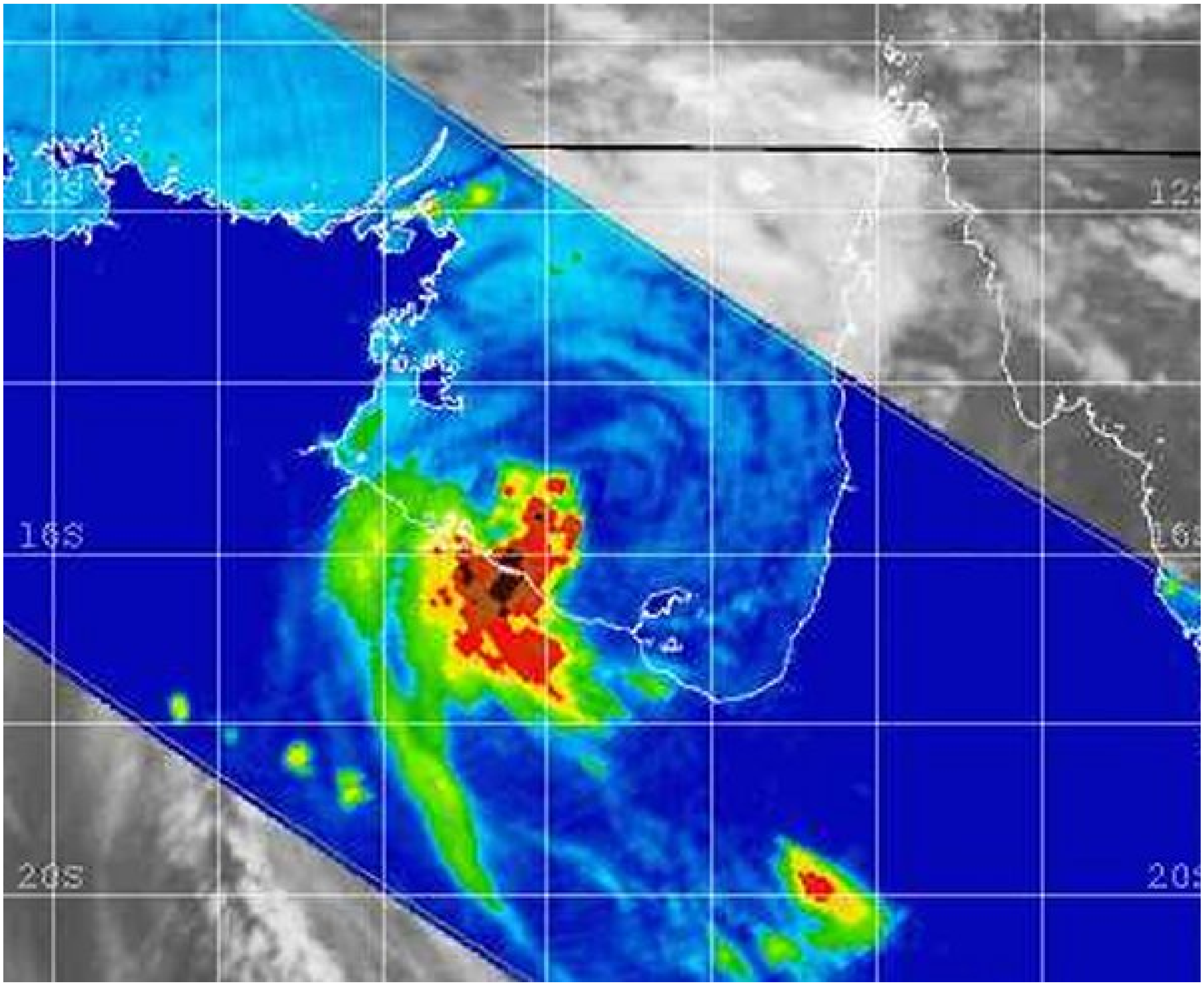
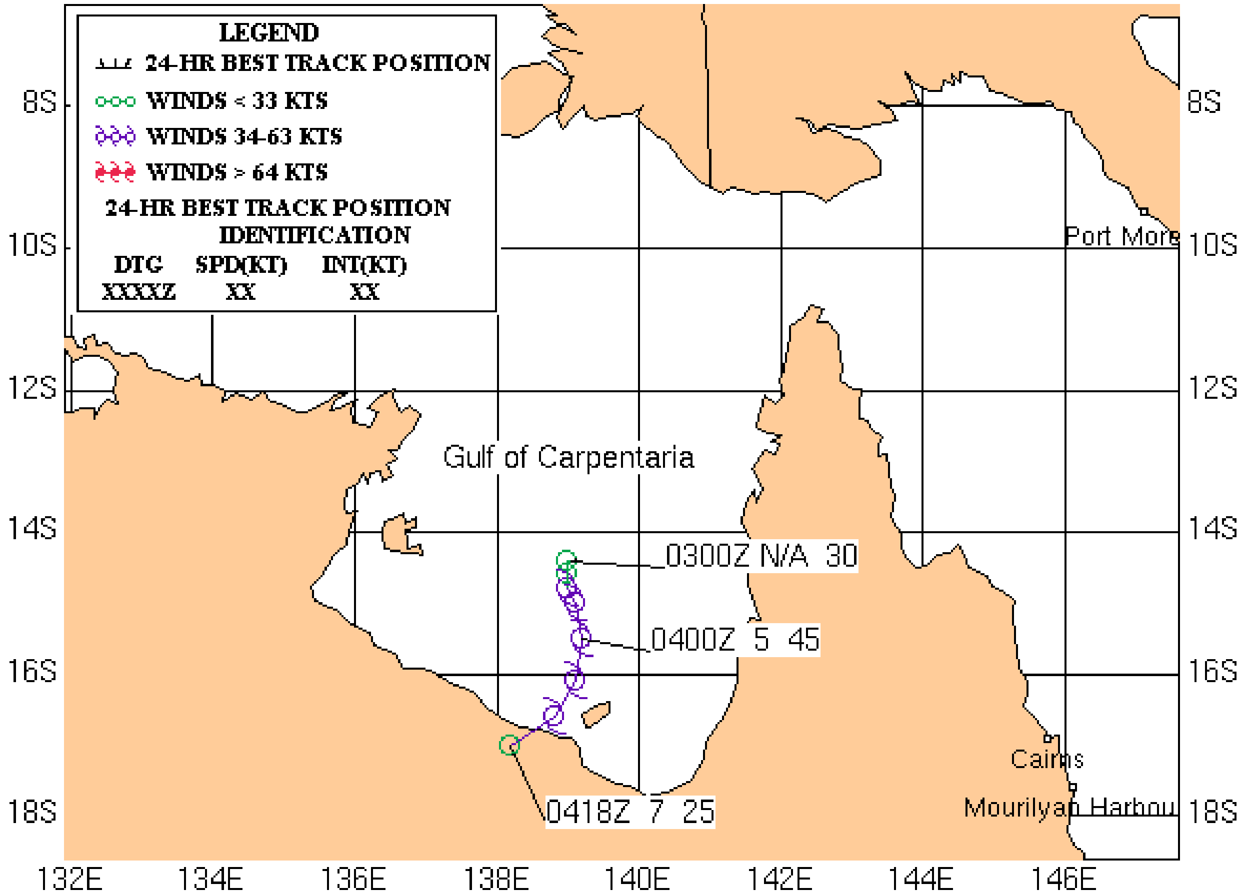



Figure 2-09P-2. 032004Z January 2002 85 GHz TRMM imagery of TC 09P (Bernie) in the Gulf of Carpentaria with an estimated intensity of 45 knots. At this time, TC 09P was experiencing easterly vertical wind shear.

# TROPICAL CYCLONE 09P (BERNIE)
## 03 - 04 JANUARY 2002



Print Friendly (PDF)



# Tropical Cyclone (TC) 10S (Dina*)

Verification Statistics

First Poor : 1800Z 15 Jan 02
First Fair : 1800Z 16 Jan 02
First TCFA : 0630Z 17 Jan 02
First Warning : 1800Z 17 Jan 02
Last Warning : 1800Z 24 Jan 02
Max Intensity : 130 kts, gusts to 160 kts
Landfall : None
Total Warnings : 15
Remarks :
(1) TC 10S developed southeast of Diego Garcia in a high vertical shear environment, and eventually attained maximum intensity on 20 January as it tracked northeast of Mauritius and La Reunion in the South Indian Ocean. It passed approximately 35 nm north of Mauritius and 50 nm northwest of La Reunion Island as an intense tropical cyclone.
(2) Both islands were spared from the system's maximum winds as the eyewall just missed them to the north. Wind gusts were recorded as high as 124 knots on Mauritius, and an elevated station on La Reunion recorded a peak gust of 151 knots.
(3) Subtantial damage was reported on both islands to homes, schools, utilities, and agriculture at a cost of approximately 190 million dollars. Record rains triggered landslides closing roads and businesses. Five casualties were reported on Mauritius, while no casualties were reported on La Reunion.

*Name assigned by RSMC La Reunion

TC 18S Hary

TC 19P

TC 20S Ikala

TC 21S Dianne-Jery

TC 22S Bonnie

TC 23S Kesiny

TC 24S Errol

TC 25P Upia

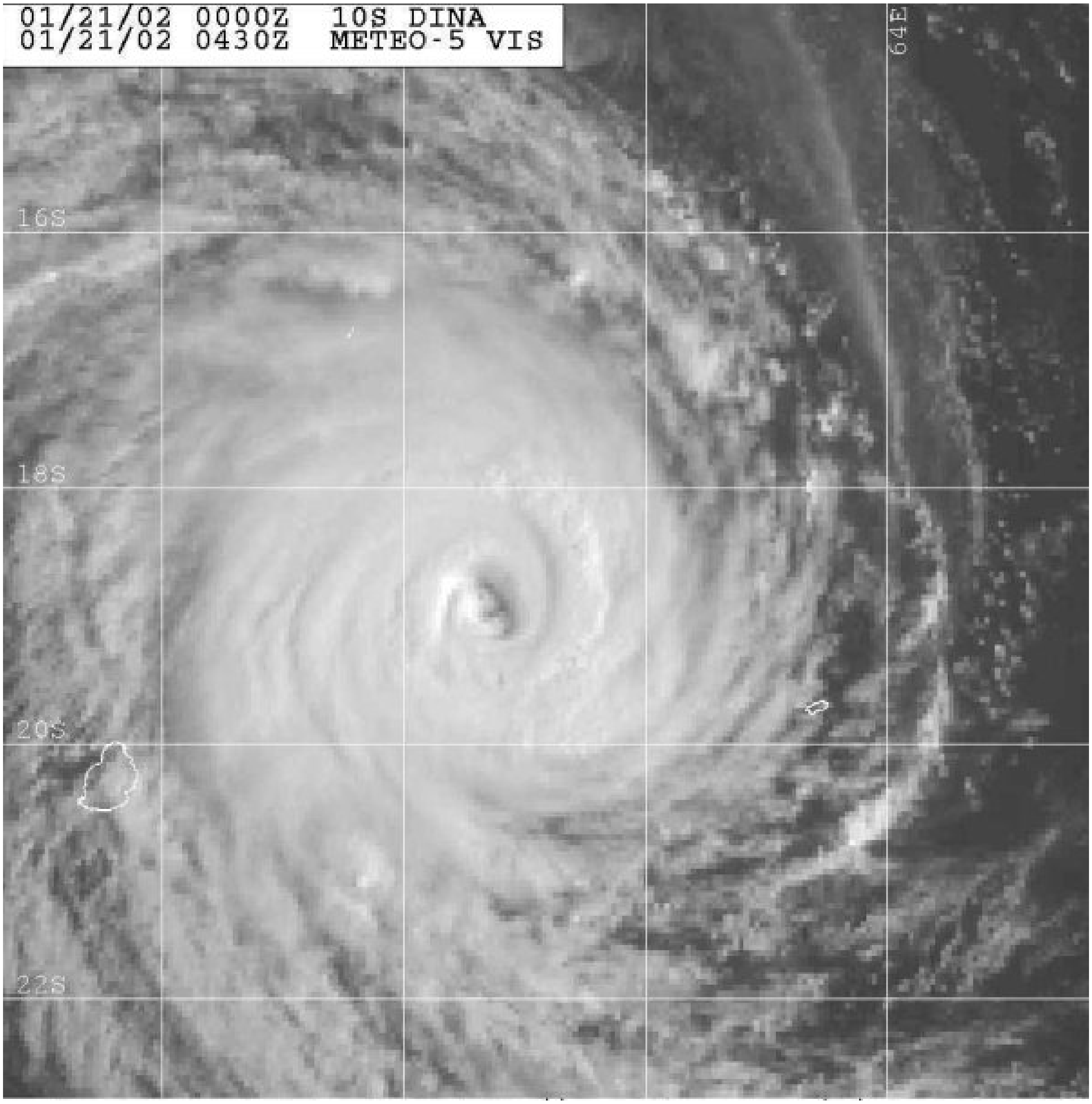



Figure 2-10S-1. 210430Z January 2002 Met-5 Visible imagery of TC 10S (Dina) northeast of La Reunion island with an estimated intensity of 125 knots.

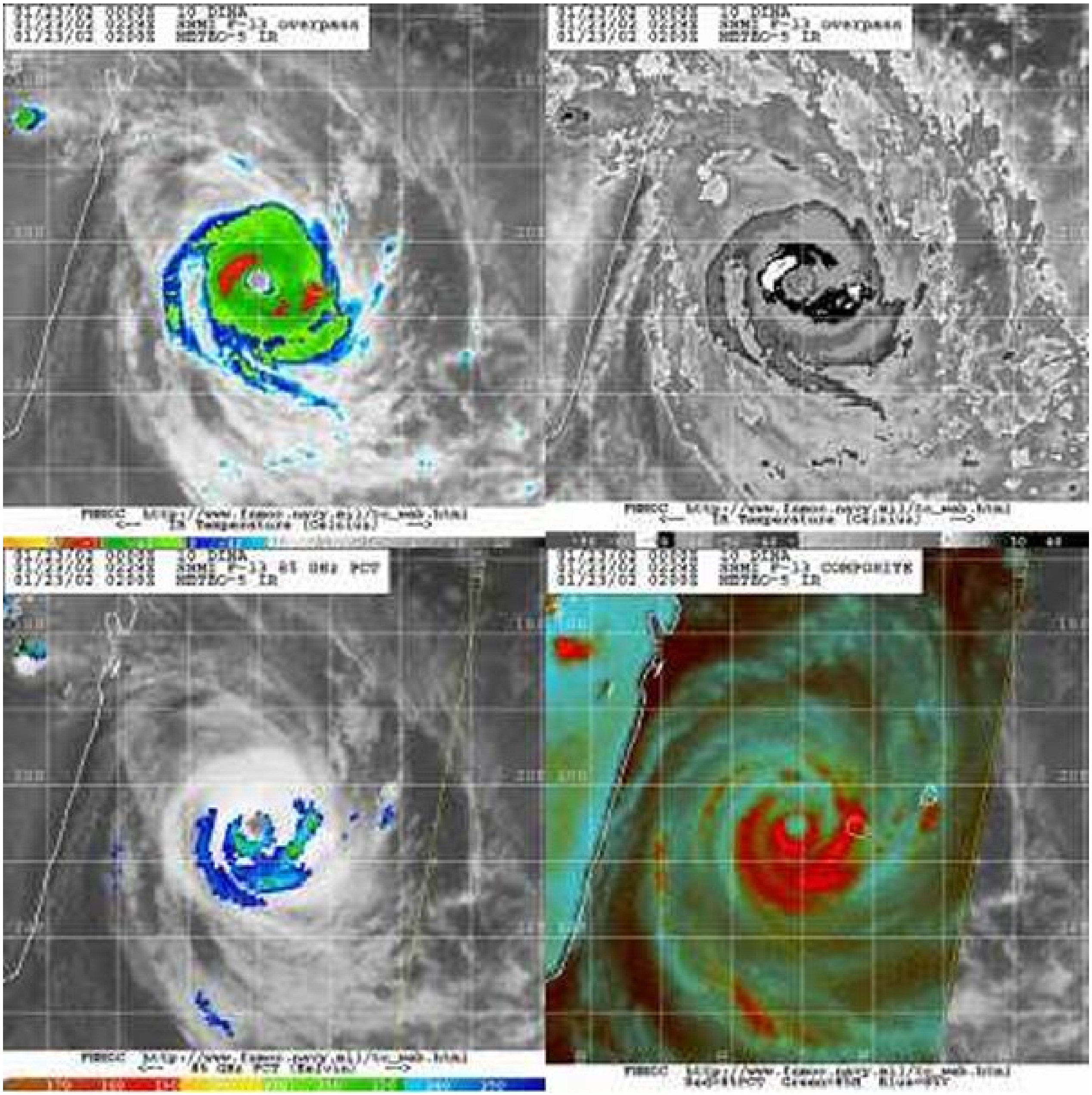
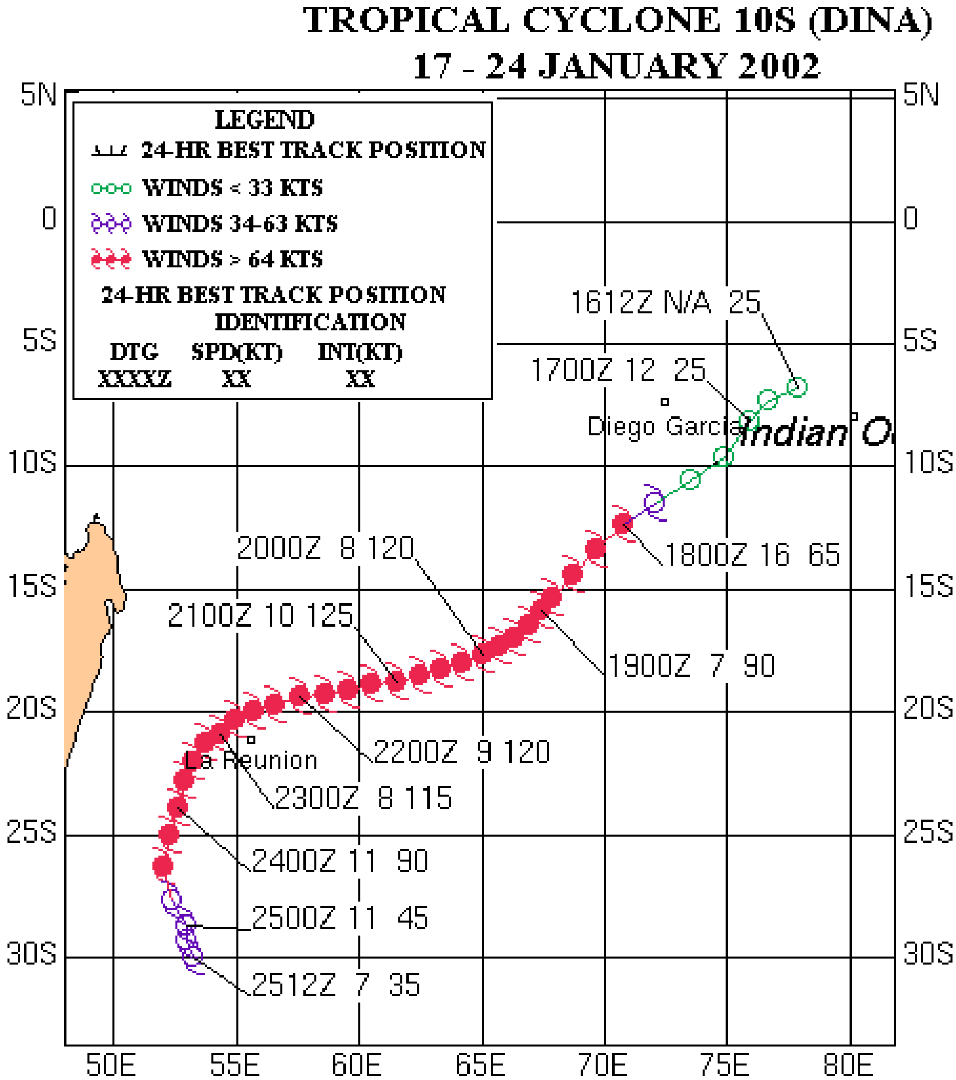


Figure 2-10S-2. 230230Z January 2002 multi-sensor imagery of TC 10S (Dina) approximately 130 nm west of La Reunion Island with an estimated intensity of 115 knots.


TROPICAL CYCLONE 10S (DINA)
17 - 24 JANUARY 2002
LEGEND
24-HR BEST TRACK POSITION
WINDS < 33 KTS
WINDS 34-63 KTS
WINDS > 64 KTS
24-HR BEST TRACK POSITION IDENTIFICATION
DTG SPD(KT) INT(KT)
XXXXZ XX XX
1612Z N/A 25
1700Z 12 25
Diego Garcia
Indian O
1800Z 16 65
1900Z 7 90
2000Z 8 120
2100Z 10 125
2200Z 9 120
2300Z 8 115
2400Z 11 90
2500Z 11 45
2512Z 7 35
La Reunion
5N
0
5S
10S
15S
20S
25S
30S
50E
55E
60E
65E
70E
75E
80E

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# Tropical Cyclone (TC) 11S (Eddy*)

Verification Statistics

First Poor : 1800Z 18 Jan 02
First Fair : 0300Z 23 Jan 02
First TCFA : 1400Z 23 Jan 02
First Warning : 0600Z 24 Jan 02
Last Warning : 0600Z 28 Jan 02
Max Intensity : 75 kts, gusts to 90 kts
Landfall : None
Total Warnings : 9
Remarks : None

*Name assigned by RSMC La Reunion

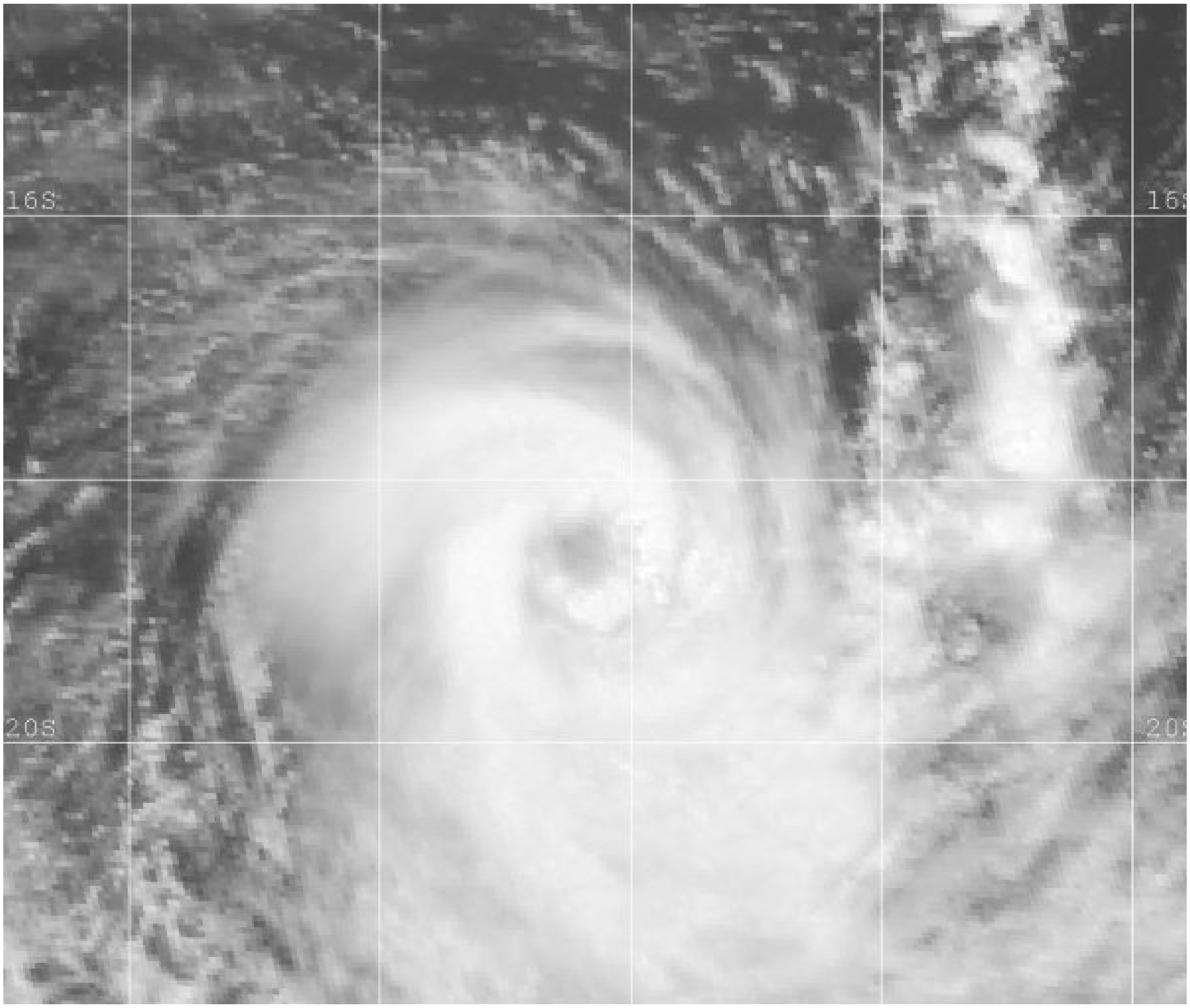



Figure 2-11S-1. 260730Z January 2002 Met-5 Visible imagery of TC 11S (Eddy) in the South Indian Ocean with an estimated intensity of 65 knots.

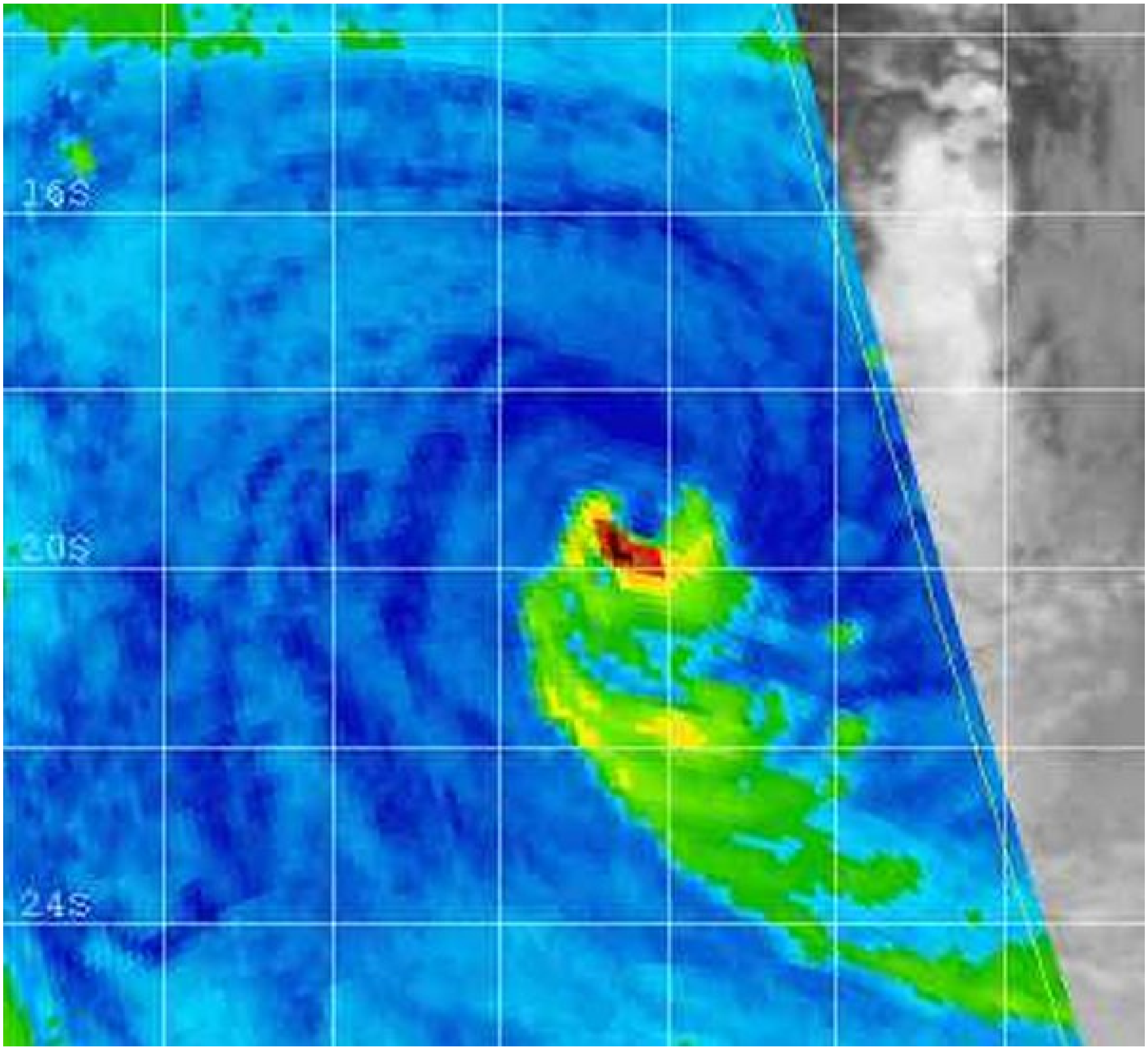
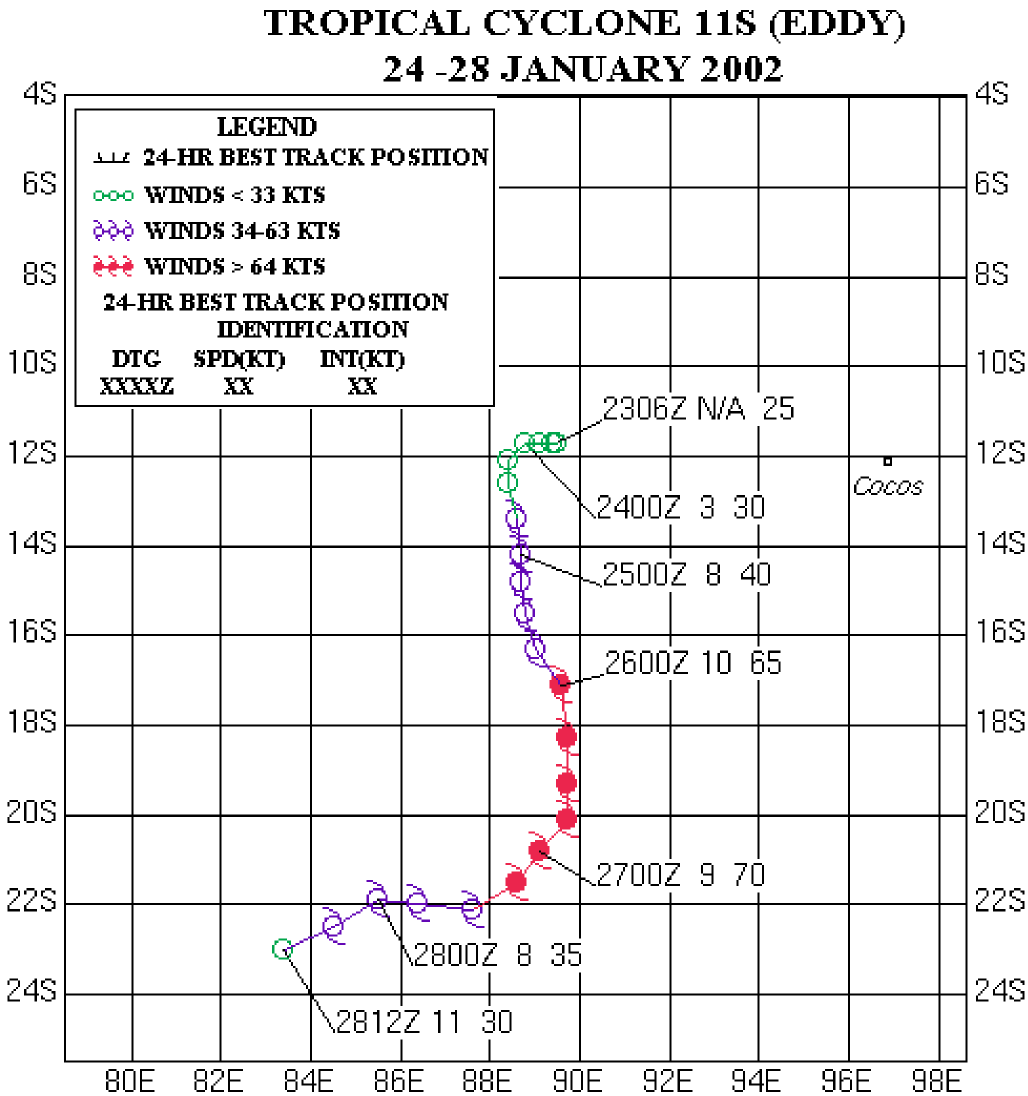



Figure 2-11S-2. 261240Z January 2002 85 GHz SSM/I imagery of TC 11S (Eddy) revealing a partial eyewall in the South Indian Ocean with an estimated intensity of 70 knots.


TROPICAL CYCLONE 11S (EDDY)
24 -28 JANUARY 2002
LEGEND
24-HR BEST TRACK POSITION
WINDS < 33 KTS
WINDS 34-63 KTS
WINDS > 64 KTS
24-HR BEST TRACK POSITION IDENTIFICATION
DTG SPD(KT) INT(KT)
XXXXZ XX XX
2306Z N/A 25
2400Z 3 30
2500Z 8 40
2600Z 10 65
2700Z 9 70
2800Z 8 35
2812Z 11 30
Cocos
4S
6S
8S
10S
12S
14S
16S
18S
20S
22S
24S
80E
82E
84E
86E
88E
90E
92E
94E
96E
98E

# Tropical Cyclone (TC) 12S (Francesca*)

Verification Statistics

First Poor : 0130Z 29 Jan 02
First Fair : 1800Z 30 Jan 02
First TCFA : 0200Z 01 Feb 02
First Warning : 1800Z 01 Feb 02
Last Warning : 1800Z 11 Feb 02
Max Intensity : 115 kts, gusts to 140 kts
Landfall : None
Total Warnings : 21
Remarks : None

*Name assigned by RSMC La Reunion

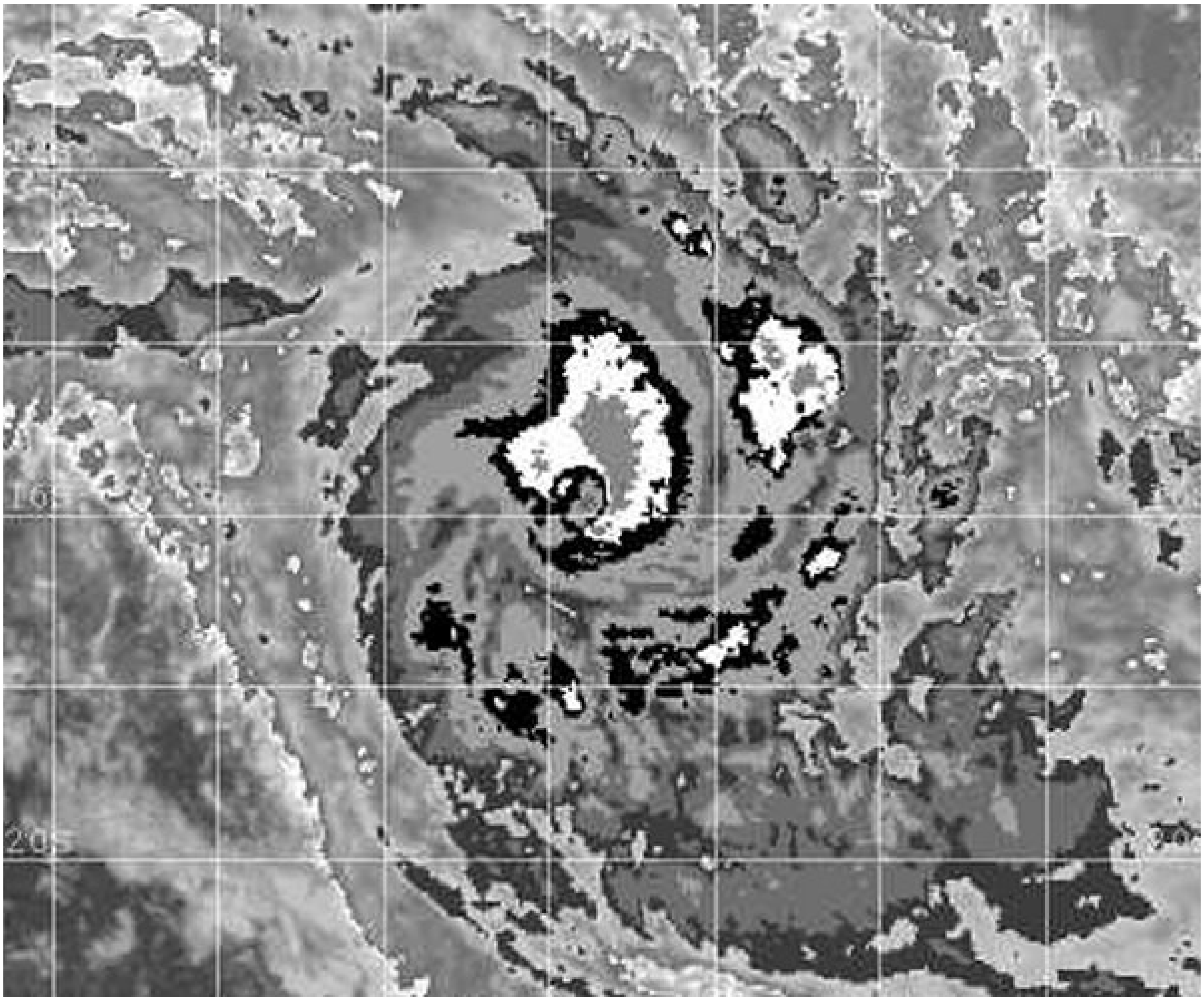



Figure 2-12S-1. 050114Z February 2002 Met-5 enhanced infrared imagery of TC 12S (Francesca) west-southwest of the Cocos islands with an estimated intensity of 110 knots.

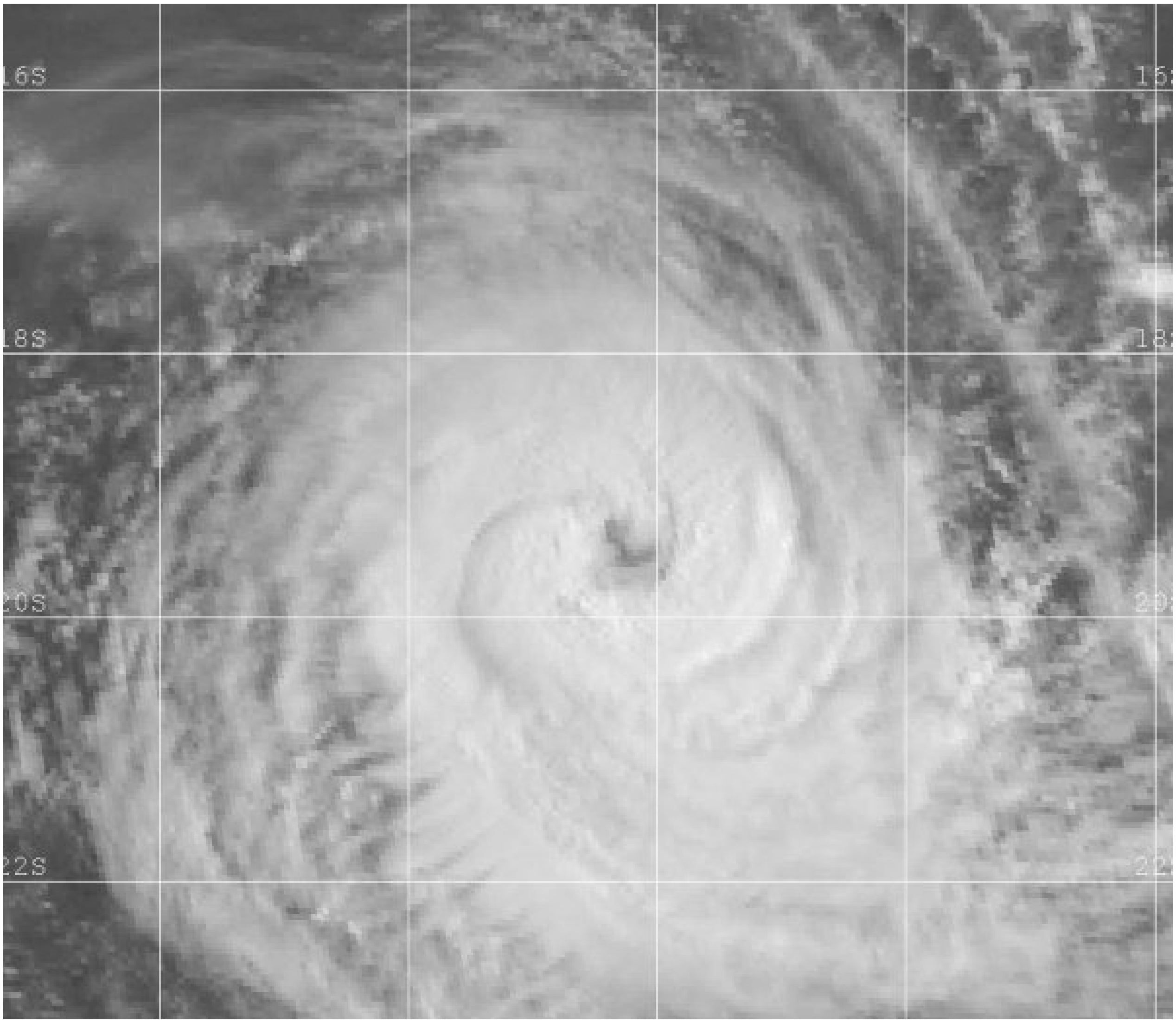
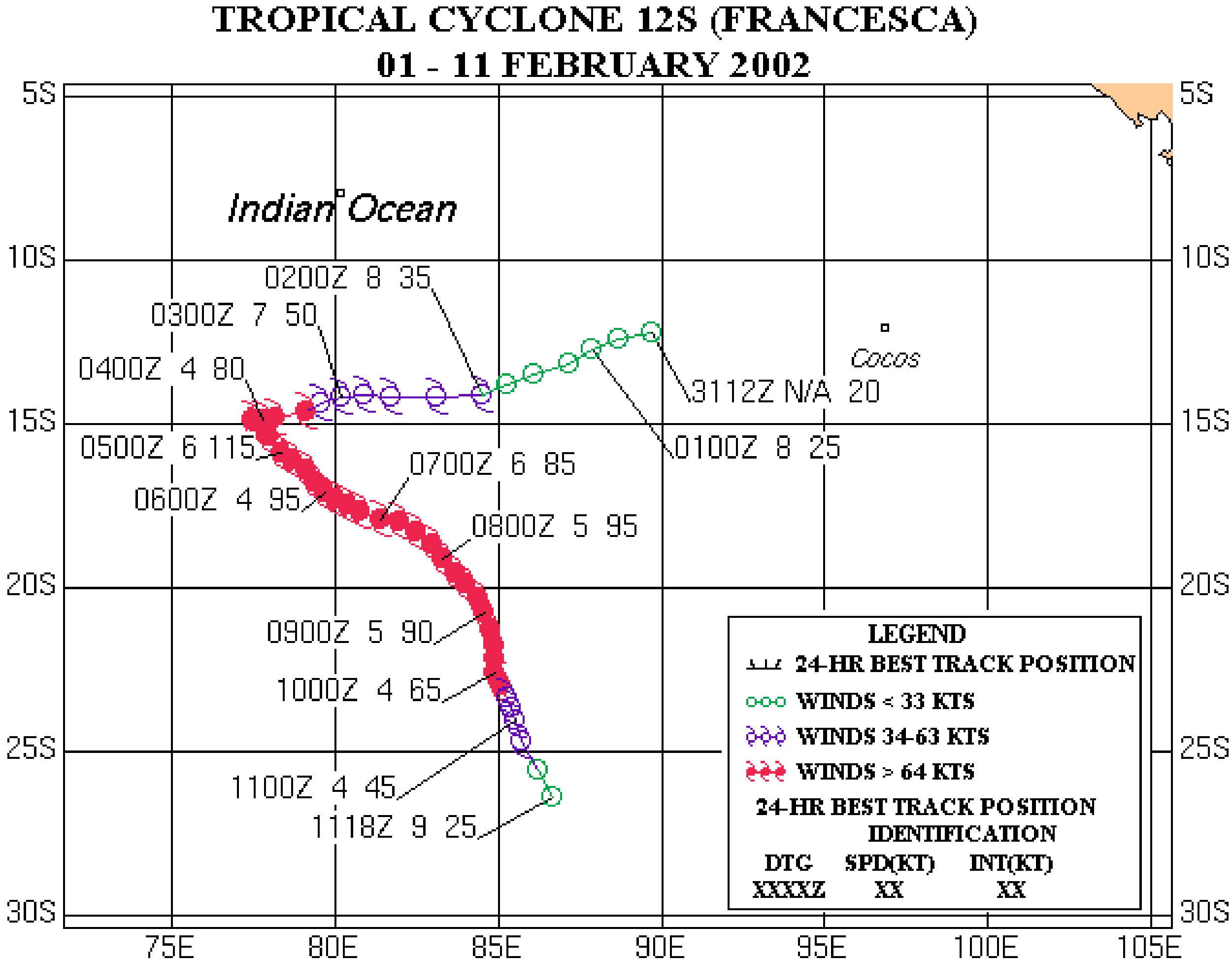



Figure 2-12S-2. 080300Z February 2002 Met-5 Visible imagery of TC 12S (Francesca) west-southwest of Cocos Island with an estimated intensity of 95 knots.


TROPICAL CYCLONE 12S (FRANCESCA)
01 - 11 FEBRUARY 2002
Indian Ocean
Cocos
0200Z 8 35
0300Z 7 50
0400Z 4 80
0500Z 6 115
0600Z 4 95
0700Z 6 85
0800Z 5 95
0900Z 5 90
1000Z 4 65
1100Z 4 45
1118Z 9 25
3112Z N/A 20
0100Z 8 25
LEGEND
24-HR BEST TRACK POSITION
WINDS < 33 KTS
WINDS 34-63 KTS
WINDS > 64 KTS
24-HR BEST TRACK POSITION IDENTIFICATION
DTG SPD(KT) INT(KT)
XXXXZ XX XX
5S
10S
15S
20S
25S
30S
75E
80E
85E
90E
95E
100E
105E

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# Tropical Cyclone (TC) 13S (Chris*)

Verification Statistics

First Poor : 0230Z 02 Feb 02
First Fair : 0630Z 02 Feb 02
First TCFA : 0200Z 03 Feb 02
First Warning : 0600Z 03 Feb 02
Last Warning : 1800Z 06 Feb 02
Max Intensity : 125 kts, gusts to 150 kts
Landfall : 1800Z 05 Feb 02, Eighty Miles Beach, approximately 85 Nm east of Port Hedland
Total Warnings : 8
Remarks :
(1) TC 13S developed west-northwest of Vampi Sound, tracked south, and became one of the most intense tropical cyclones ever to make landfall in Australia.
(2) Prior to landfall, TC 13S had winds estimated as high as 150 knots. Due to the sparse population along Eighty Miles Beach, there were no human casualties, but there were reports of livestock loss and flooding due to heavy rain.
(3) TC 13S dissipated over land due to dryer air entrainment and vertical wind shear.

*Name assigned by Perth TCWC

**TC 18S Hary**

**TC 19P**

**TC 20S Ikala**

**TC 21S Dianne-Jery**

**TC 22S Bonnie**

**TC 23S Kesiny**

**TC 24S Errol**

**TC 25P Upia**

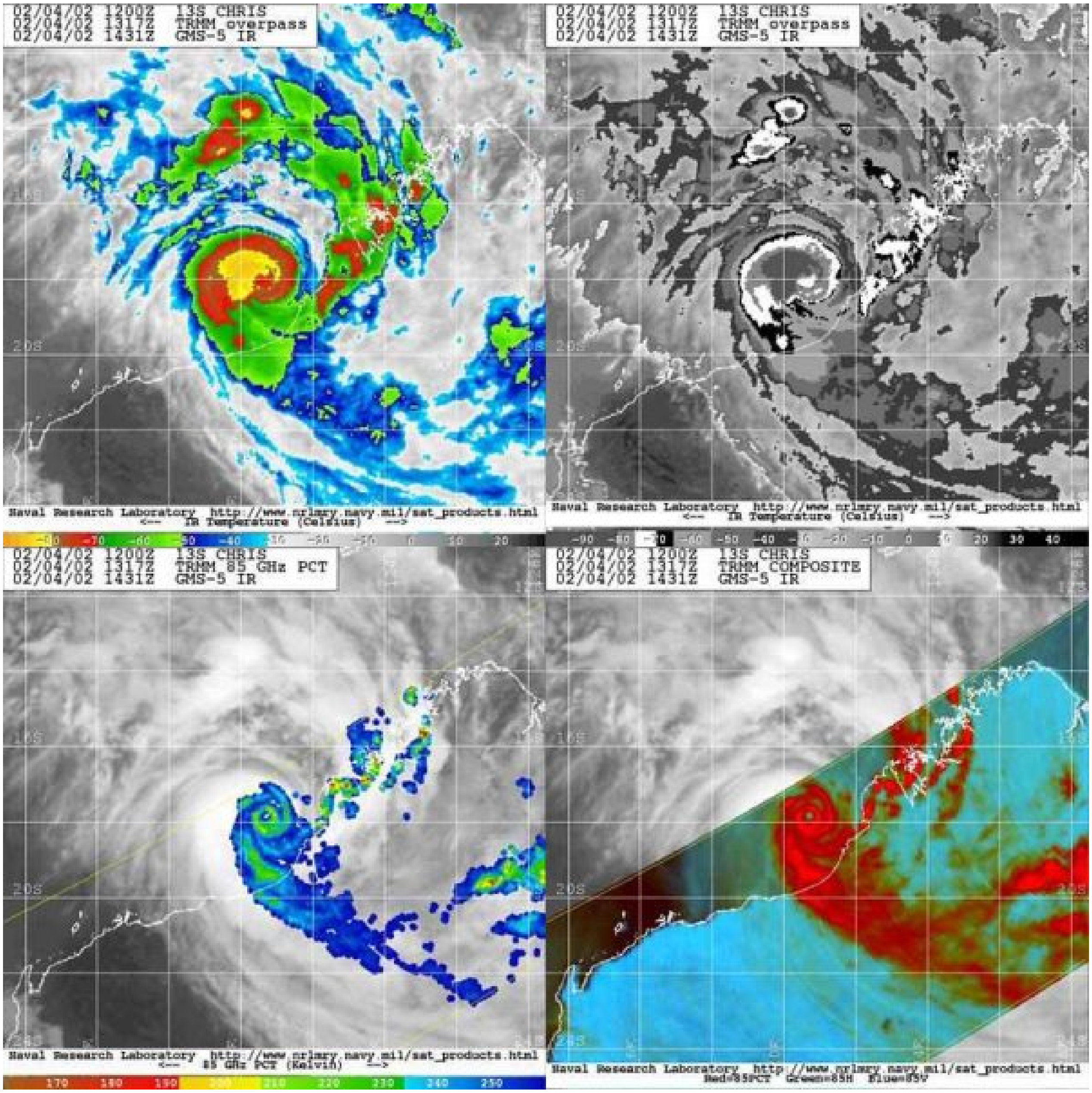



Figure 2-13S-1. 041317Z February 2002 multi-sensor imagery of TC 13S (Chris) approximately 130 nm north of Eighty Miles Beach in northwest Australia with an estimated intensity of 85 knots. The eye was visible in the 85 GHz images (lower), while the enhanced infrared images indicate no eye (top).

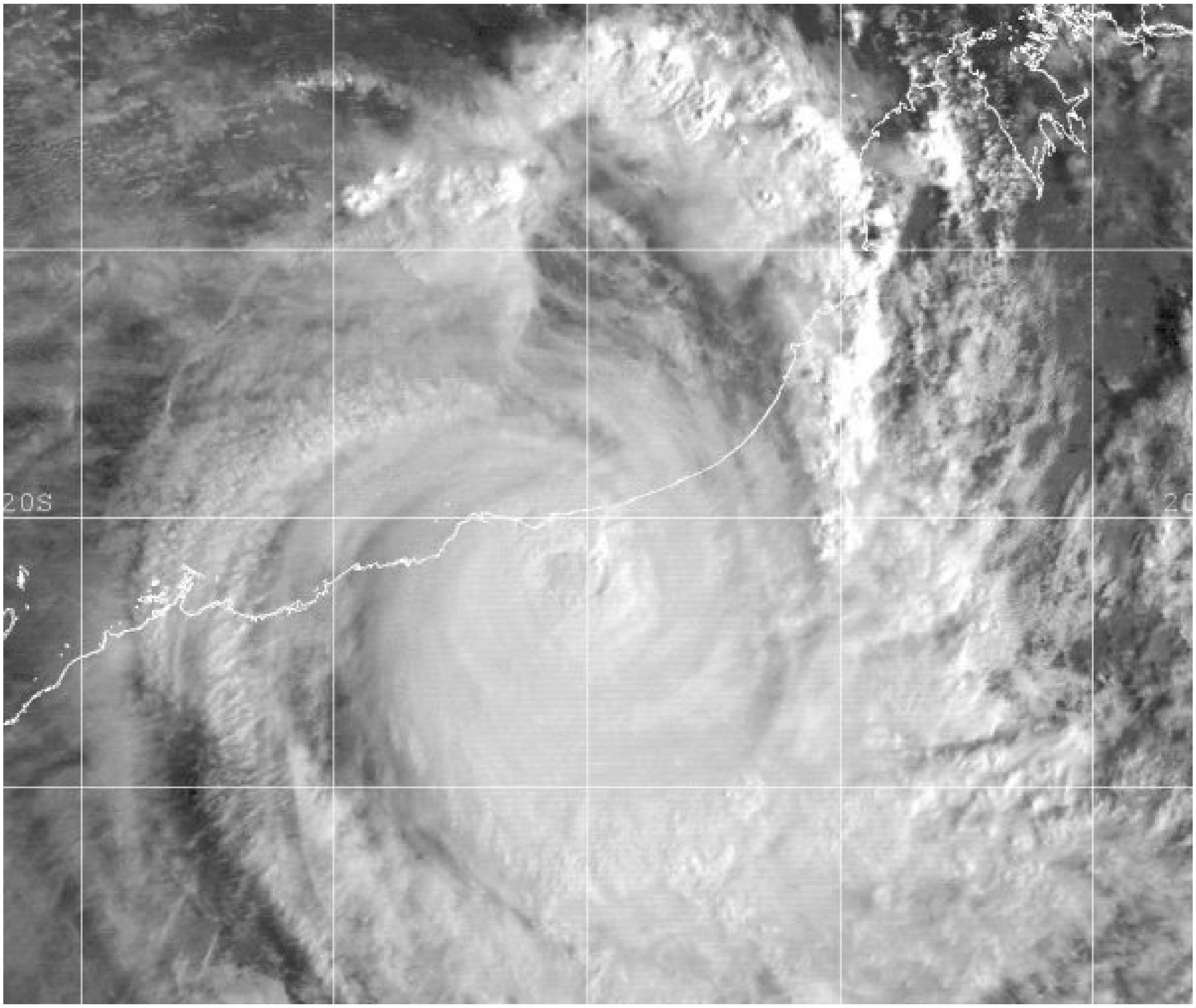
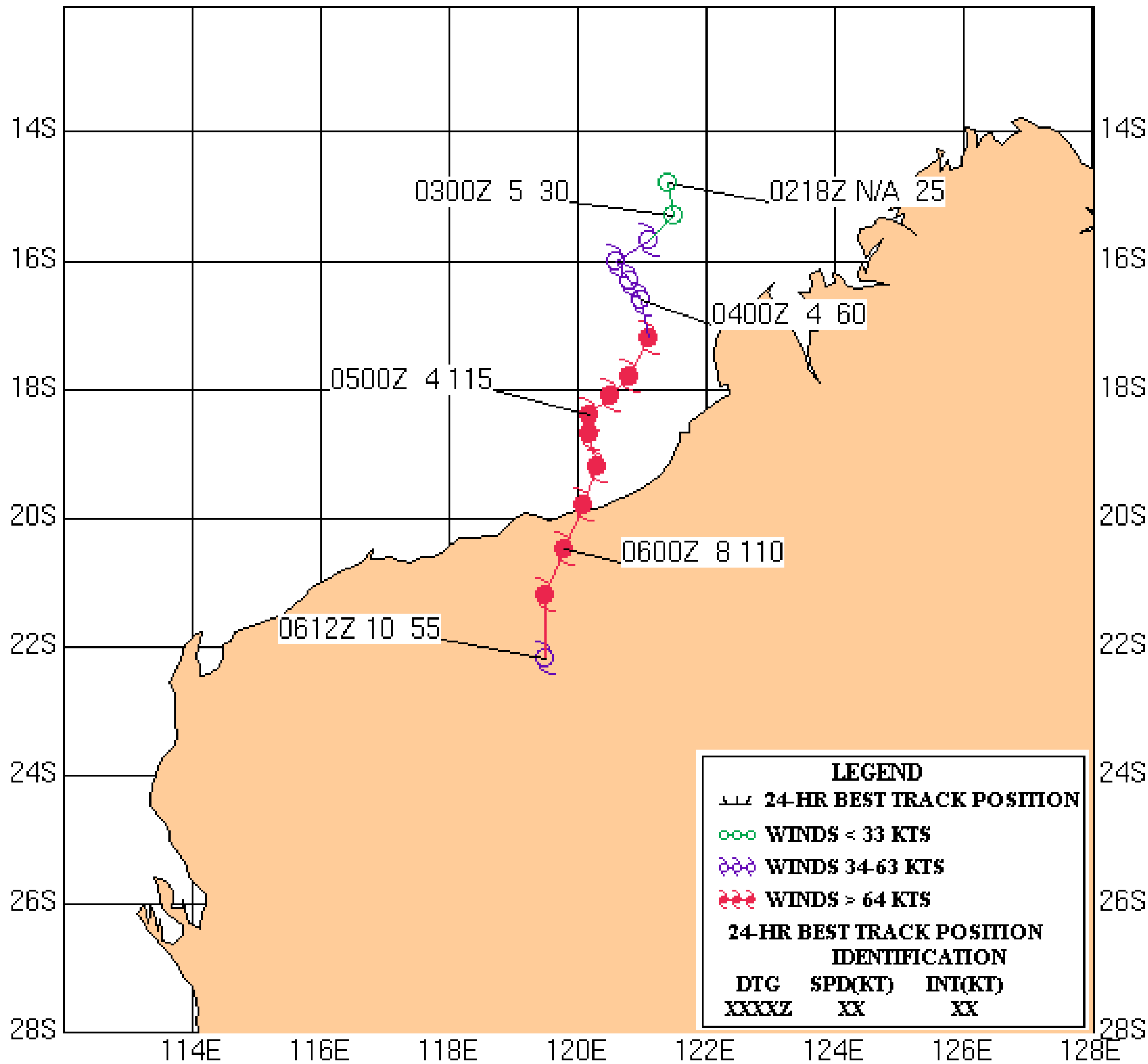



Figure 2-13S-2. 052301Z February 2002 GMS-5 visible imagery of TC 13S (Chris) just after it made landfall along Eighty Miles Beach in northwest Australia with maximum intensity of 125 knots.

## TROPICAL CYCLONE 13S (CHRIS)
## 03 - 06 FEBRUARY 2002



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# Tropical Cyclone (TC) 14P (Claudia*)

Verification Statistics

First Poor : 0600Z 09 Feb 02
First Fair : None
First TCFA : 0430Z 11 Feb 02
First Warning : 0600Z 11 Feb 02
Last Warning : 1800Z 13 Feb 02
Max Intensity : 75 kts, gusts to 90 kts
Landfall : None
Total Warnings : 9
Remarks : None

*Name assigned by Brisbane TCWC

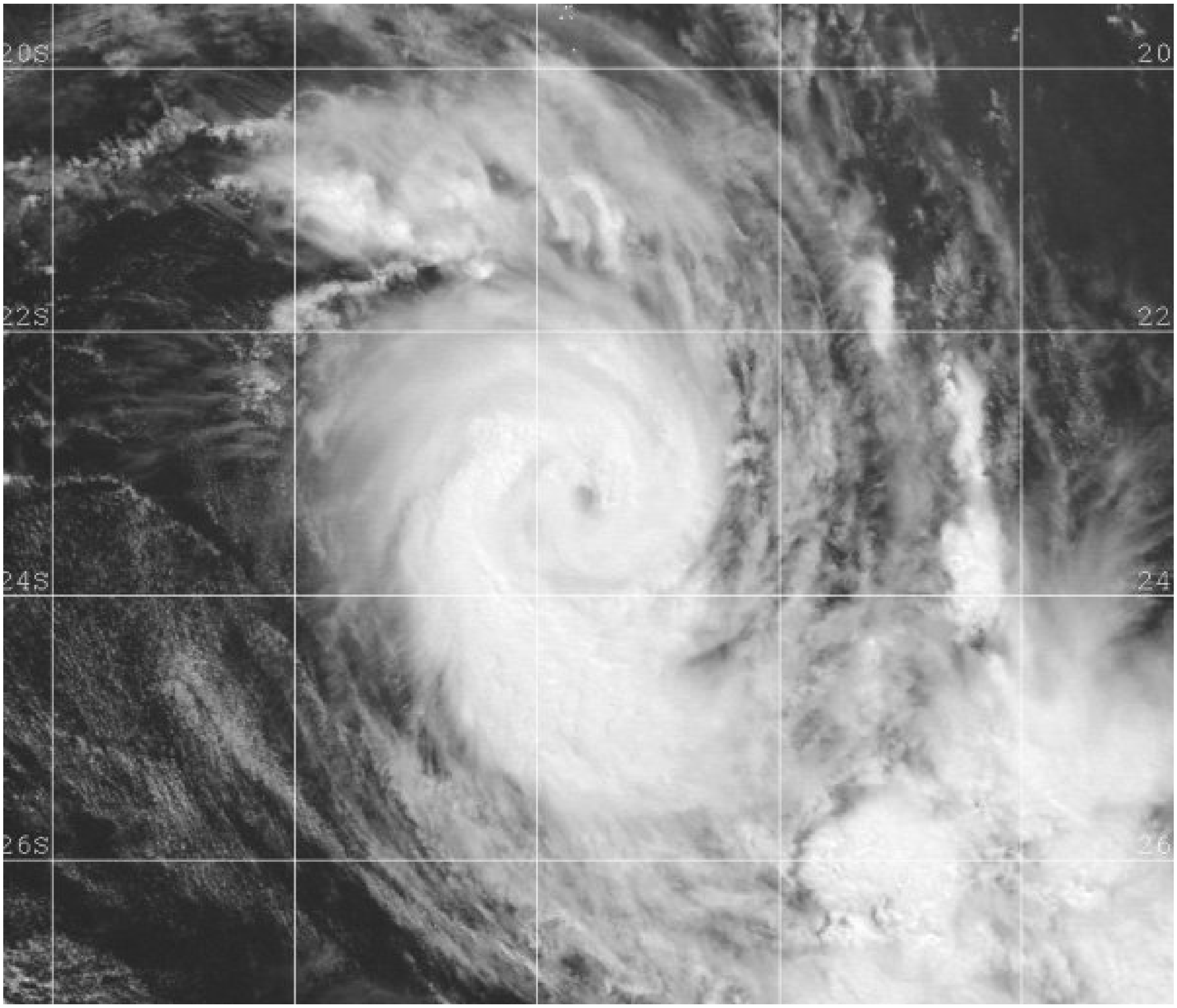



Figure 2-14P-1. 112331Z February 2002 GMS-5 Visible imagery of TC 14P (Claudia) approximately 380 nm west-southwest of New Caledonia with an estimated intensity of 70 knots.

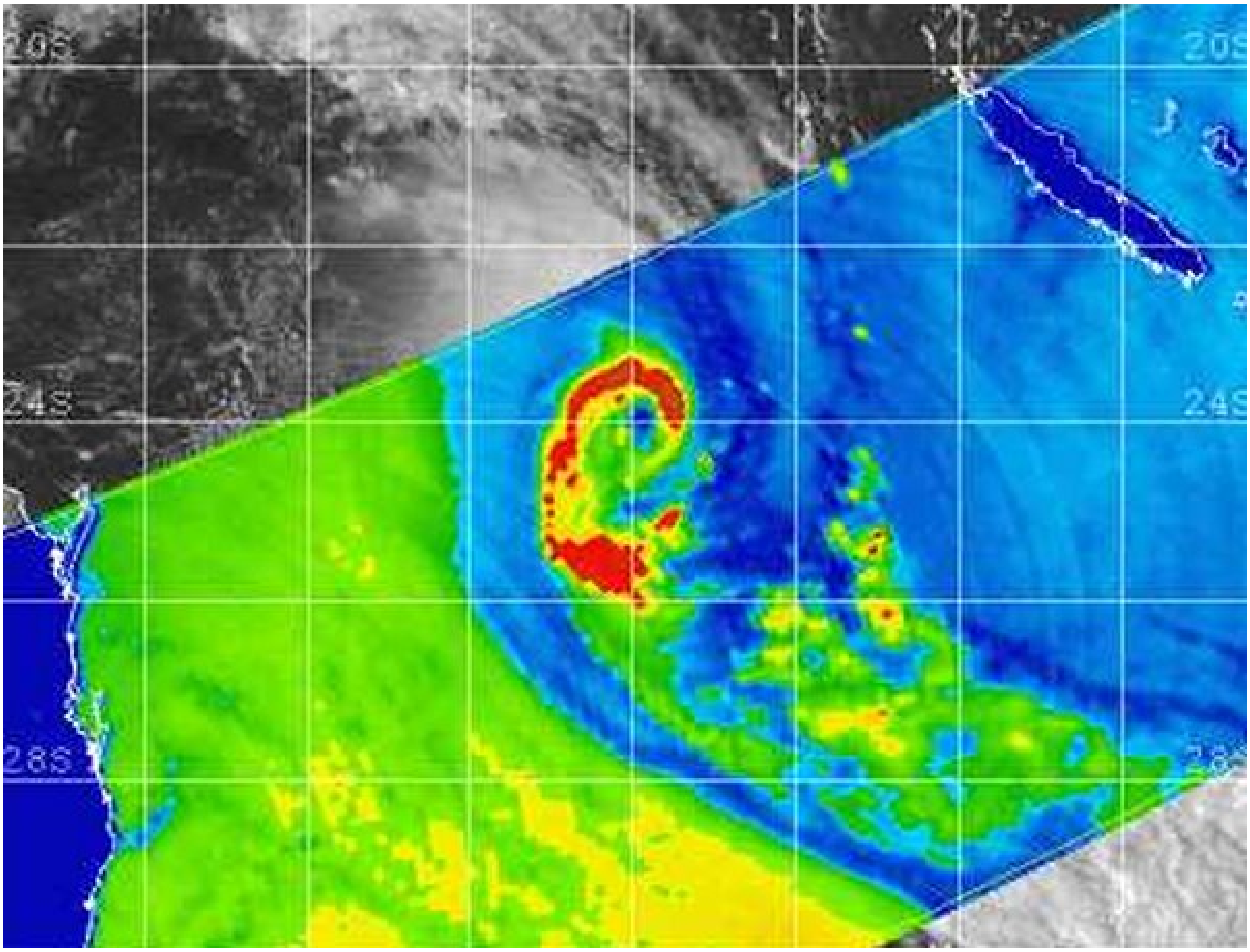
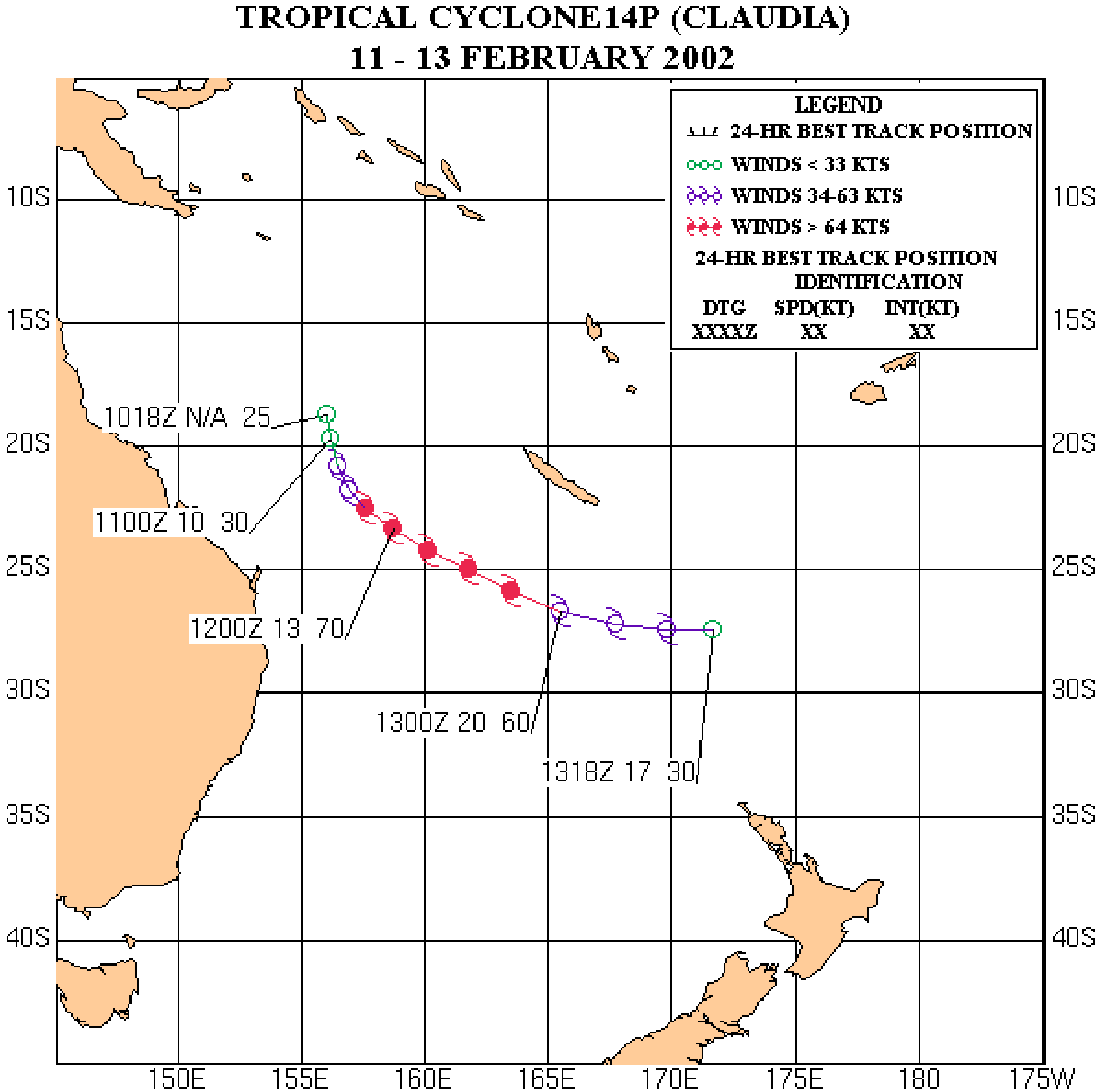



Figure 2-14P-2. 120558Z February 2002 85 GHz TRMM imagery of TC 14P (Claudia) approximately 340 nm west-southwest of New Caledonia with an estimated intensity of 75 knots.


TROPICAL CYCLONE14P (CLAUDIA)
11 - 13 FEBRUARY 2002
LEGEND
24-HR BEST TRACK POSITION
WINDS < 33 KTS
WINDS 34-63 KTS
WINDS > 64 KTS
24-HR BEST TRACK POSITION IDENTIFICATION
DTG SPD(KT) INT(KT)
XXXXZ XX XX
1018Z N/A 25
1100Z 10 30
1200Z 13 70
1300Z 20 60
1318Z 17 30
10S
15S
20S
25S
30S
35S
40S
150E
155E
160E
165E
170E
175E
180
175W

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# Tropical Cyclone (TC) 15S (Guillaume*)

Verification Statistics

First Poor : 2100Z 13 Feb 02
First Fair : 2100Z 14 Feb 02
First TCFA : 0100Z 15 Feb 02
First Warning : 1800Z 15 Feb 02
Last Warning : 1800Z 22 Feb 02
Max Intensity : 120 kts, gusts to 145 kts
Landfall : None
Total Warnings : 17
Remarks :
(1) TC 15S developed east of Madagascar, and initially tracked northeast then east as it intensified. The cyclone eventually made a southward turn in response to the mid-level ridge to the east-northeast.
(2) TC 15S attained maximum intensity as it passed within 80 nm of Mauritius while moving southward. Subsequently, the cyclone began to move more southeastward while undergoing extratropical transition.
(3) Minimal damage and no casualties were reported on Mauritius.

*Name assigned by RSMC La Reunion

**TC 18S Hary**

**TC 19P**

**TC 20S Ikala**

**TC 21S Dianne-Jery**

**TC 22S Bonnie**

**TC 23S Kesiny**

**TC 24S Errol**

**TC 25P Upia**

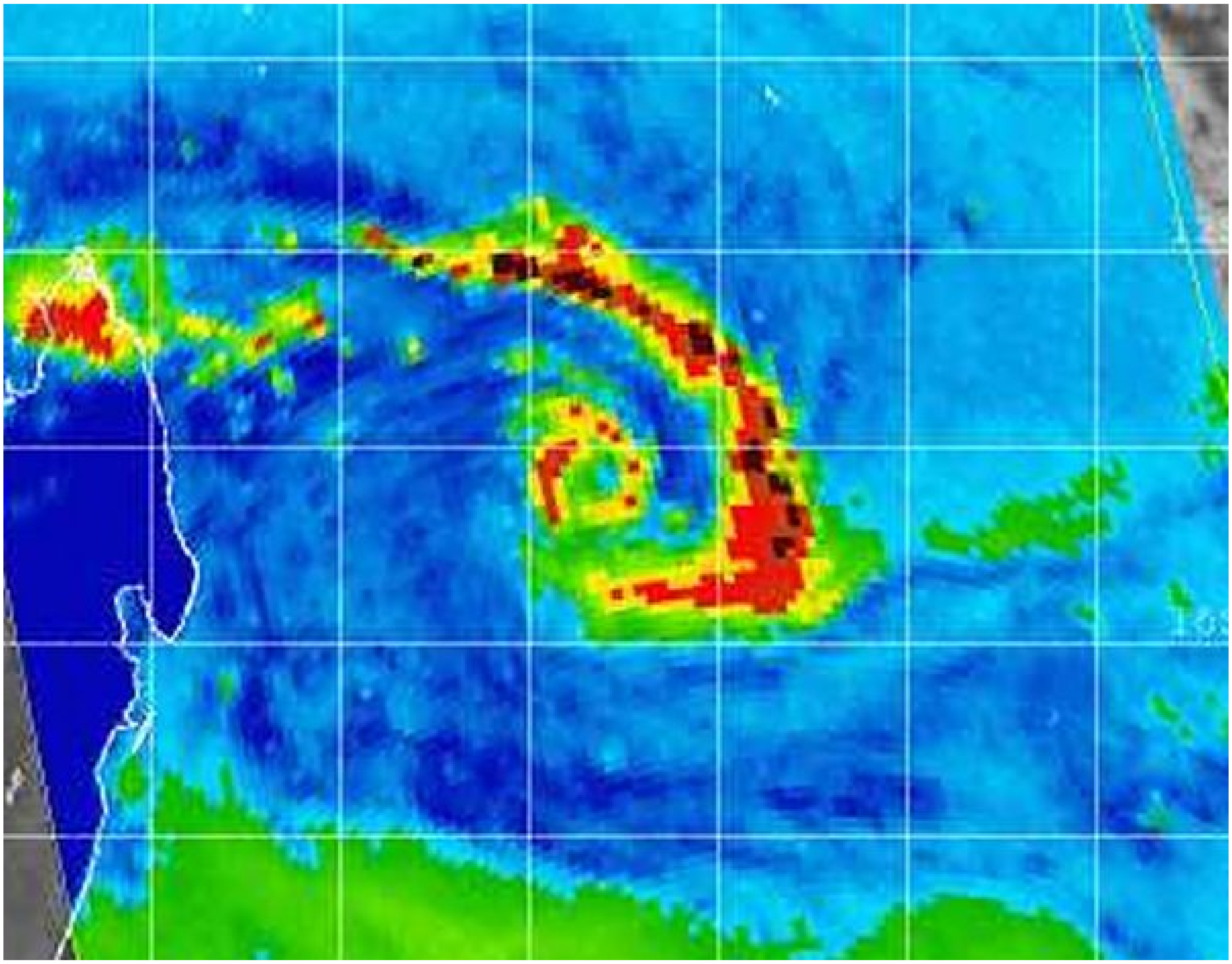


Figure 2-15S-1. 161800Z February 2002 85 GHz SSM/I imagery of TC 15S (Guillaume) approximately 260 nm east of Madagascar with an estimated maximum intensity of 50 knots.

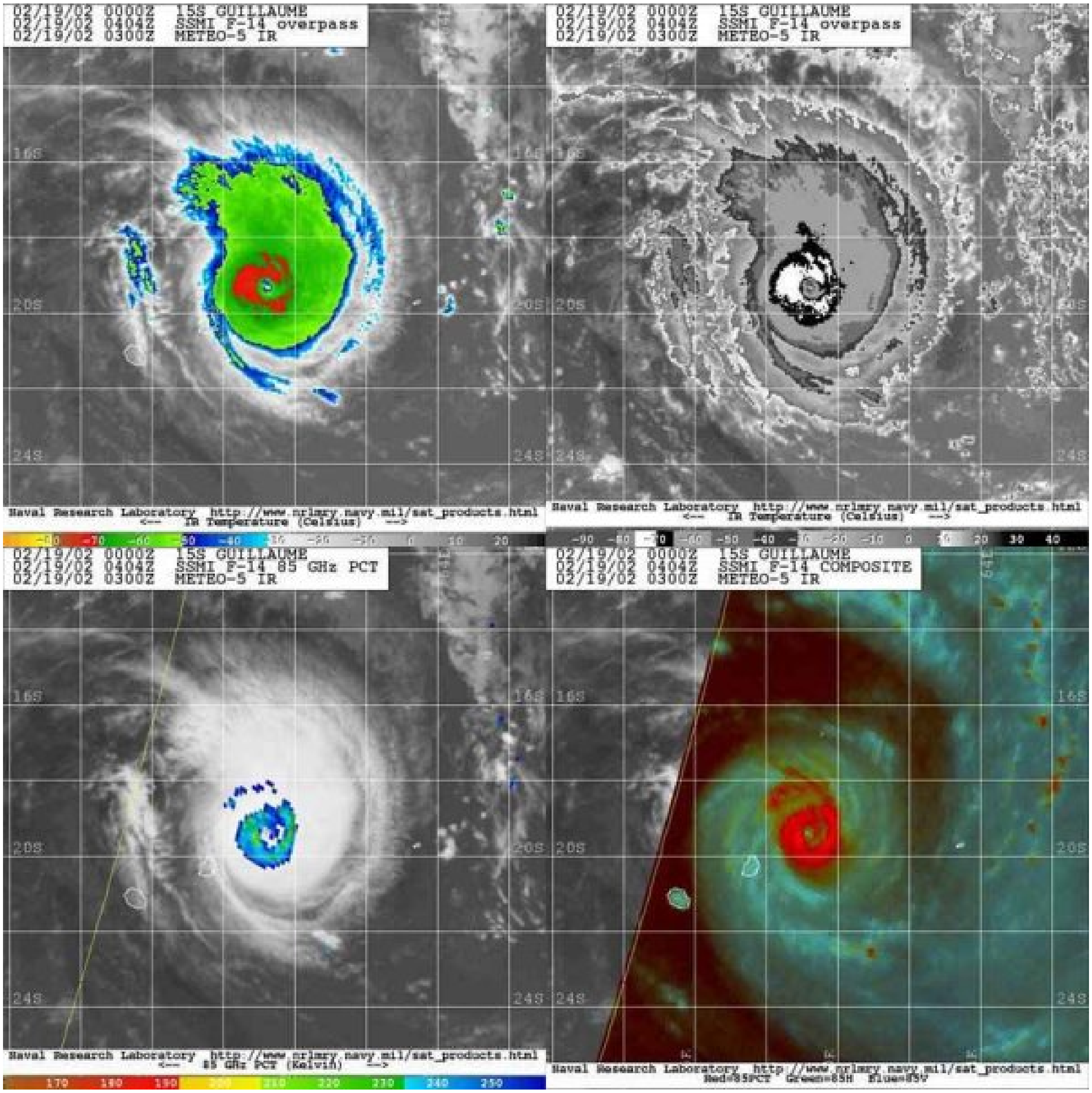
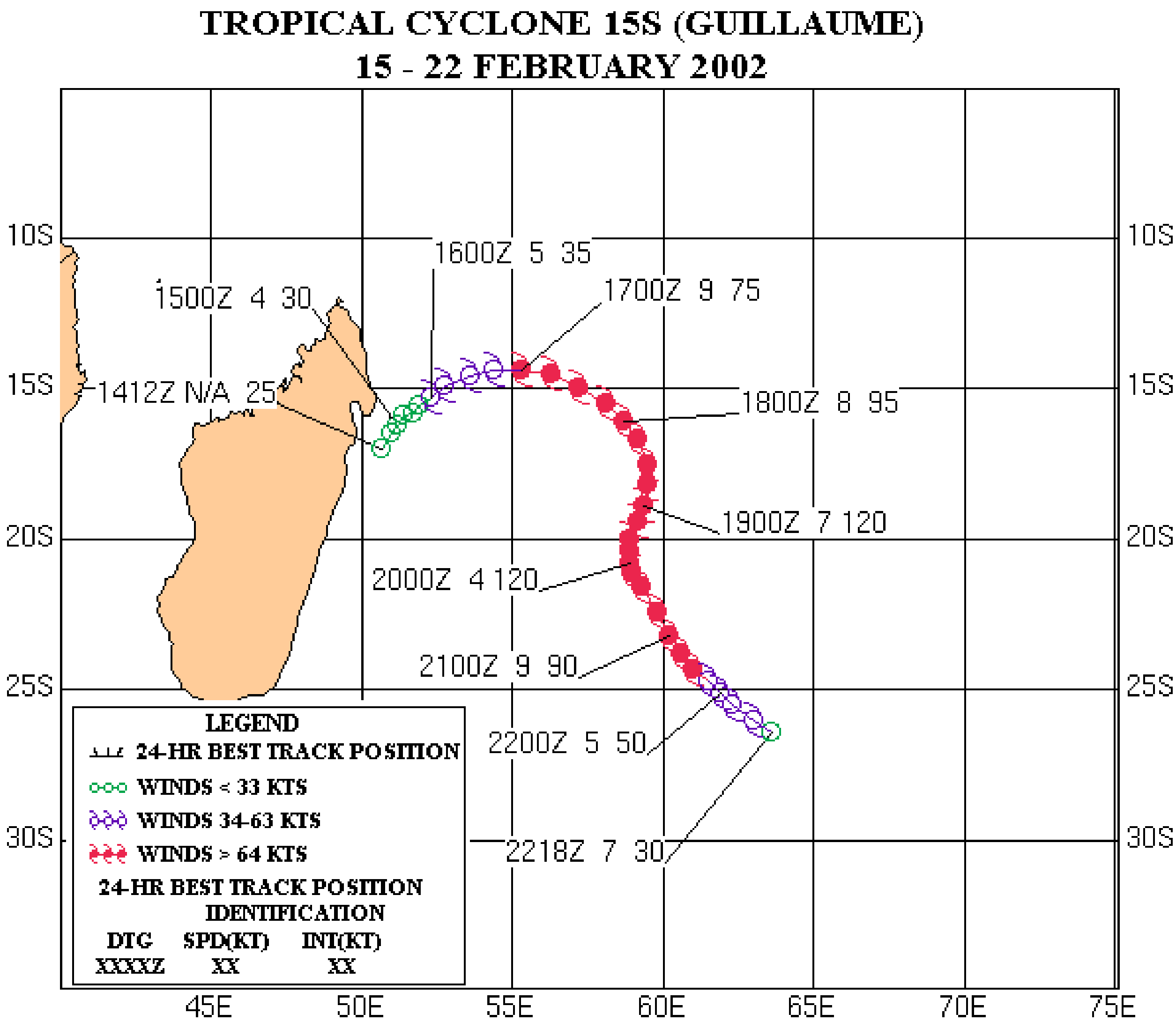


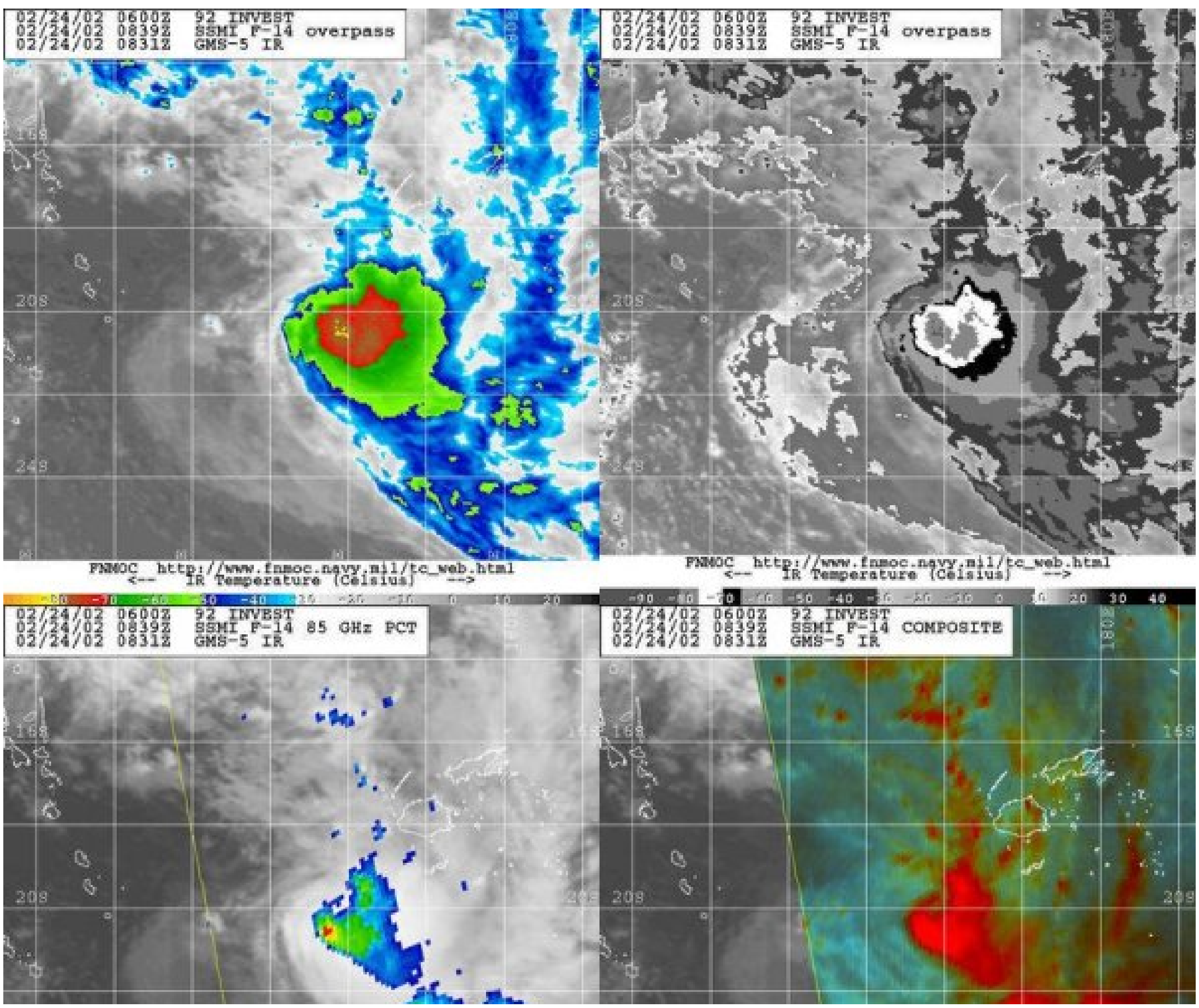

Figure 2-15S-2. 190404Z February 2002 multi-sensor imagery of TC 15S (Guillaume) approximately 100 nm east-northeast of Mauritius with an estimated maximum intensity of 120 knots.


TROPICAL CYCLONE 15S (GUILLAUME)
15 - 22 FEBRUARY 2002
10S
15S
20S
25S
30S
45E
50E
55E
60E
65E
70E
75E
1412Z N/A 25
1500Z 4 30
1600Z 5 35
1700Z 9 75
1800Z 8 95
1900Z 7 120
2000Z 4 120
2100Z 9 90
2200Z 5 50
2218Z 7 30
LEGEND
24-HR BEST TRACK POSITION
WINDS < 33 KTS
WINDS 34-63 KTS
WINDS > 64 KTS
24-HR BEST TRACK POSITION IDENTIFICATION
DTG SPD(KT) INT(KT)
XXXXZ XX XX

# Tropical Cyclone (TC) 16P

Verification Statistics

First Poor : 0200Z 23 Feb 02
First Fair : 0600Z 23 Feb 02
First TCFA : 0130Z 24 Feb 02
First Warning : 1200Z 24 Feb 02
Last Warning : 0000Z 26 Feb 02
Max Intensity : 35 kts, gusts to 45 kts
Landfall : None
Total Warnings : 4
Remarks : None



TC 18S Hary

TC 19P

TC 20S Ikala

TC 21S Dianne-Jery

TC 22S Bonnie

TC 23S Kesiny

TC 24S Errol

TC 25P Upia

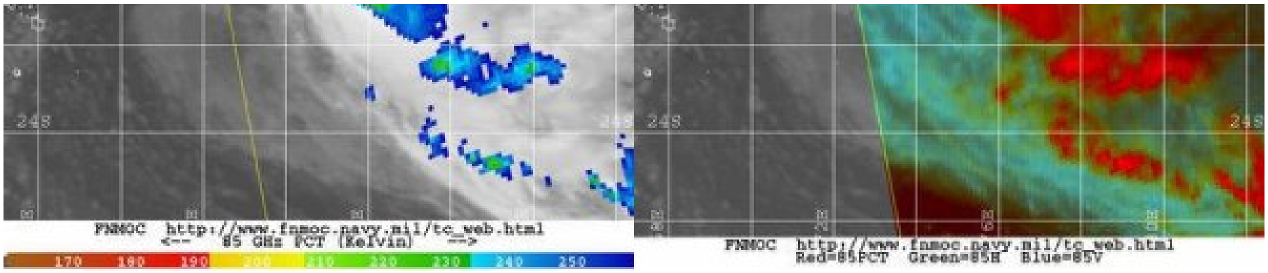
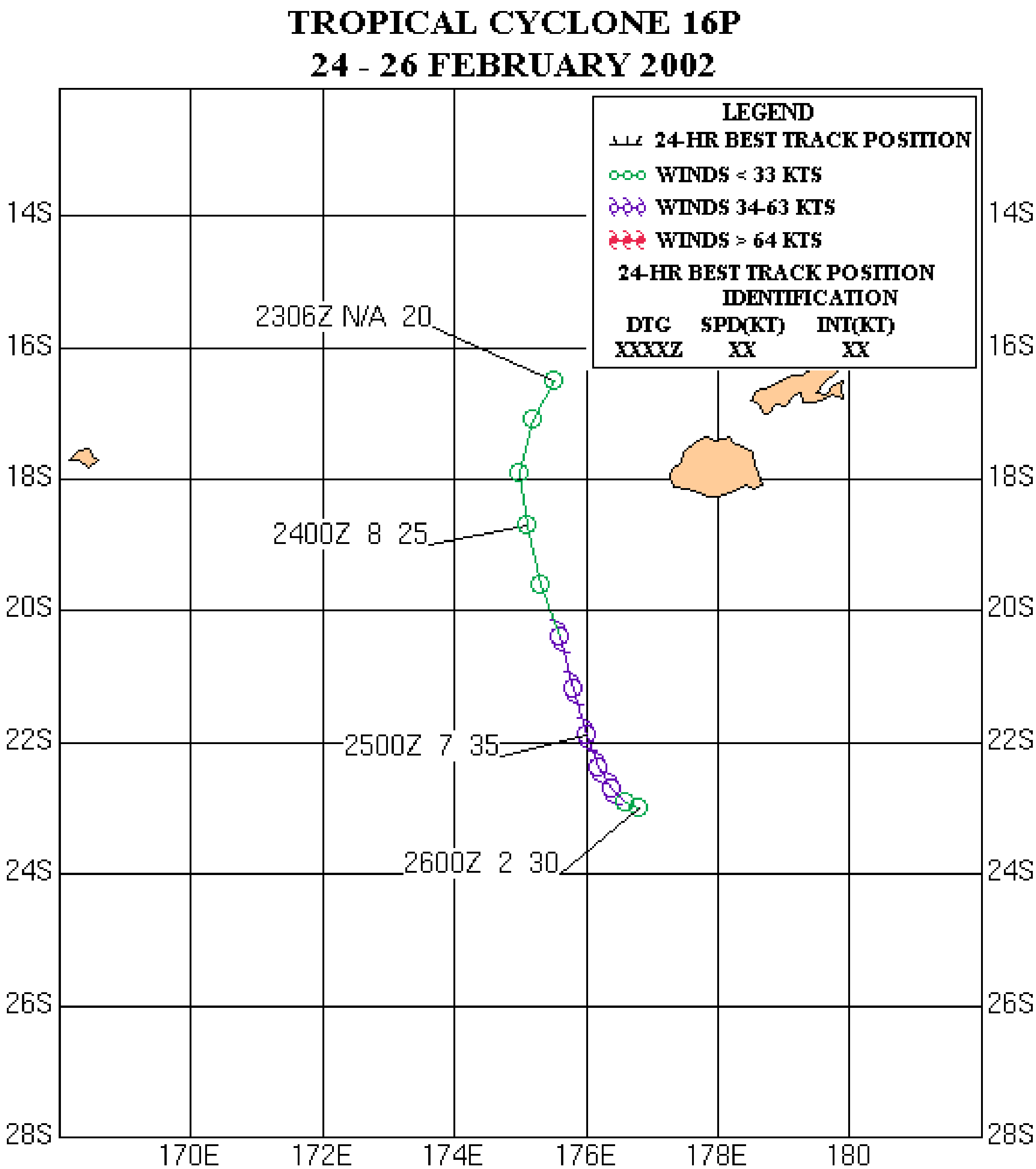



Figure 2-16P-1. 240839Z February 2002 multi-sensor imagery of TC 16P approximately 190 nm west-southwest of Suva with an estimated maximum intensity of 30 knots.



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# Tropical Cyclone (TC) 17P (Des)

Verification Statistics

First Poor : 0600Z 03 Mar 02
First Fair : 1500Z 04 Mar 02
First TCFA : 2130Z 04 Mar 02
First Warning : 0600Z 05 Mar 02
Last Warning : 0600Z 07 Mar 02
Max Intensity : 50 kts, gusts to 65 kts
Landfall : None
Total Warnings : 5
Remarks : None

*Name assigned by Brisbane TCWC

TC 18S Hary

TC 19P

TC 20S Ikala

TC 21S Dianne-Jery

TC 22S Bonnie

TC 23S Kesiny

TC 24S Errol

TC 25P Upia

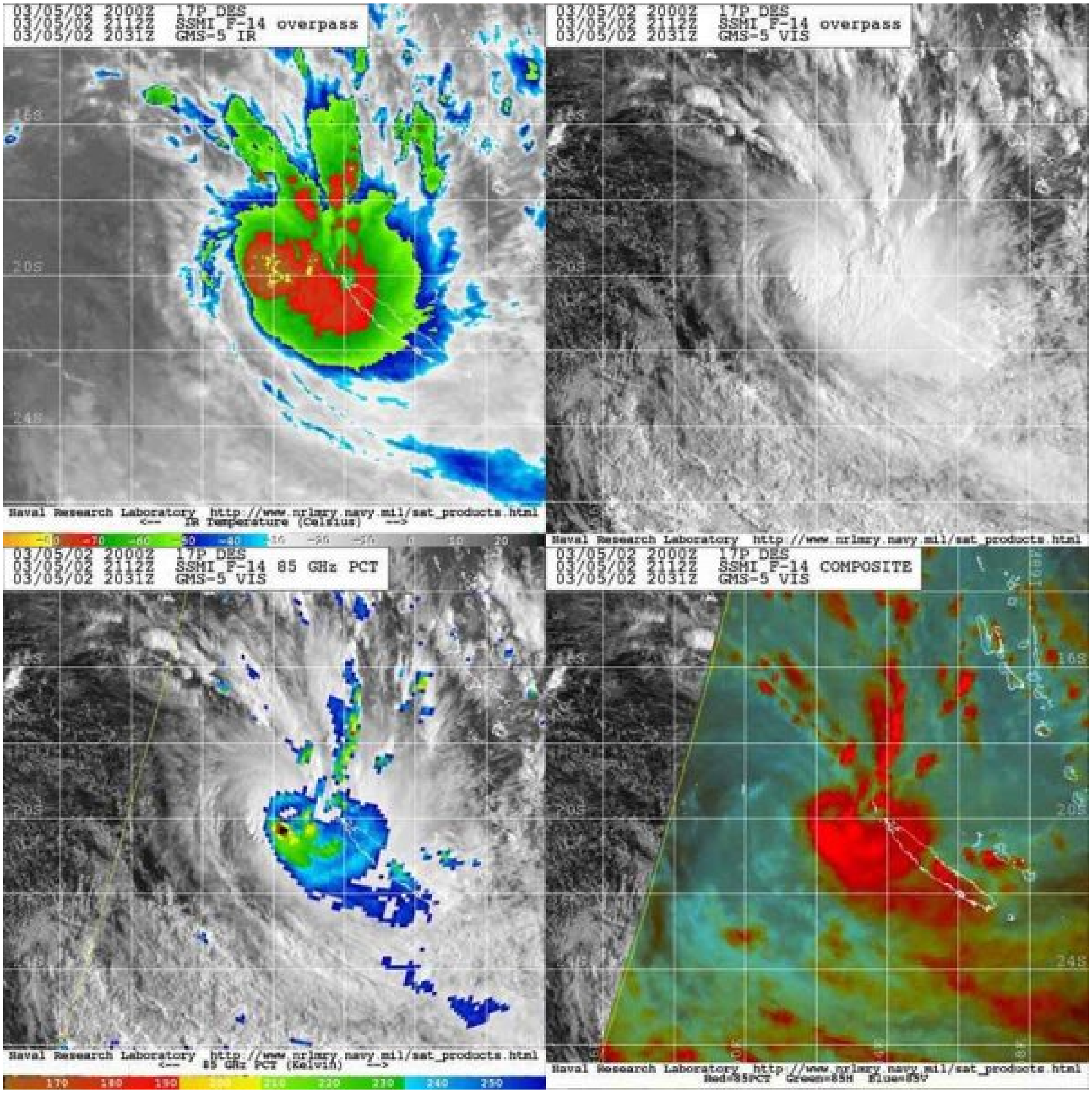
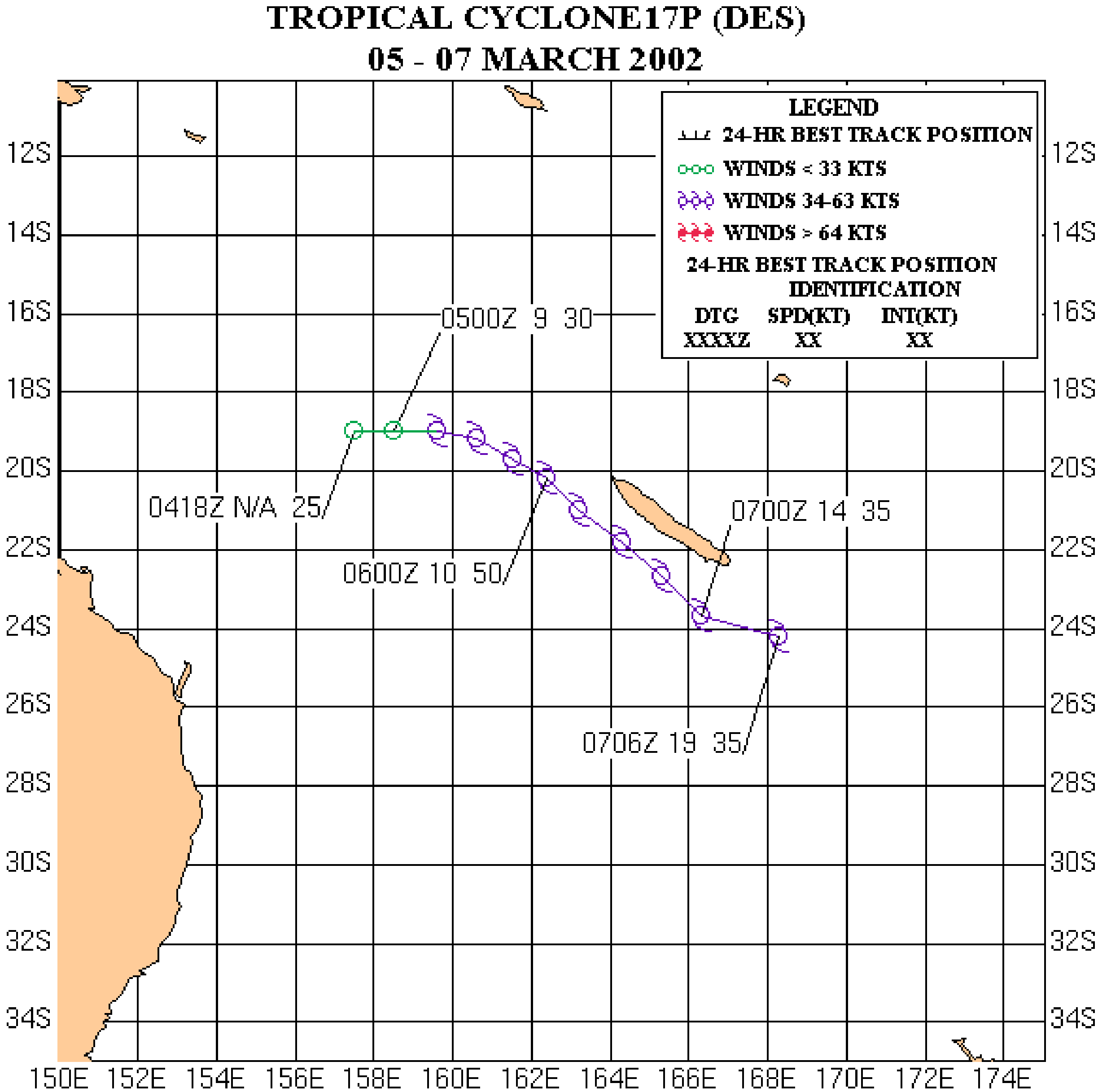



Figure 2-17P-1. 052112Z March 2002 multi-sensor imagery of TC 17P (Des) approximately 150 nm west-northwest of New Caledonia with an estimated maximum intensity of 45 knots.


TROPICAL CYCLONE17P (DES)
05 - 07 MARCH 2002
LEGEND
24-HR BEST TRACK POSITION
WINDS < 33 KTS
WINDS 34-63 KTS
WINDS > 64 KTS
24-HR BEST TRACK POSITION IDENTIFICATION
DTG SPD(KT) INT(KT)
XXXXZ XX XX
0500Z 9 30
0418Z N/A 25
0600Z 10 50
0700Z 14 35
0706Z 19 35
12S
14S
16S
18S
20S
22S
24S
26S
28S
30S
32S
34S
150E 152E 154E 156E 158E 160E 162E 164E 166E 168E 170E 172E 174E

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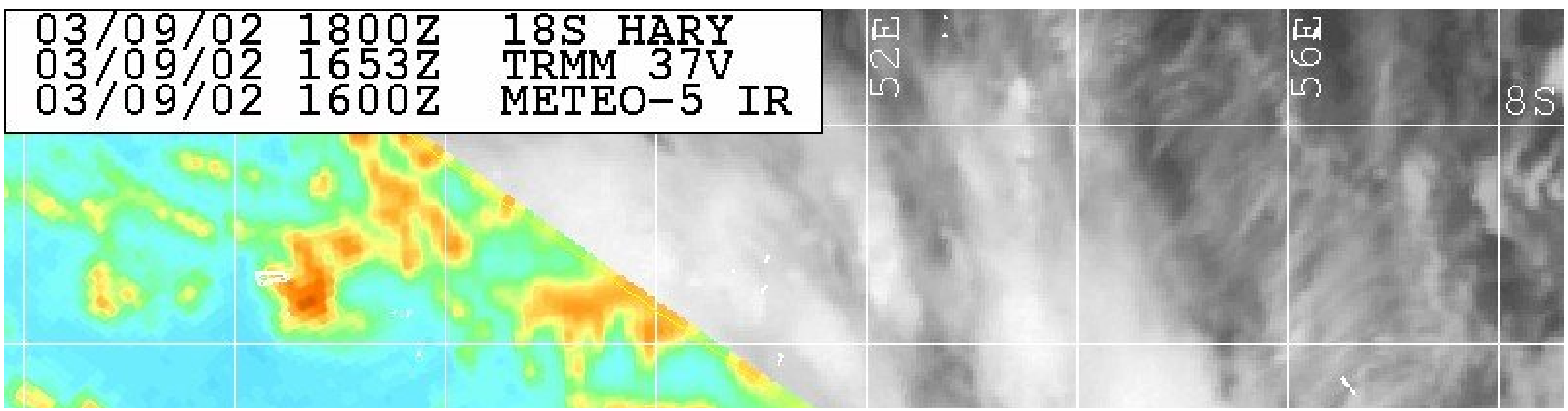
# Tropical Cyclone (TC) 18S (Hary)

Verification Statistics

First Poor : 1800Z 02 Mar 02
First Fair : 0500Z 05 Mar 02
First TCFA : 1630Z 05 Mar 02
First Warning : 0000Z 06 Mar 02
Last Warning : 1200Z 13 Mar 02
Max Intensity : 140 kts, gusts to 170 kts
Landfall : Eastern coast of Madagascar
Total Warnings : 17
Remarks :
(1) TC 18S developed southwest of Diego Garcia in the South Indian Ocean, tracked west for a few days as it intensified, and then turned south passing over northern Madagascar near Ambalabe.
(2) Although TC Hary made landfall with winds as high as 140 knots, there were no casualties and minimal damage reported.

*Name assigned by RSMC La Reunion



TC 11S Eddy
TC 12S Francesca
TC 13S Chris
TC 14P Claudia
TC 15S Guillaume
TC 16P
TC 17P Des
TC 18S Hary
TC 19P
TC 20S Ikala
TC 21S Dianne-Jery
TC 22S Bonnie
TC 23S Kesiny
TC 24S Errol
TC 25P Upia

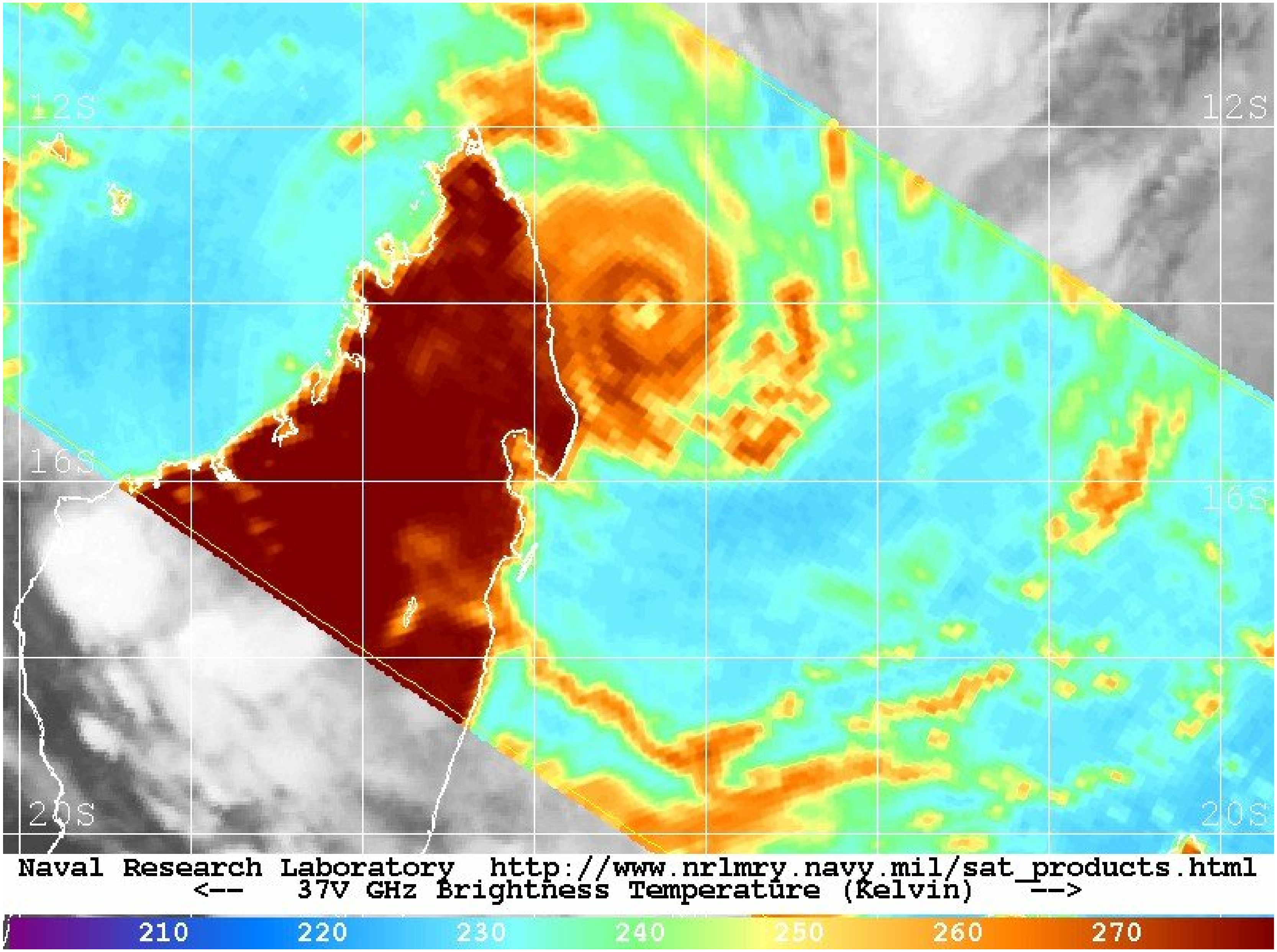



Figure 2-18S-1. 091653Z March 2002 37 GHz TRMM imagery of TC 18S (Hary) approximately 60 nm east of Madagascar with an estimated intensity of 130 knots.

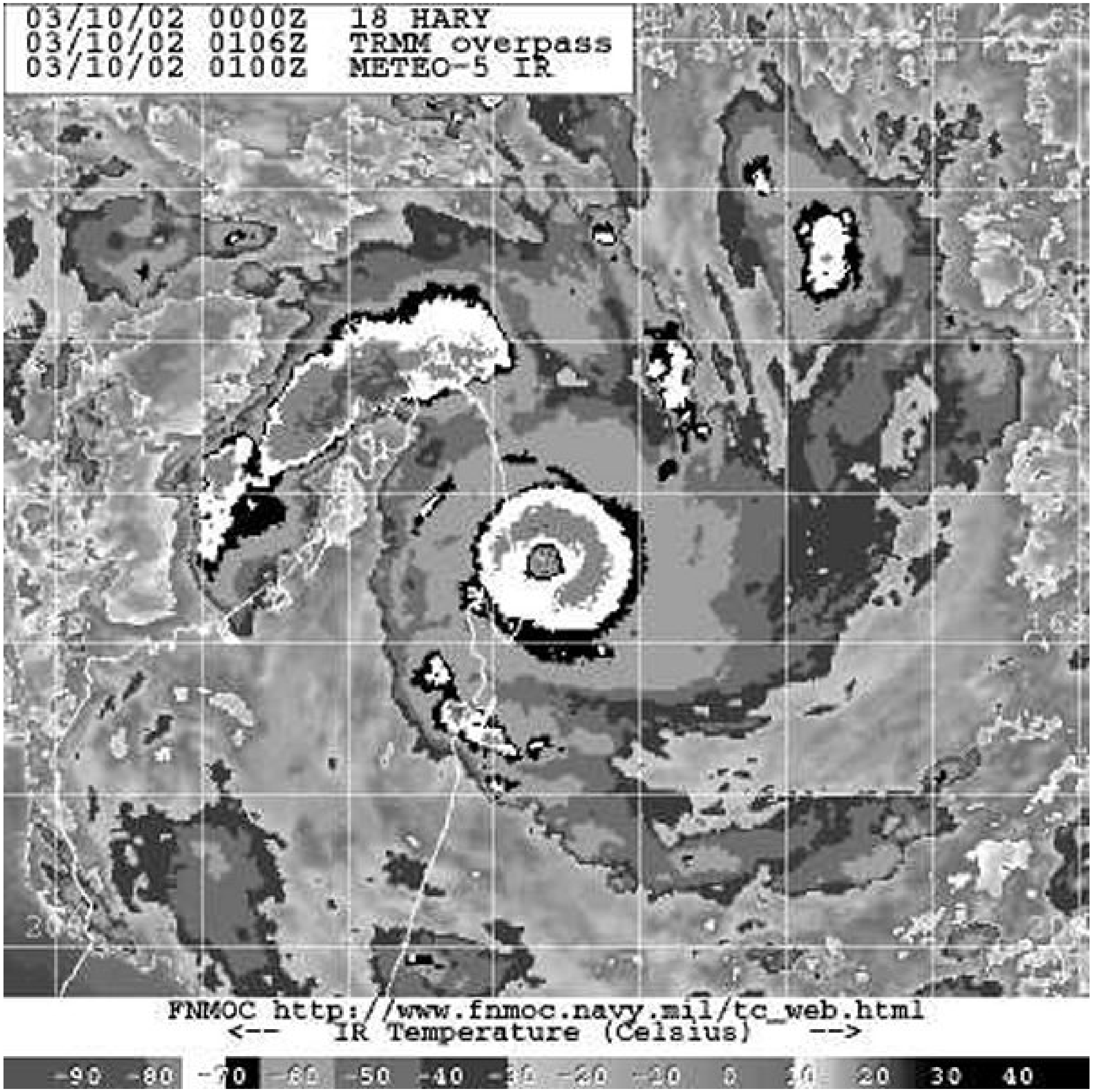
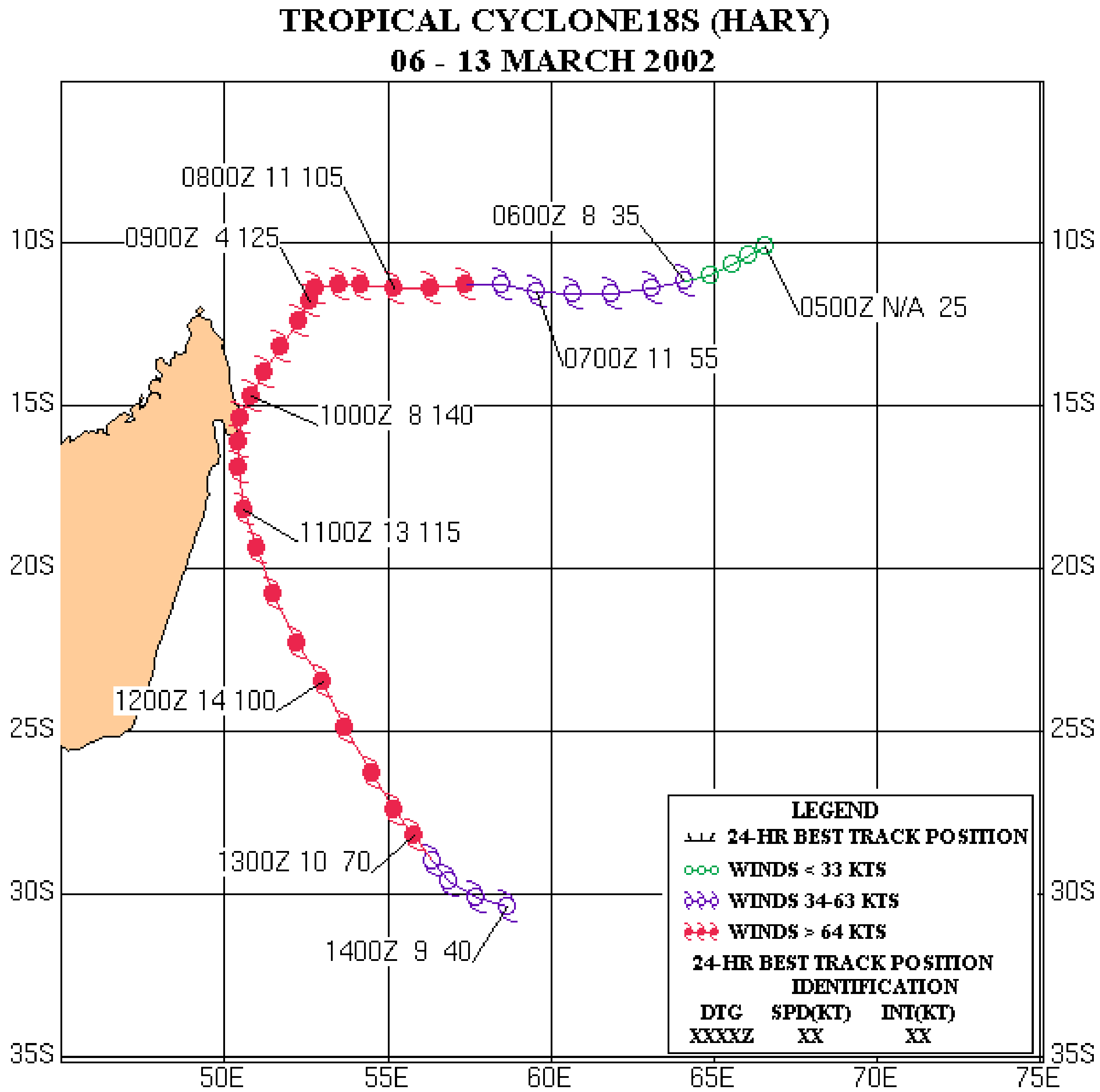


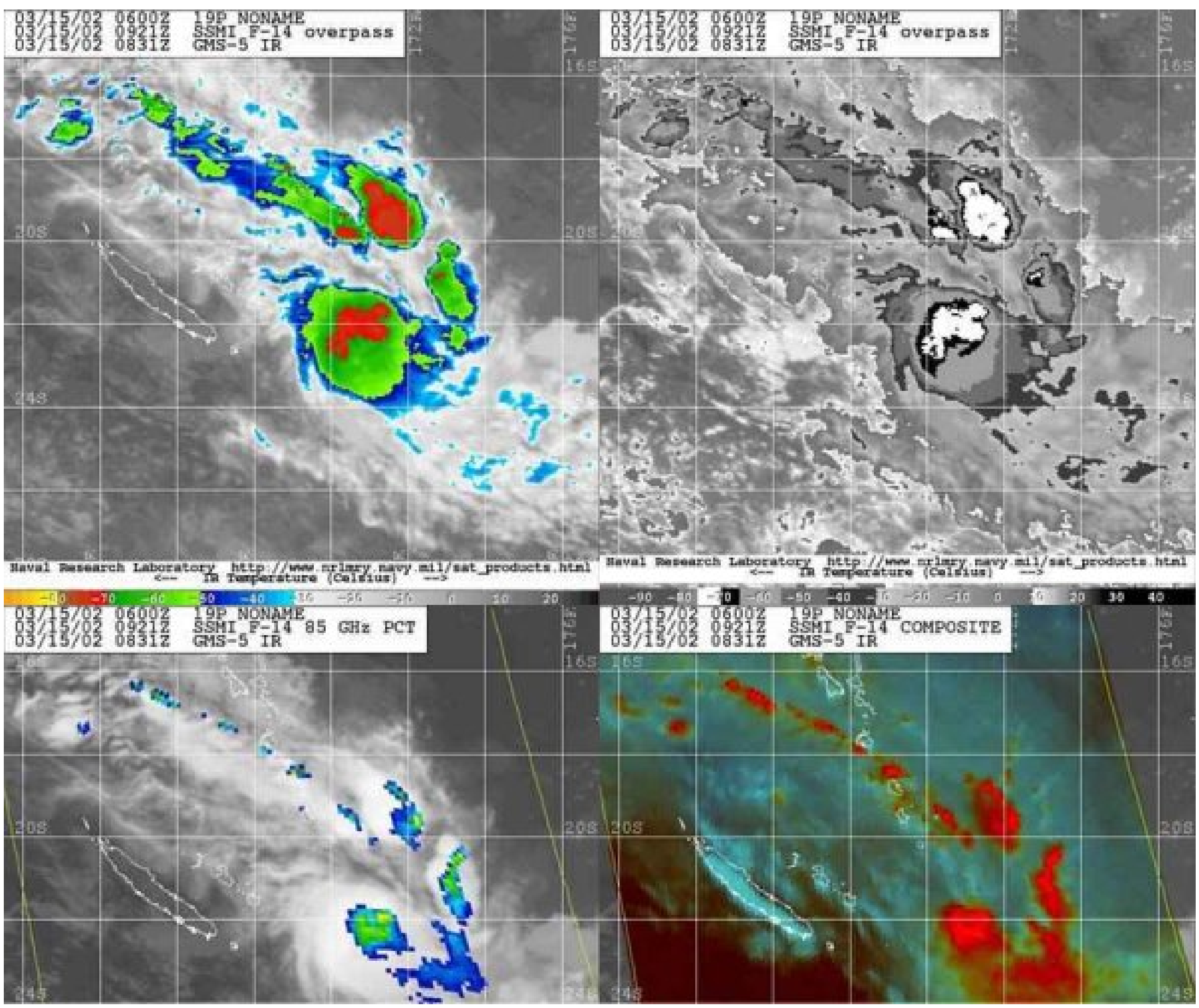

Figure 2-18S-2. 100106Z March 2002 enhanced infrared imagery of TC 18S (Hary) approximately 30 nm east of Madagascar at its peak intensity of 140 knots.


TROPICAL CYCLONE 18S (HARY)
06 - 13 MARCH 2002
0800Z 11 105
0600Z 8 35
0900Z 4 125
0500Z N/A 25
0700Z 11 55
1000Z 8 140
1100Z 13 115
1200Z 14 100
1300Z 10 70
1400Z 9 40
10S
15S
20S
25S
30S
35S
50E
55E
60E
65E
70E
75E
LEGEND
24-HR BEST TRACK POSITION
WINDS < 33 KTS
WINDS 34-63 KTS
WINDS > 64 KTS
24-HR BEST TRACK POSITION IDENTIFICATION
DTG SPD(KT) INT(KT)
XXXXZ XX XX

# Tropical Cyclone (TC) 19P

Verification Statistics

First Poor : 0600Z 13 Mar 02
First Fair : 2030Z 13 Mar 02
First TCFA : 0800Z 14 Mar 02
First Warning : 1800Z 14 Mar 02
Last Warning : 0600Z 16 Mar 02
Max Intensity : 35 kts, gusts to 45 kts
Landfall : None
Total Warnings : 4
Remarks : None



TC 18S Hary

TC 19P

TC 20S Ikala

TC 21S Dianne-Jery

TC 22S Bonnie

TC 23S Kesiny

TC 24S Errol

TC 25P Upia

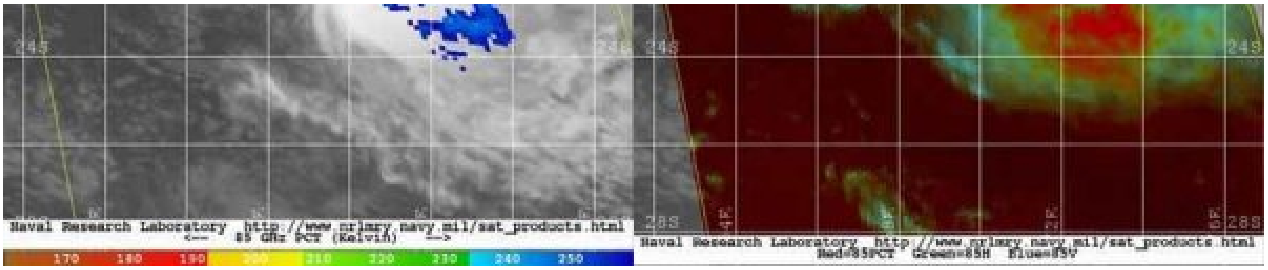
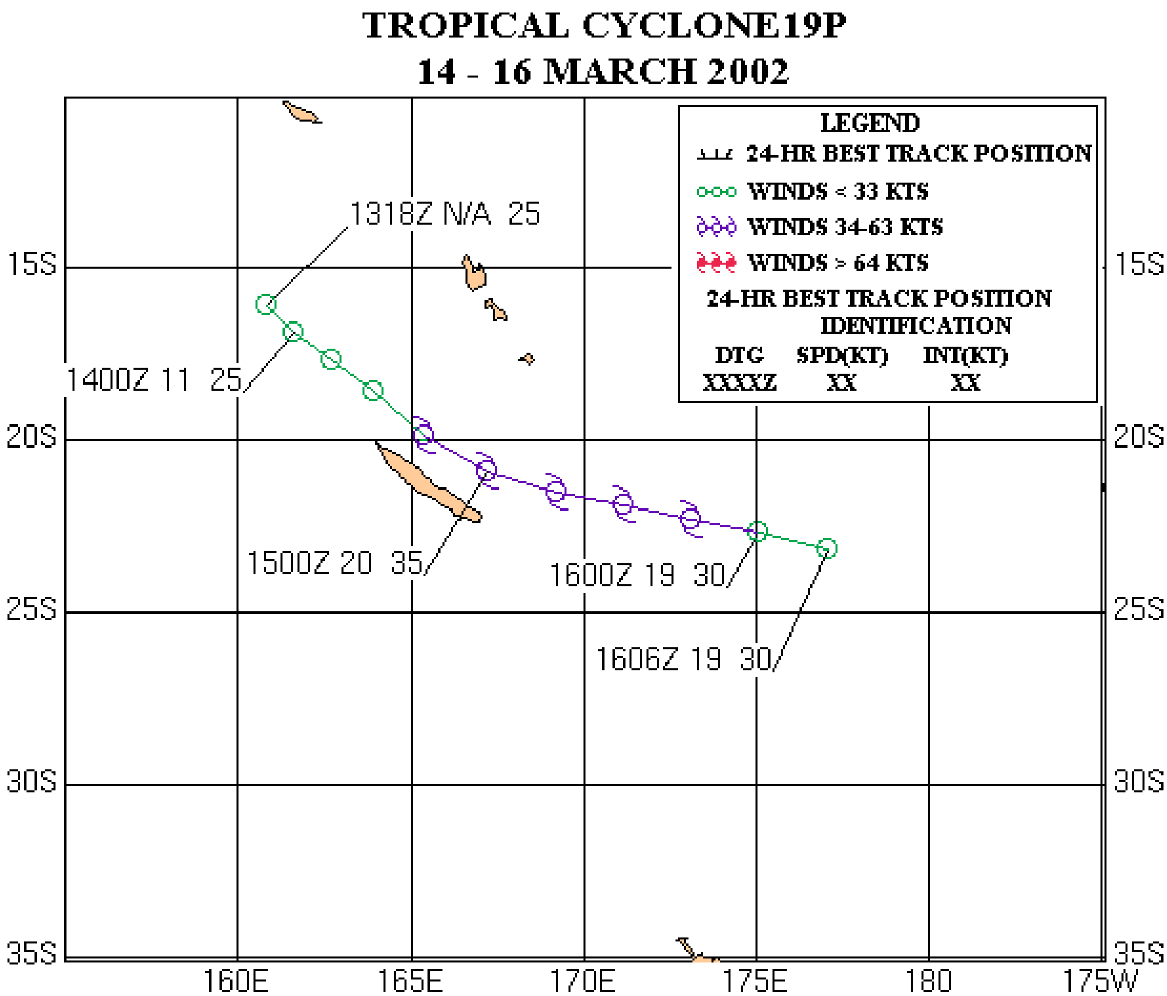



Figure 2-19P-1. 150921Z March 2002 multi-sensor imagery of TC 19P approximately 150 nm east of New Caledonia at peak intensity of 35 knots.



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# Tropical Cyclone (TC) 20S (Ikala*)

Verification Statistics

First Poor : 1800Z 20 Mar 02
First Fair : 1300Z 22 Mar 02
First TCFA : 2330Z 22 Mar 02
First Warning : 0600Z 24 Mar 02
Last Warning : 1800Z 28 Mar 02
Max Intensity : 110 kts, gusts to 135 kts
Landfall : None
Total Warnings : 10
Remarks : None

*Name assigned by RSMC La Reunion

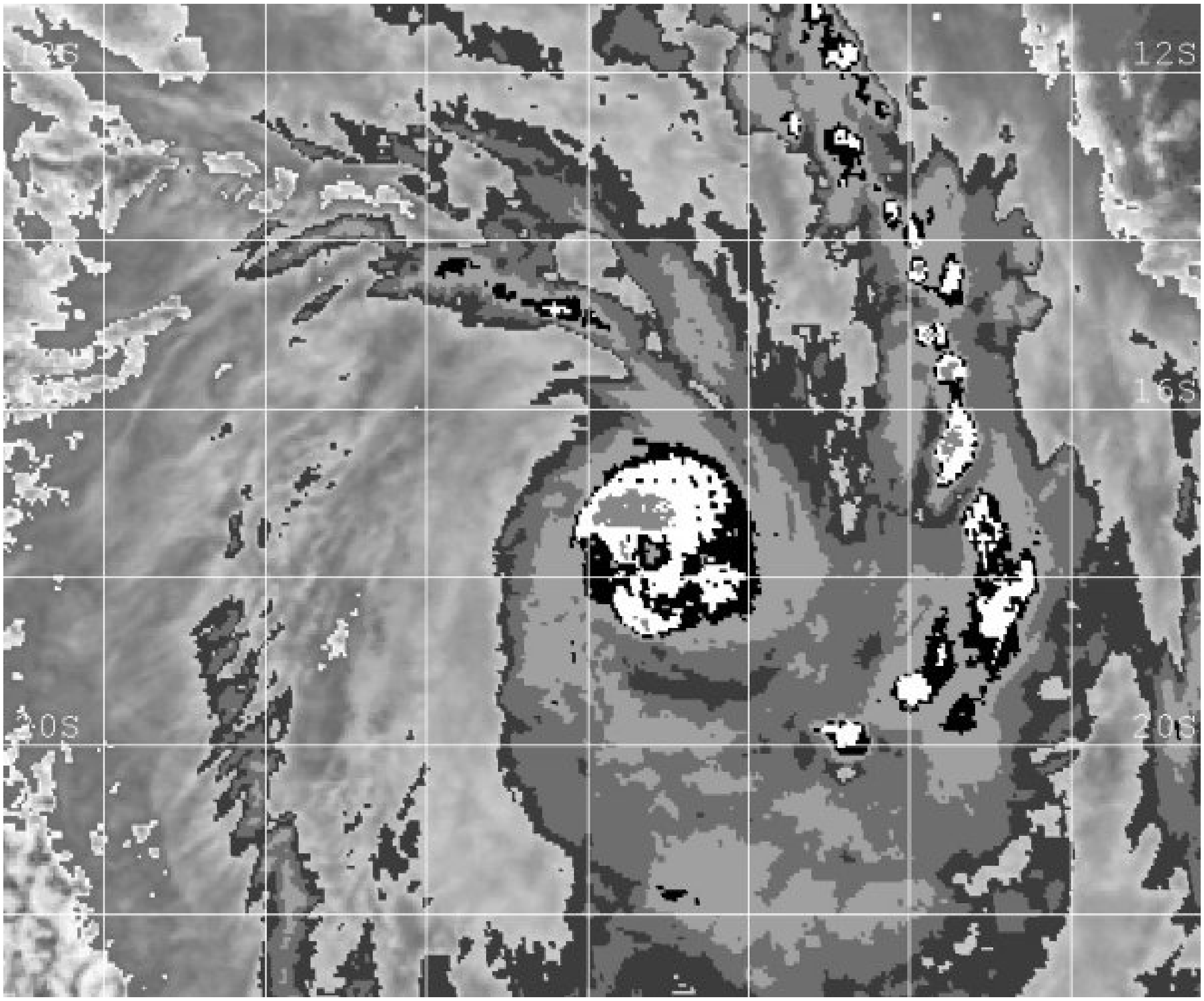
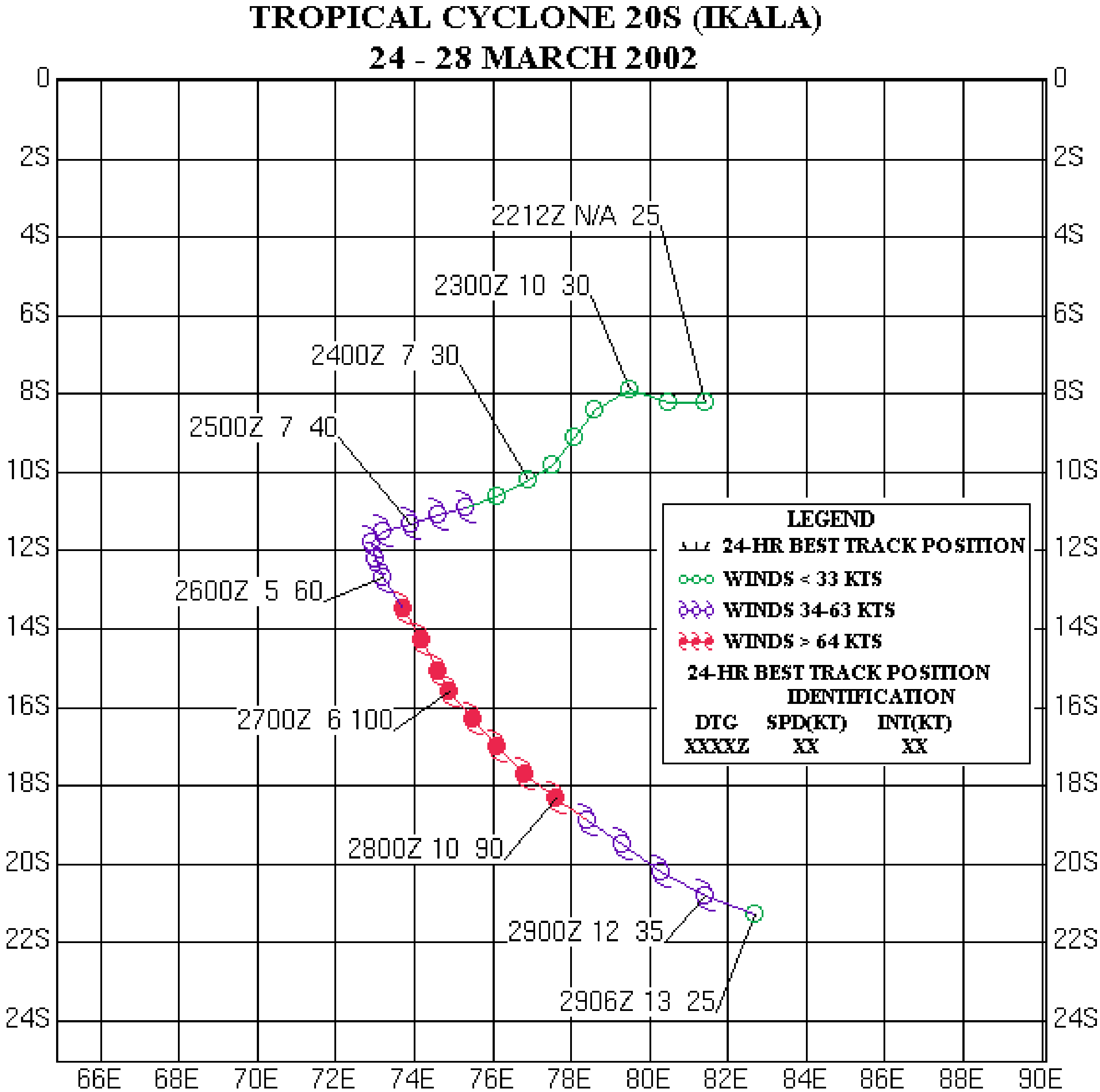
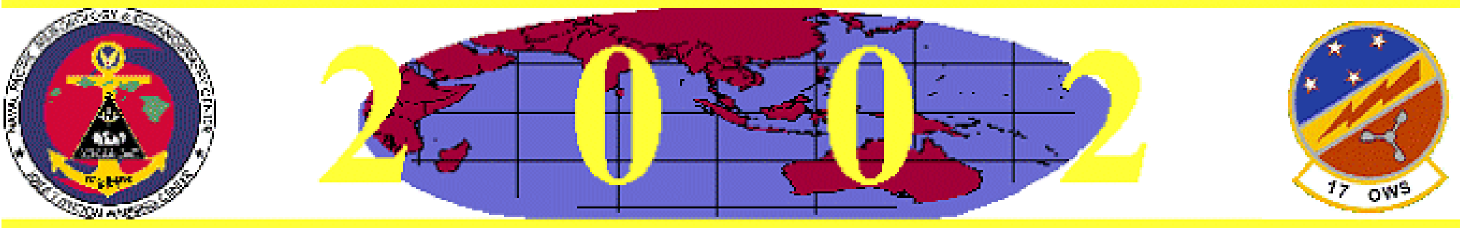



Figure 2-20S-1. 271647Z March 2002 enhanced infrared imagery of TC 20S (Ikala) approximately 620 nm south-southeast of Diego Garcia at peak intensity of 110 knots.


TROPICAL CYCLONE 20S (IKALA)
24 - 28 MARCH 2002
0
2S
4S
6S
8S
10S
12S
14S
16S
18S
20S
22S
24S
66E
68E
70E
72E
74E
76E
78E
80E
82E
84E
86E
88E
90E
2212Z N/A 25
2300Z 10 30
2400Z 7 30
2500Z 7 40
2600Z 5 60
2700Z 6 100
2800Z 10 90
2900Z 12 35
2906Z 13 25
LEGEND
24-HR BEST TRACK POSITION
WINDS < 33 KTS
WINDS 34-63 KTS
WINDS > 64 KTS
24-HR BEST TRACK POSITION IDENTIFICATION
DTG SPD(KT) INT(KT)
XXXXZ XX XX






# Tropical Cyclone (TC) 21S (Dianne-Jery*)

Verification Statistics

First Poor : 0130Z 04 Apr 02
First Fair : 1800Z 05 Apr 02
First TCFA : 1100Z 06 Apr 02
First Warning : 0000Z 07 Apr 02
Last Warning : 1200Z 11 Apr 02
Max Intensity : 105 kts, gusts to 130 kts
Landfall : None
Total Warnings : 10
Remarks : None

*Names assigned by Perth TCWC and RSMC La Reunion

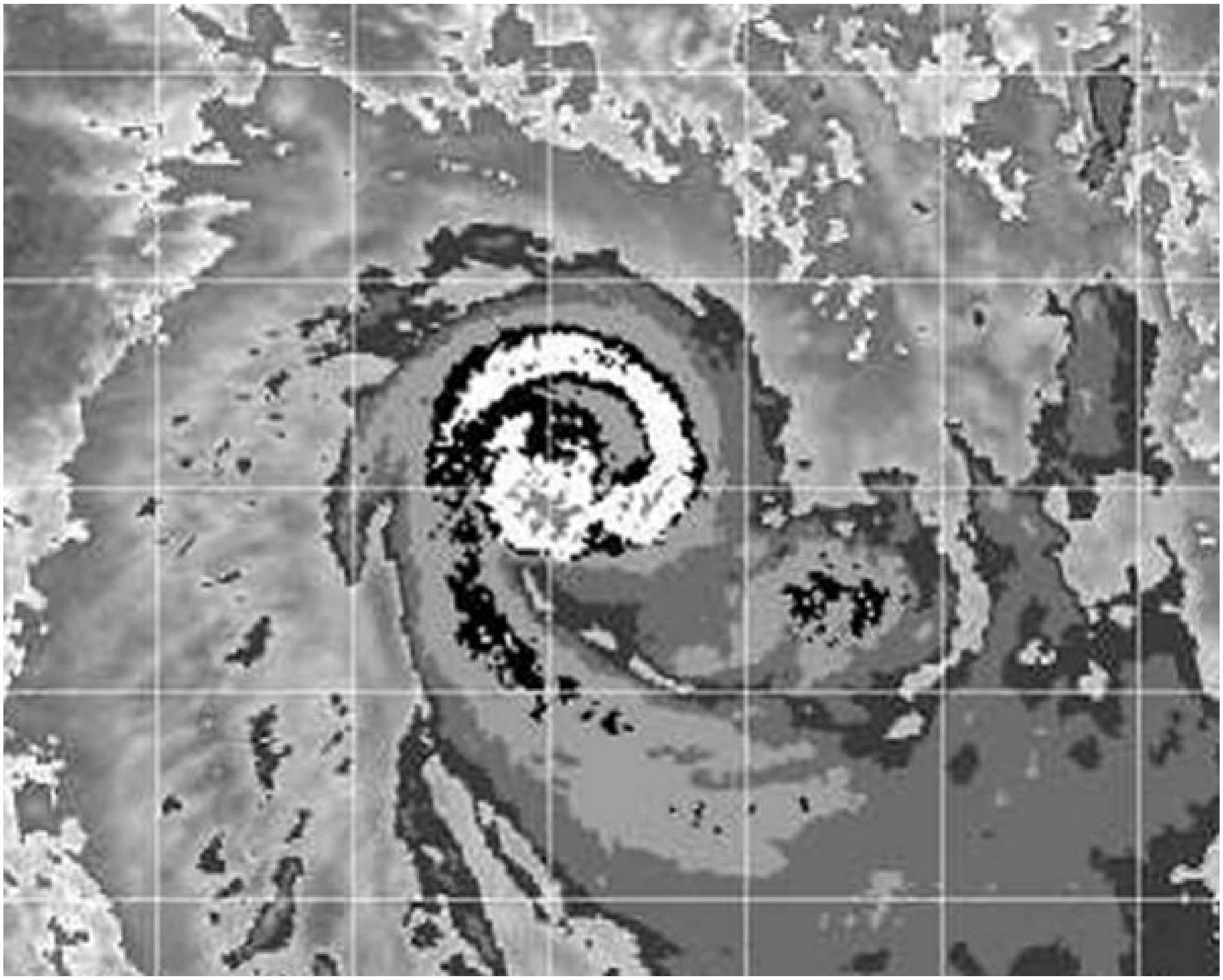
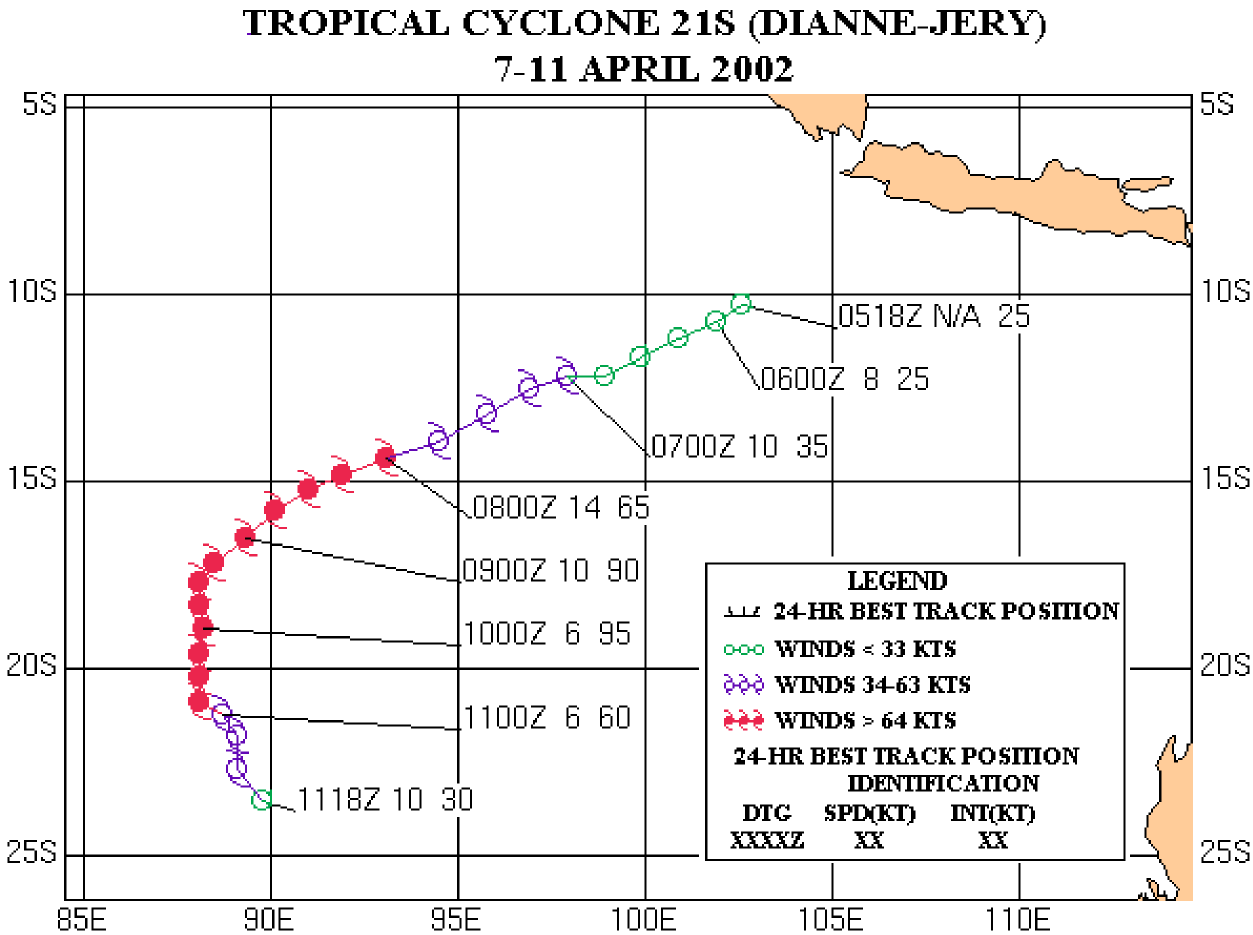


Figure 2-21S-1. 091515Z April 2002 enhanced infrared image of TC 21S (Dianne-Jery) approximately 1120 nm southeast of Diego Garcia with an estimated intensity of 105 knots.


TROPICAL CYCLONE 21S (DIANNE-JERY)
7-11 APRIL 2002
5S
10S
15S
20S
25S
85E
90E
95E
100E
105E
110E
0518Z N/A 25
0600Z 8 25
0700Z 10 35
0800Z 14 65
0900Z 10 90
1000Z 6 95
1100Z 6 60
1118Z 10 30
LEGEND
24-HR BEST TRACK POSITION
WINDS < 33 KTS
WINDS 34-63 KTS
WINDS > 64 KTS
24-HR BEST TRACK POSITION IDENTIFICATION
DTG SPD(KT) INT(KT)
XXXXZ XX XX

# Tropical Cyclone (TC) 22S (Bonnie*)

Verification Statistics

First Poor : 1800Z 07 Apr 02
First Fair : none
First TCFA : 1730Z 09 Apr 02
First Warning : 0000Z 10 Apr 02
Last Warning : 1200Z 15 Apr 02
Max Intensity : 50 kts, gusts to 65 kts
Landfall : Timor and Sumba Islands, Indonesia
Total Warnings : 12
Remarks :
(1) TC 22S developed in the Timor Sea under an easterly vertical wind shear environment and tracked slowly west-southwest until dissipating. The cyclone remained weak while it passed over Timor and Sumba Islands, and then began to intensify as it moved into the Indian Ocean south of Java. It reached its maximum intensity as it moved away from land over open waters.
(2) No casualties or damage were reported.

*Name assigned by TCWC Darwin

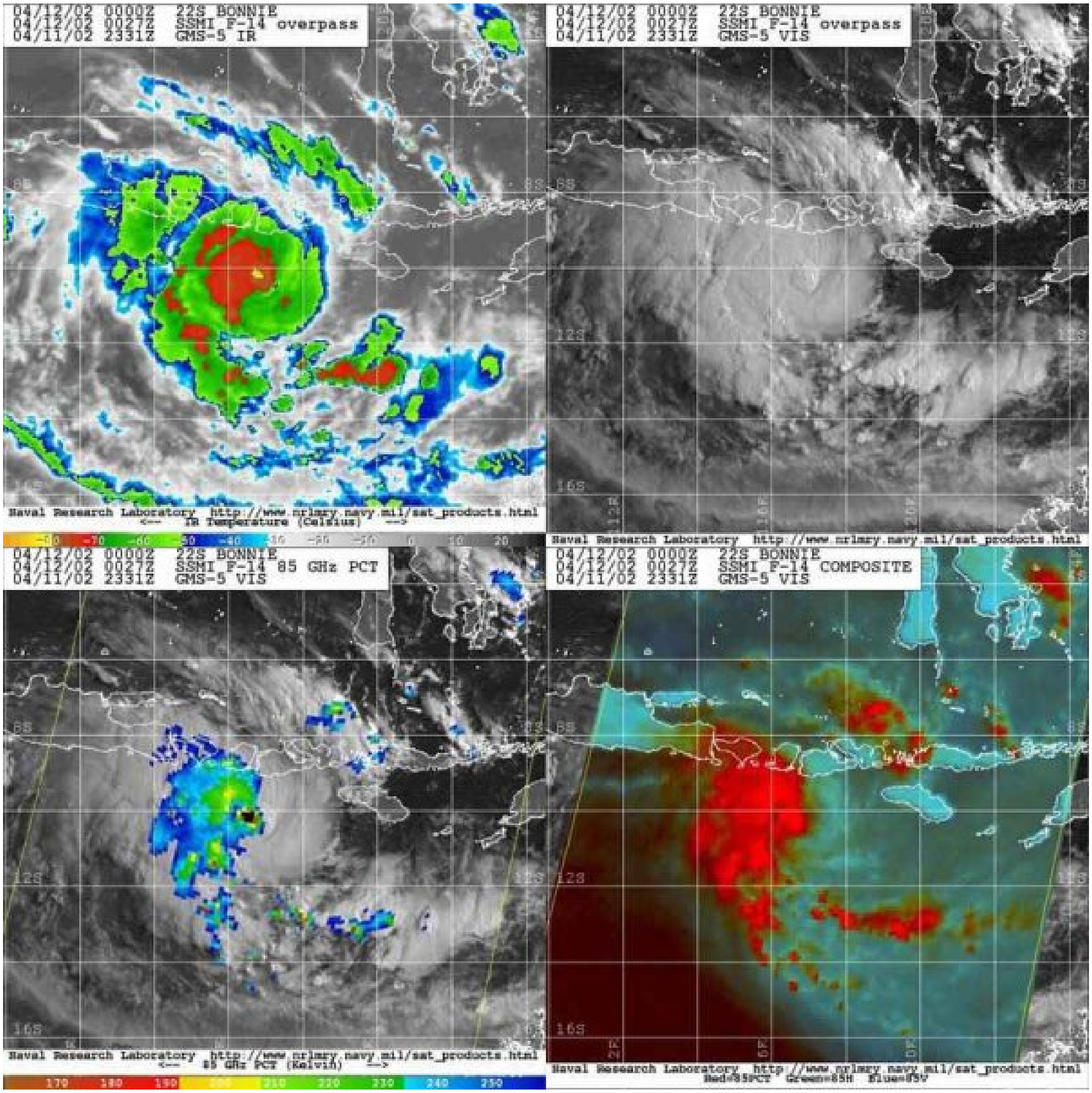



Figure 2-22S-1. 120027Z April 2002 multi-sensor satellite imagery of TC 22S (Bonnie) approximately 400 nm southeast of Java with an estimated intensity of 50 knots.

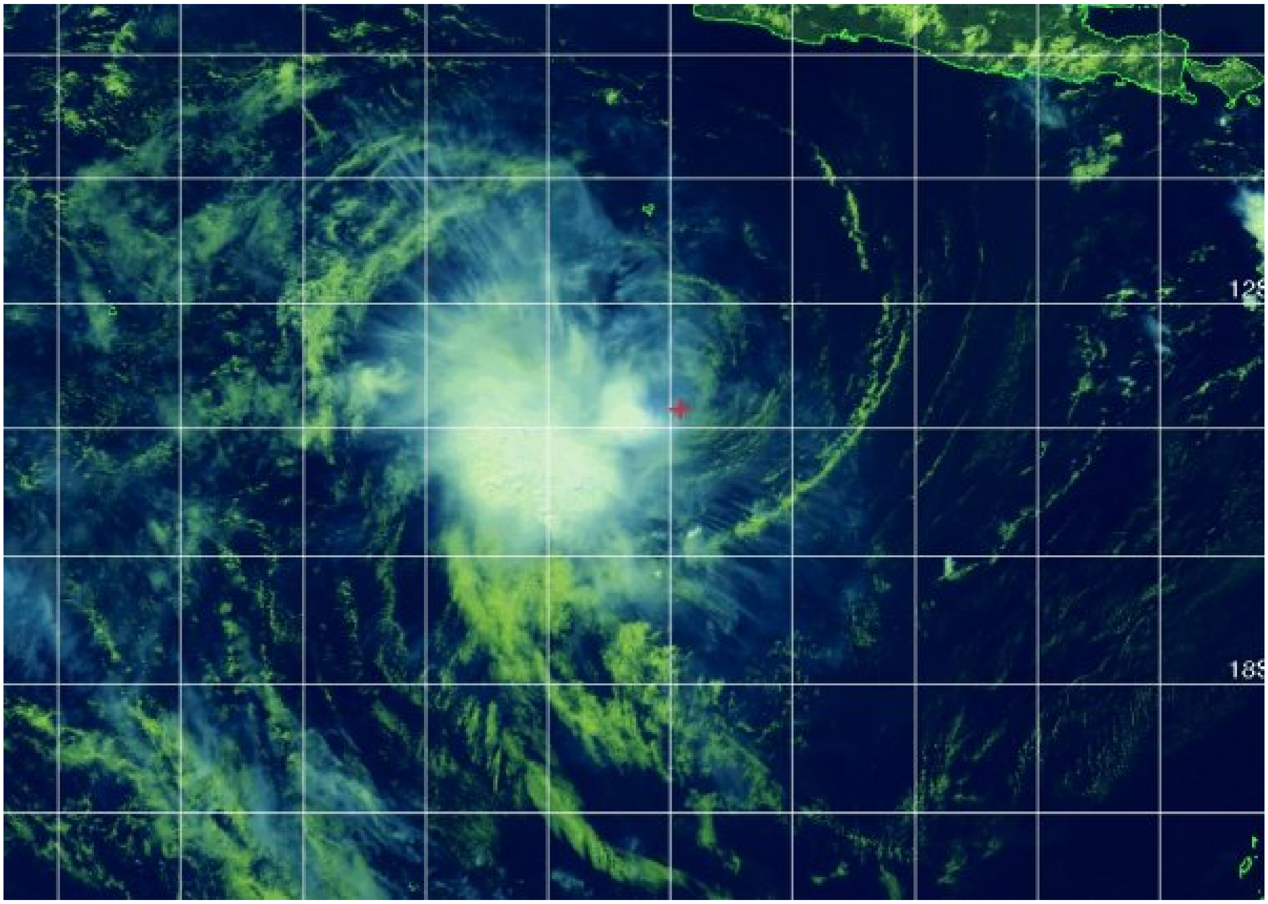
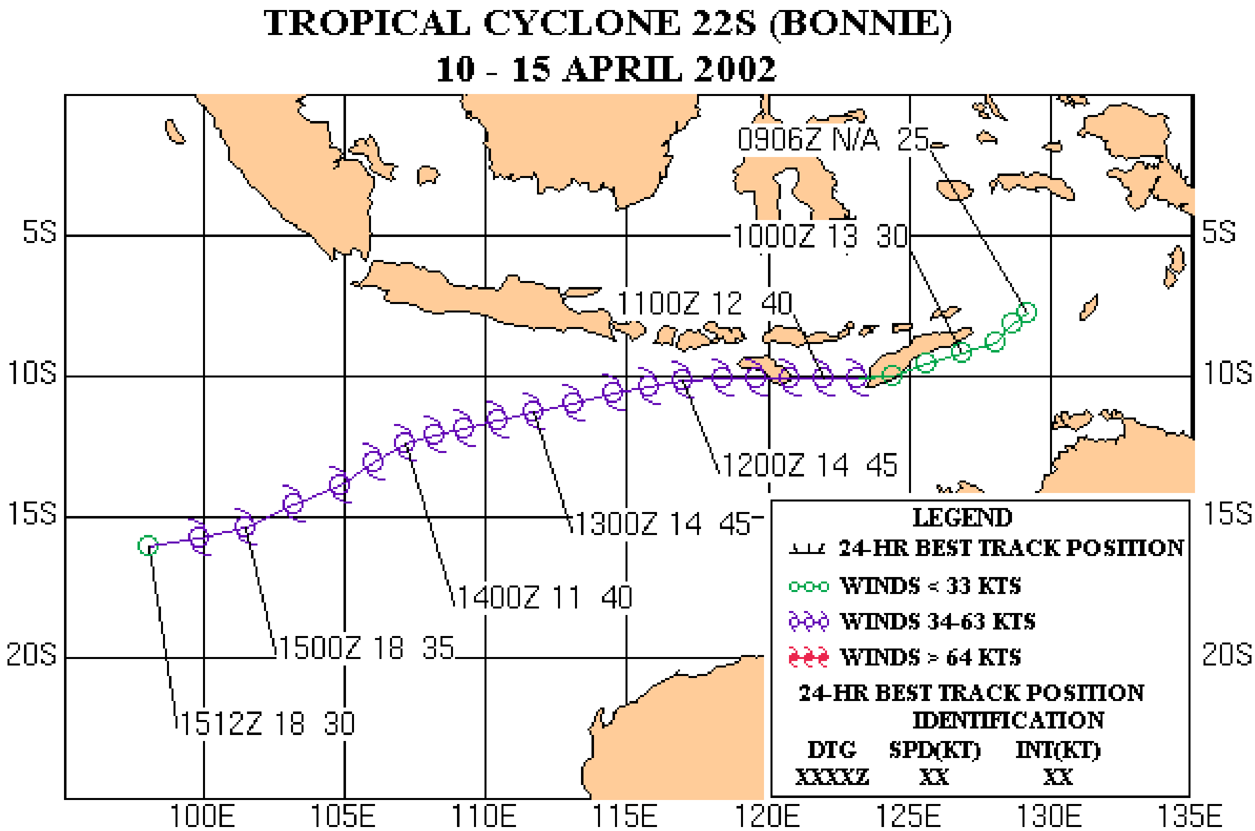



Figure 2-22S-2. 140530Z April 2002 multi-spectral satellite imagery of TC 22S (Bonnie) approximately 235 nm southeast of Cocos Island with an estimated intensity of 40 kts.


TROPICAL CYCLONE 22S (BONNIE)
10 - 15 APRIL 2002
0906Z N/A 25
1000Z 13 30
1100Z 12 40
1200Z 14 45
1300Z 14 45
1400Z 11 40
1500Z 18 35
1512Z 18 30
5S
10S
15S
20S
100E
105E
110E
115E
120E
125E
130E
135E
LEGEND
24-HR BEST TRACK POSITION
WINDS < 33 KTS
WINDS 34-63 KTS
WINDS > 64 KTS
24-HR BEST TRACK POSITION IDENTIFICATION
DTG SPD(KT) INT(KT)
XXXXZ XX XX

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# Tropical Cyclone (TC) 23S (Kesiny*)

Verification Statistics

First Poor : 0130Z 30 Apr 02
First Fair : 1800Z 01 May 02
First TCFA : 1000Z 02 May 02
First Warning : 0900Z 03 May 02
Last Warning : 2100Z 11 May 02
Max Intensity : 65 kts, gusts to 80 kts
Landfall : Ambaro and Tsianinkira, Madagascar
Total Warnings : 18
Remarks : None

*Name assigned by RSMC La Reunion

TC 18S Hary

TC 19P

TC 20S Ikala

TC 21S Dianne-Jery

TC 22S Bonnie

TC 23S Kesiny

TC 24S Errol

TC 25P Upia

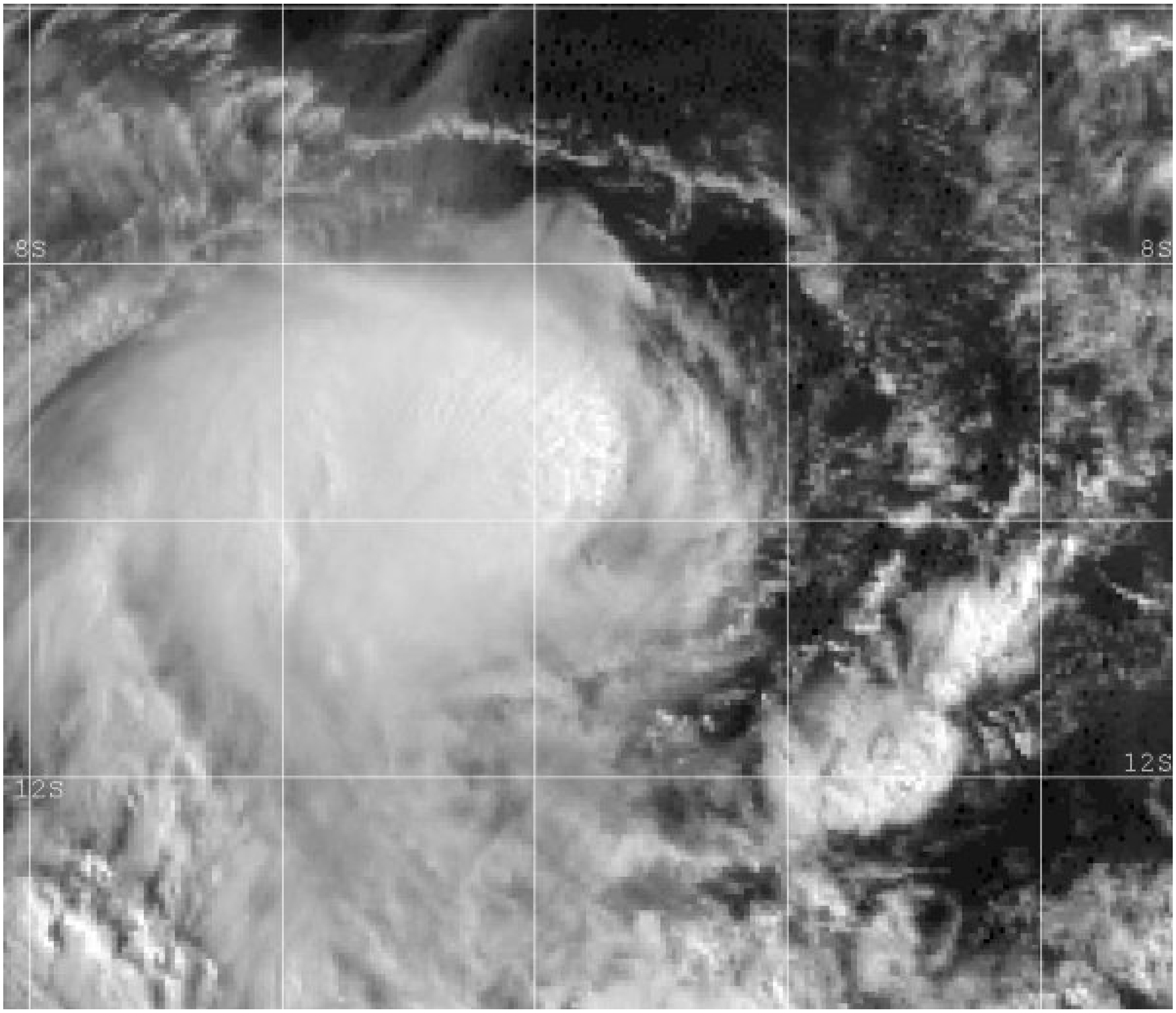



Figure 2-23S-1. 040400Z May 2002 Met-5 visible imagery of TC 23S (Kesiny) approximately 417 nm southwest of Diego Garcia, with an estimated intensity of 30 knots.

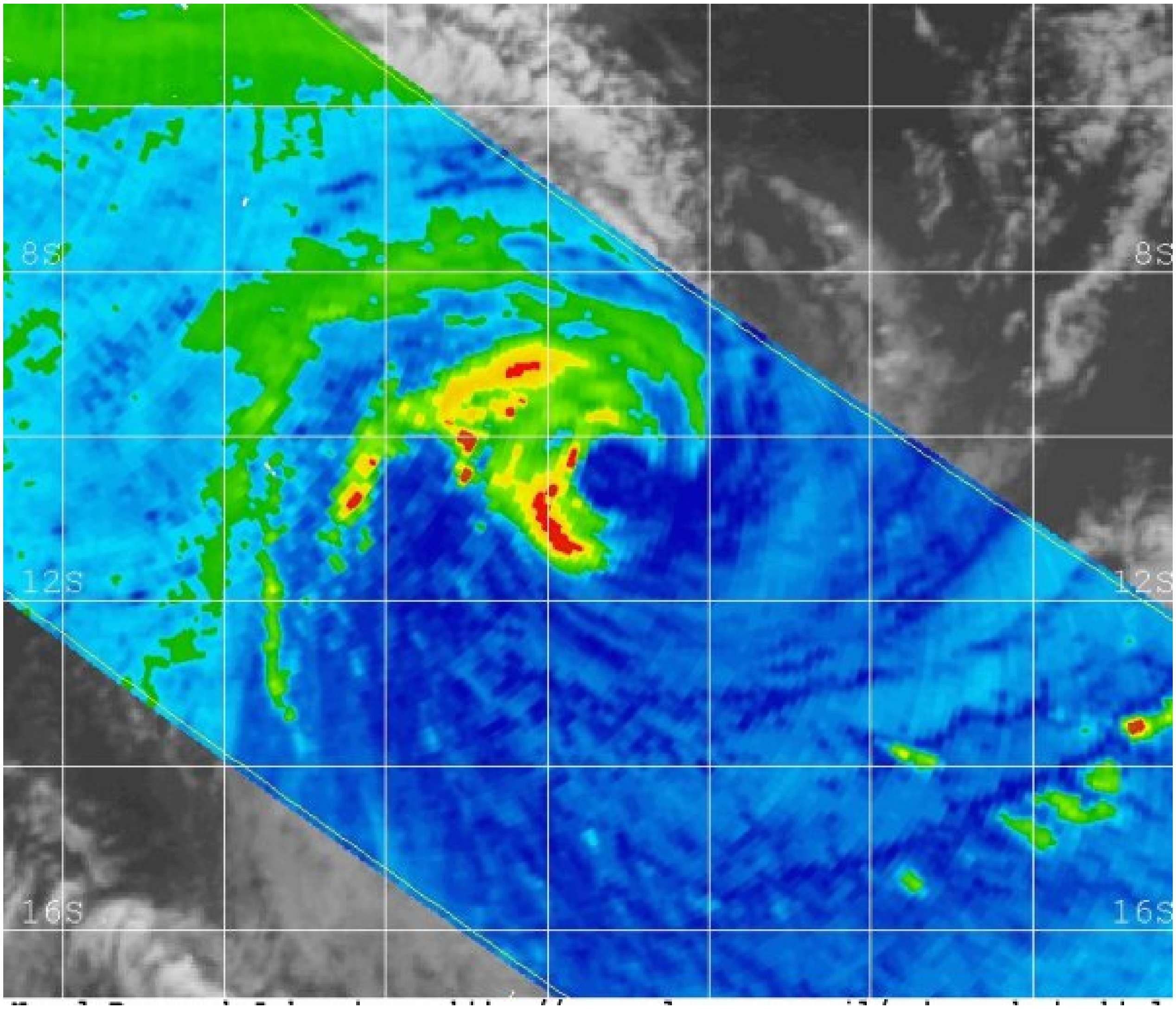
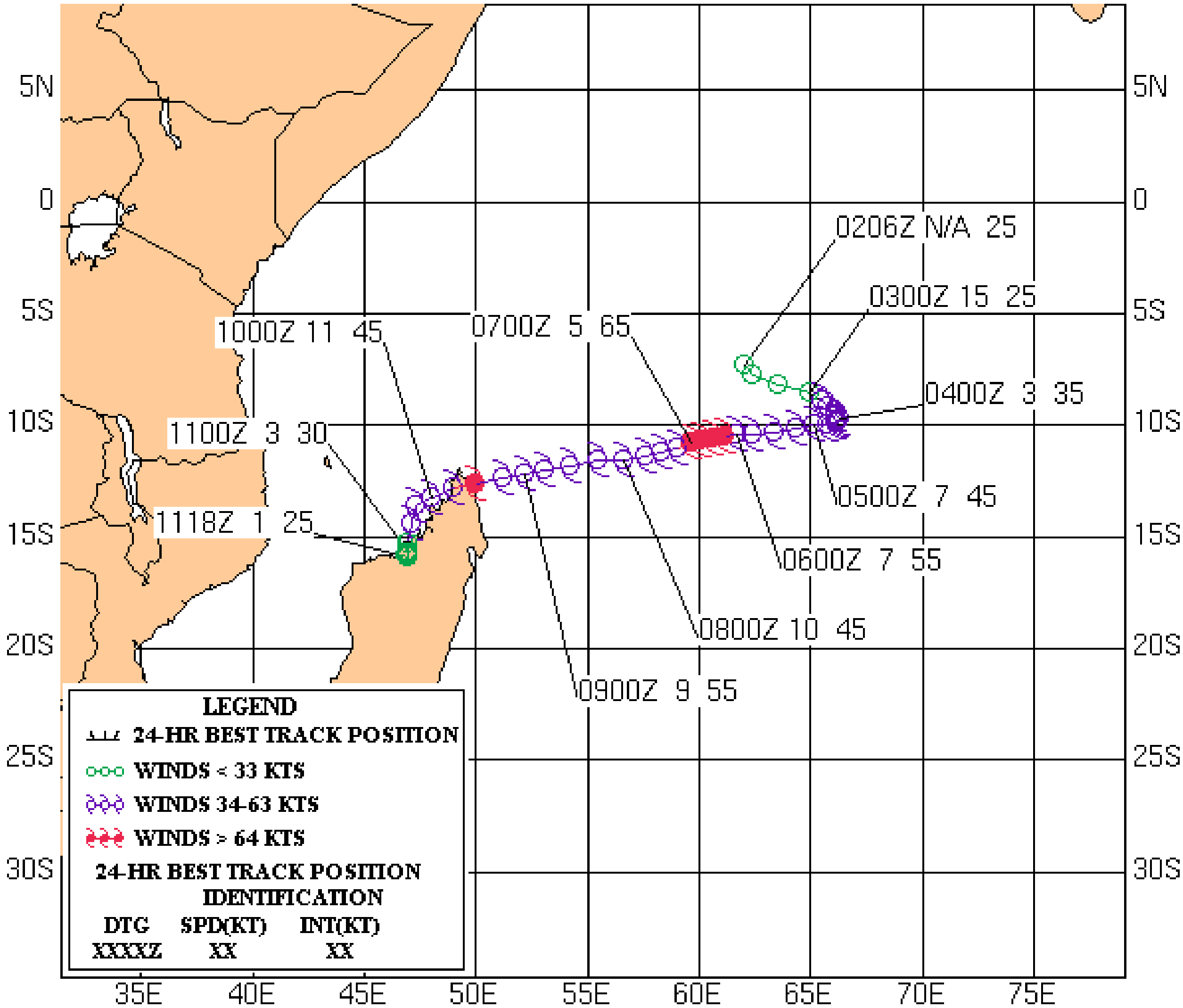



Figure 2-23S-2. 061040Z May 2002 85 GHz TRMM imagery of TC 23S (Kesiny) depicting a partial eyewall feature. At this time the cyclone was approximately 665 nm east-northeast of the northern tip of Madagascar with an estimated intensity of 65 knots.

# TROPICAL CYCLONE 23S (KESINY)
## 03 - 11 MAY 2002



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# Tropical Cyclone (TC) 24S (Errol*)

Verification Statistics

First Poor : 0500Z 08 May 02
First Fair : 0500Z 09 May 02
First TCFA : 0630Z 09 May 02
First Warning : 2100Z 09 May 02
Last Warning : 0900Z 14 May 02
Max Intensity : 45 kts, gusts to 55 kts
Landfall : None
Total Warnings : 10
Remarks :
(1) Thorough post-analysis of metsat data revealed that the circulation center appeared to have "jumped" convection between 100000Z and 100600Z.

*Name assigned by Perth TCWC

TC 18S Hary

TC 19P

TC 20S Ikala

TC 21S Dianne-Jery

TC 22S Bonnie

TC 23S Kesiny

TC 24S Errol

TC 25P Upia

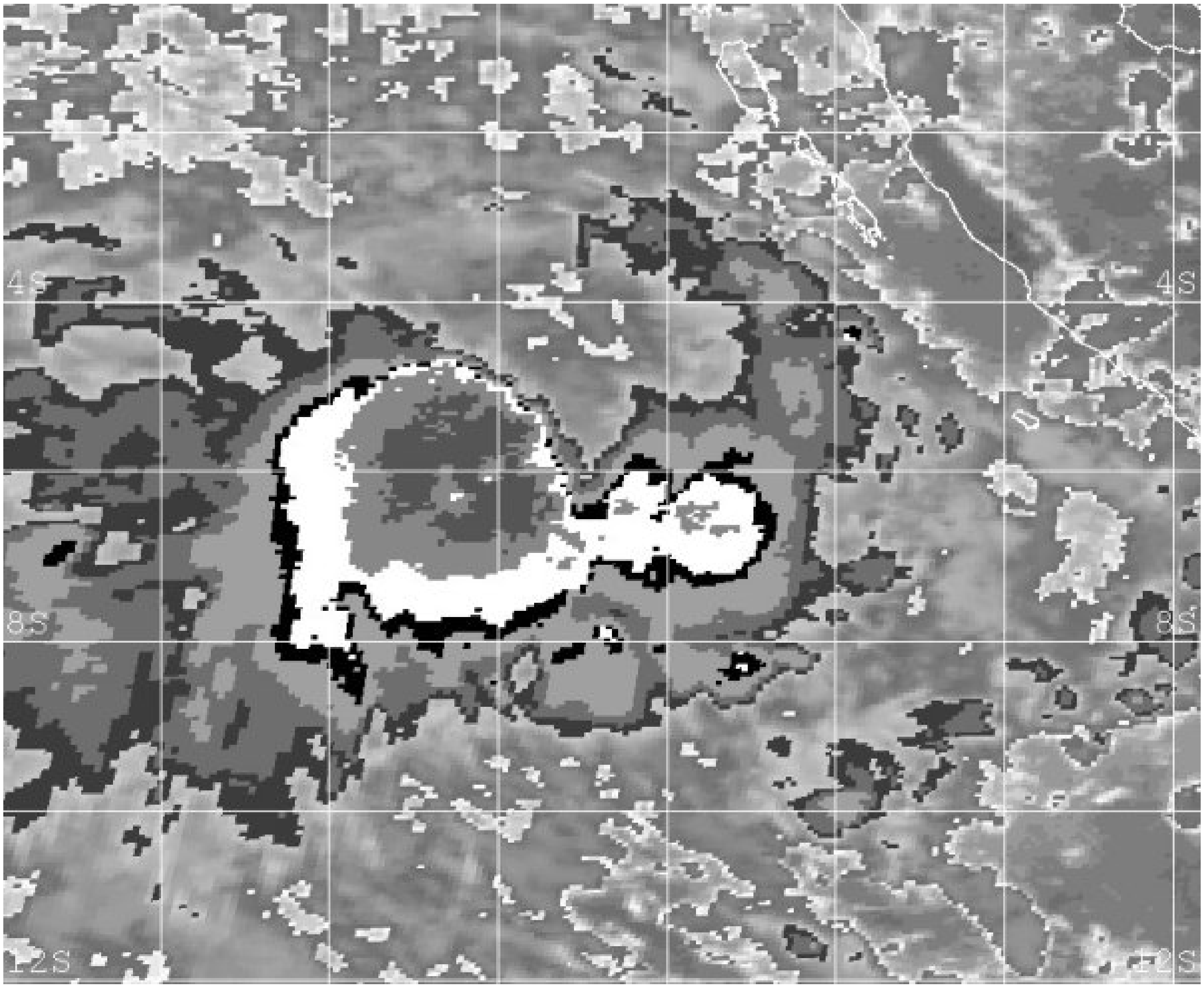
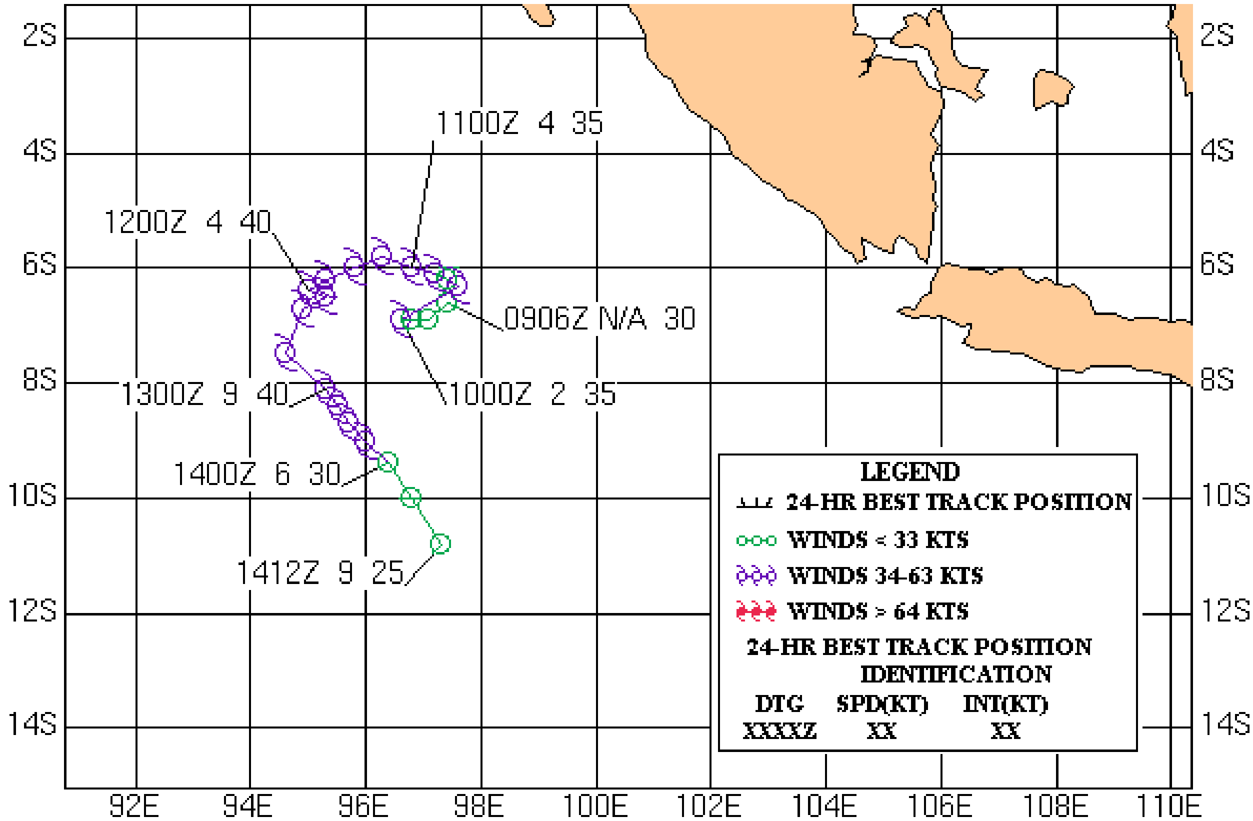



Figure 2-24S-1. 110307Z May 2002 enhanced infrared imagery of TC 24S (Errol) approximatley 361 nm north of Cocos Island with an estimated intensity of 35 knots.

**TROPICAL CYCLONE 24S (ERROL)**
**9-14 MAY 2002**



# Tropical Cyclone (TC) 25P (Upia*)

Verification Statistics

First Poor : None
First Fair : 0200Z 23 May 02
First TCFA : 0130Z 25 May 02
First Warning : 1500Z 25 May 02
Last Warning : 0900Z 28 May 02
Max Intensity : 35 kts, gusts to 45 kts
Landfall : Solomon Islands
Total Warnings : 12
Remarks : None

*Name assigned by Brisbane TCWC

TC 18S Hary

TC 19P

TC 20S Ikala

TC 21S Dianne-Jery

TC 22S Bonnie

TC 23S Kesiny

TC 24S Errol

TC 25P Upia

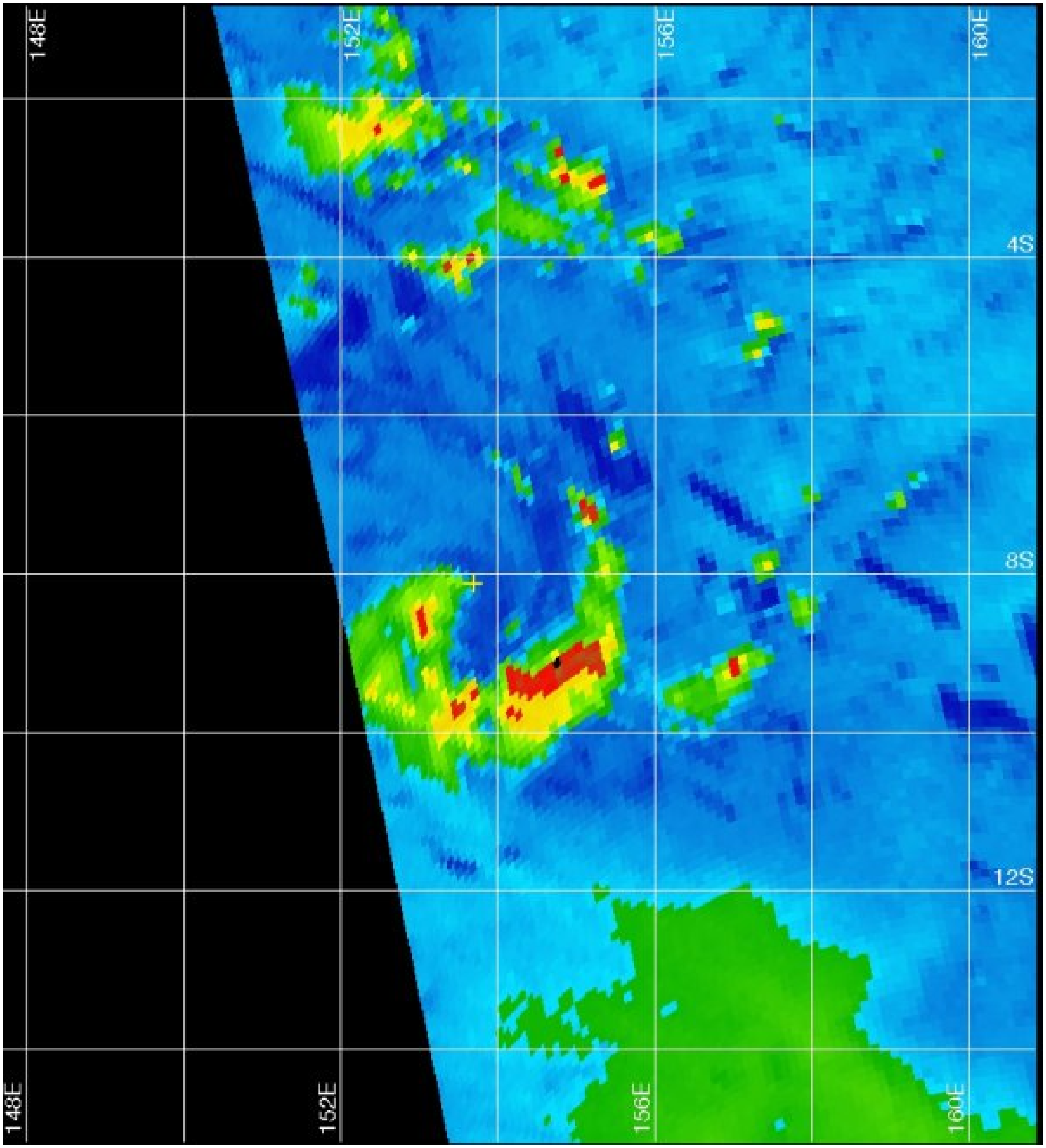



Figure 2-25P-1. 250950Z May 2002 85 GHz SSM/I imagery of TC 25P (Upia) revealing a partially exposed low level circulation with a banding feature wrapping around the southern periphery of the system. At this time, the cyclone was located approximately 380 nm west-northwest of Honiara, Solomon Islands with an estimated intensity of 35 knots.

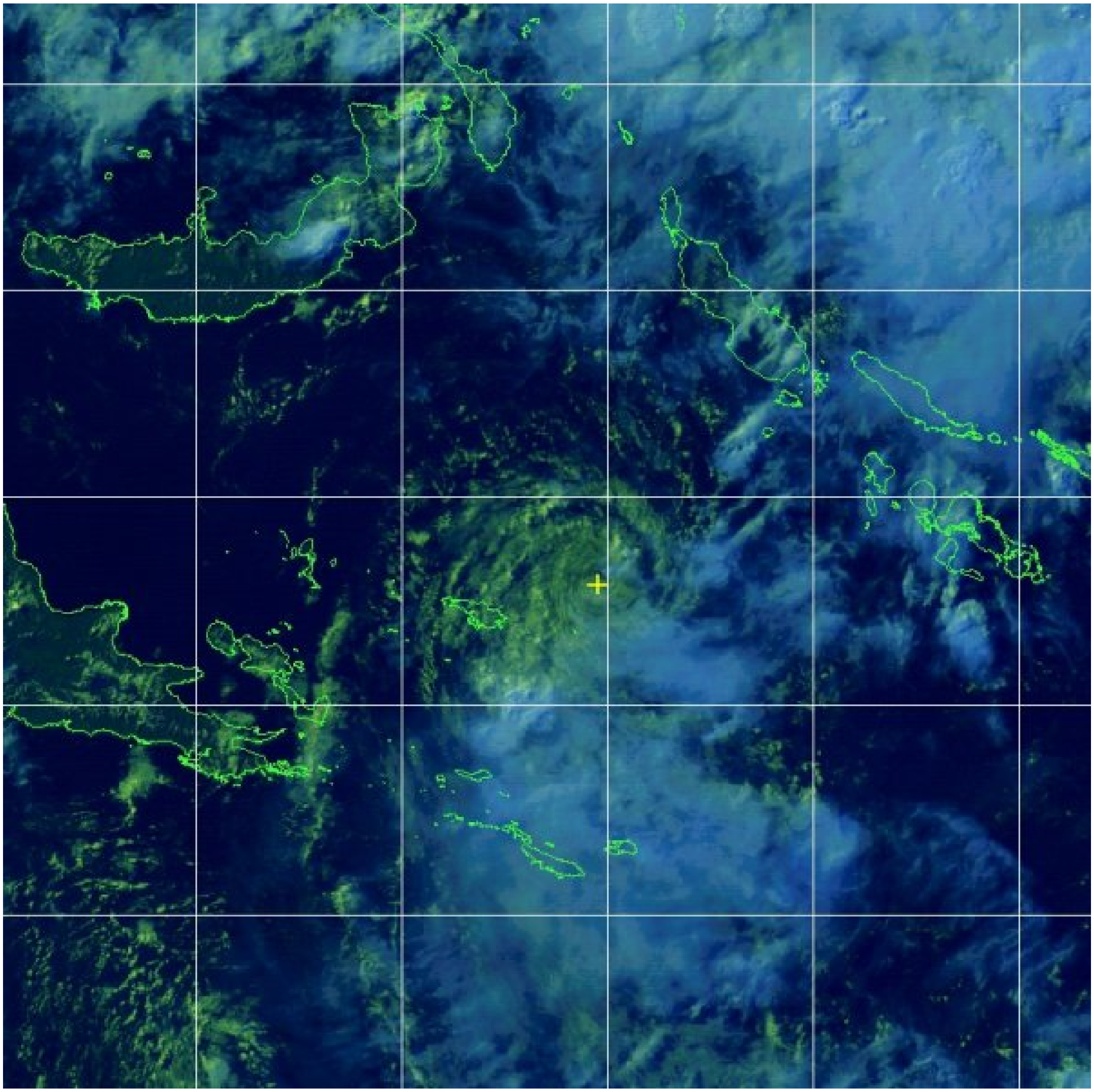
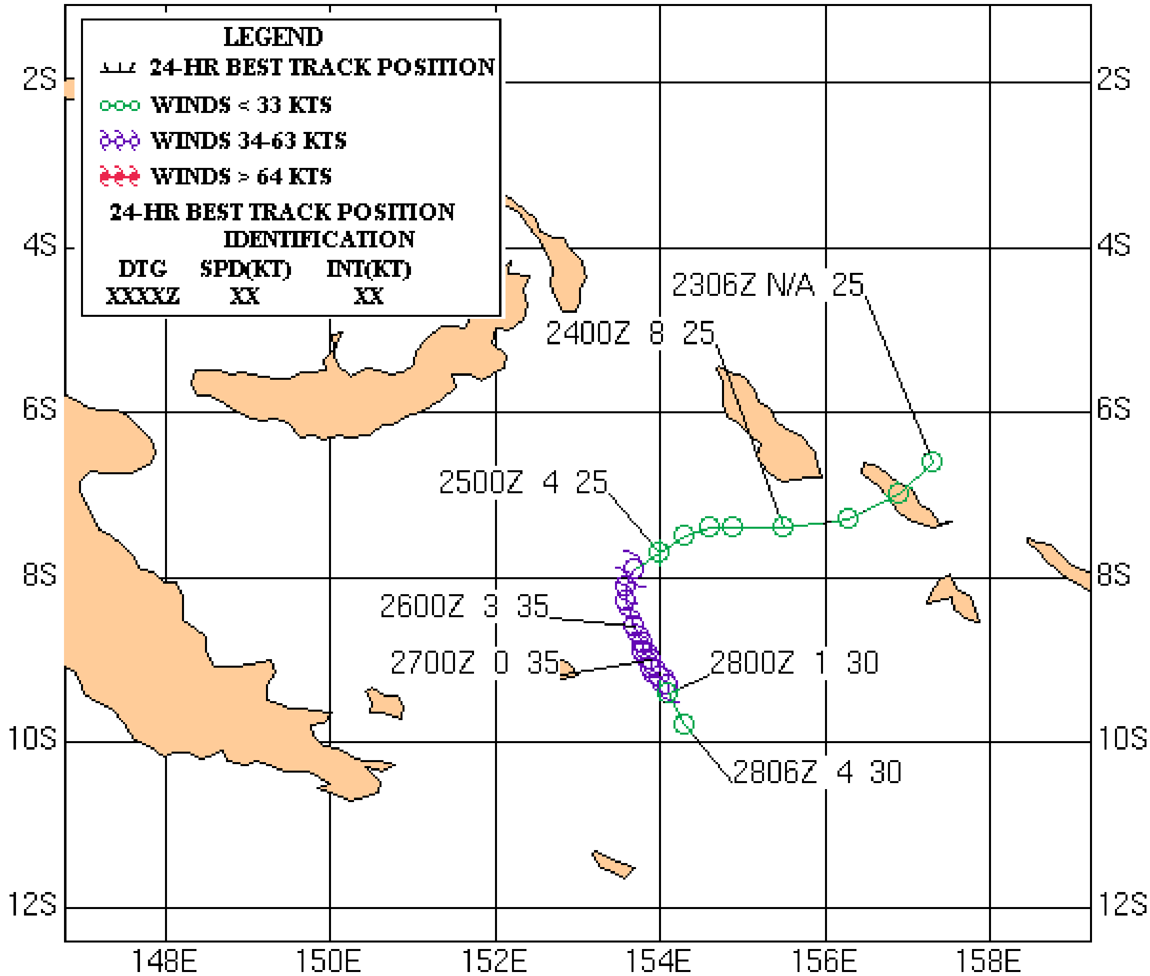


Figure 2-25P-2. 270530Z May 2002 multi-spectral satellite imagery of TC 25P (Upia) revealing a fully exposed low level circulation. At this time, the system was located approximately 355 nm west of Honiara, Solomon Islands with an estimated intensity of 35 knots.

# TROPICAL CYCLONE 25P (UPIA)
## 25-28 MAY 2002



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4.1 ANNUAL FORECAST VERIFICATION

4.2 TESTING AND RESULTS

## 4.2 TESTING AND RESULTS

A comparison of selected techniques is included in Table 4-4 for all western North Pacific tropical cyclones, Table 4-5 for North Indian Ocean tropical cyclones, and Table 4-6 for Southern Hemisphere tropical cyclones. For example, in Table 4-5 for the homogeneous comparison of the 12-hour mean forecast error between JTWC and NGPS, 324 cases were available. The average forecast error at 12 hours was 62 nm for NGPS and 48 nm for JTWC. The difference of 14 nm is shown in the lower right. Due to computational round-off, differences are not always exact.

## Table 4-4 Error Statistics for Selected Objective Techniques

## Western North Pacific Ocean

**12-HOUR MEAN FORECAST ERROR (NM)**

| | JTWC | | NGPS | | EGRR | | AFW1 | | GFDN | | JGSM | | JTYM | | JAVN | | CLIP | | CONU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JTWC | 715 | 40 | | | | | | | | | | | | | | | | | | |
| | 40 | 0 | | | | | | | | | | | | | | | | | | |
| NGPS | 676 | 40 | 745 | 62 | | | | | | | | | | | | | | | | |
| | 57 | 17 | 62 | 0 | | | | | | | | | | | | | | | | |
| EGRR | 347 | 40 | 349 | 58 | 387 | 60 | | | | | | | | | | | | | | |
| | 57 | 17 | 57 | -1 | 60 | 0 | | | | | | | | | | | | | | |
| AFW1 | 284 | 40 | 282 | 55 | 273 | 54 | 284 | 70 | | | | | | | | | | | | |
| | 70 | 30 | 70 | 15 | 70 | 16 | 70 | 0 | | | | | | | | | | | | |
| GFDN | 304 | 39 | 301 | 55 | 7 | 103 | 0 | 0 | 323 | 49 | | | | | | | | | | |
| | 49 | 10 | 48 | -7 | 46 | -57 | 0 | 0 | 49 | 0 | | | | | | | | | | |
| JGSM | 274 | 37 | 271 | 52 | 264 | 52 | 230 | 63 | 2 | 33 | 278 | 61 | | | | | | | | |
| | 61 | 24 | 61 | 9 | 60 | 8 | 60 | -3 | 89 | 56 | 61 | 0 | | | | | | | | |
| JTYM | 520 | 36 | 512 | 53 | 258 | 54 | 224 | 64 | 240 | 45 | 246 | 47 | 524 | 45 | | | | | | |
| | 45 | 9 | 45 | -8 | 46 | -8 | 45 | -19 | 43 | -2 | 45 | -2 | 45 | 0 | | | | | | |
| JAVN | 590 | 38 | 619 | 61 | 319 | 58 | 241 | 67 | 262 | 46 | 240 | 64 | 445 | 45 | 707 | 70 | | | | |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 62 | 24 | 65 | 4 | 62 | 4 | 61 | -6 | 58 | 12 | 56 | -8 | 58 | 13 | 70 | 0 | | | | |
| CLIP | 714 | 40 | 740 | 62 | 383 | 59 | 283 | 70 | 322 | 49 | 277 | 61 | 522 | 46 | 676 | 67 | 856 | 57 | | |
| | 53 | 13 | 54 | -8 | 53 | -6 | 52 | -18 | 53 | 4 | 50 | -11 | 50 | 4 | 54 | -13 | 57 | 0 | | |
| CONU | 682 | 40 | 698 | 57 | 353 | 57 | 280 | 69 | 309 | 47 | 272 | 61 | 513 | 45 | 615 | 61 | 751 | 54 | 753 | 43 |
| | 41 | 1 | 42 | -15 | 41 | -16 | 40 | -29 | 41 | -6 | 37 | -24 | 37 | -8 | 41 | -20 | 43 | -11 | 43 | 0 |

**24-HOUR MEAN FORECAST ERROR (NM)**

| | JTWC | | NGPS | | EGRR | | AFW1 | | GFDN | | JGSM | | JTYM | | JAVN | | CLIP | | CONU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JTWC | 659 | 66 | | | | | | | | | | | | | | | | | | |
| | 66 | 0 | | | | | | | | | | | | | | | | | | |
| NGPS | 629 | 65 | 695 | 91 | | | | | | | | | | | | | | | | |
| | 85 | 20 | 91 | 0 | | | | | | | | | | | | | | | | |
| EGRR | 321 | 66 | 324 | 87 | 362 | 86 | | | | | | | | | | | | | | |
| | 86 | 20 | 83 | -4 | 86 | 0 | | | | | | | | | | | | | | |
| AFW1 | 263 | 63 | 261 | 85 | 253 | 83 | 263 | 97 | | | | | | | | | | | | |
| | 97 | 34 | 96 | 11 | 97 | 14 | 97 | 0 | | | | | | | | | | | | |
| GFDN | 281 | 64 | 280 | 84 | 7 | 134 | 0 | 0 | 300 | 79 | | | | | | | | | | |
| | 79 | 15 | 78 | -6 | 95 | -39 | 0 | 0 | 79 | 0 | | | | | | | | | | |
| JGSM | 259 | 60 | 257 | 80 | 248 | 77 | 217 | 89 | 2 | 32 | 263 | 89 | | | | | | | | |
| | 89 | 29 | 88 | 8 | 89 | 12 | 88 | -1 | 71 | 39 | 89 | 0 | | | | | | | | |
| JTYM | 491 | 60 | 484 | 80 | 243 | 82 | 212 | 90 | 226 | 74 | 234 | 74 | 494 | 74 | | | | | | |
| | 74 | 14 | 73 | -7 | 75 | -7 | 74 | -16 | 71 | -3 | 75 | 1 | 74 | 0 | | | | | | |
| JAVN | 541 | 64 | 570 | 89 | 295 | 80 | 219 | 95 | 243 | 75 | 226 | 93 | 412 | 73 | 653 | 91 | | | | |
| | 81 | 17 | 86 | -3 | 83 | 3 | 81 | -14 | 75 | 0 | 76 | -17 | 75 | 2 | 91 | 0 | | | | |
| CLIP | 658 | 66 | 690 | 90 | 358 | 85 | 262 | 97 | 299 | 79 | 262 | 89 | 492 | 74 | 623 | 88 | 796 | 106 | | |
| | 104 | 38 | 104 | 14 | 102 | 17 | 101 | 4 | 103 | 24 | 101 | 12 | 101 | 27 | 103 | 15 | 106 | 0 | | |
| CONU | 630 | 65 | 649 | 85 | 330 | 83 | 260 | 96 | 288 | 76 | 258 | 87 | 486 | 72 | 565 | 81 | 696 | 103 | 698 | 66 |
| | 64 | -1 | 65 | -20 | 63 | -20 | 63 | -33 | 63 | -13 | 59 | -28 | 59 | -13 | 64 | -17 | 66 | -37 | 66 | 0 |

**36-HOUR MEAN FORECAST ERROR (NM)**

| | JTWC | | NGPS | | EGRR | | AFW1 | | GFDN | | JGSM | | JTYM | | JAVN | | CLIP | | CONU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JTWC | 597 | 91 | | | | | | | | | | | | | | | | | | |
| | 91 | 0 | | | | | | | | | | | | | | | | | | |
| NGPS | 572 | 90 | 637 | 122 | | | | | | | | | | | | | | | | |
| | 117 | 27 | 122 | 0 | | | | | | | | | | | | | | | | |
| EGRR | 285 | 91 | 292 | 116 | 325 | 111 | | | | | | | | | | | | | | |
| | 112 | 21 | 110 | -6 | 111 | 0 | | | | | | | | | | | | | | |
| AFW1 | 236 | 87 | 236 | 114 | 225 | 106 | 237 | 121 | | | | | | | | | | | | |
| | 121 | 34 | 121 | 7 | 118 | 12 | 121 | 0 | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GFDN | 256 | 88 | 255 | 115 | 7 | 183 | 0 | 0 | 275 | 105 | | | | | | | | | | |
| | 105 | 17 | 103 | -12 | 156 | -27 | 0 | 0 | 105 | 0 | | | | | | | | | | |
| JGSM | 234 | 85 | 233 | 108 | 224 | 104 | 195 | 114 | 2 | 63 | 238 | 113 | | | | | | | | |
| | 114 | 29 | 114 | 6 | 114 | 10 | 113 | -1 | 72 | 9 | 113 | 0 | | | | | | | | |
| JTYM | 446 | 82 | 440 | 111 | 218 | 104 | 190 | 113 | 206 | 100 | 212 | 97 | 449 | 102 | | | | | | |
| | 103 | 21 | 101 | -10 | 104 | 0 | 101 | -12 | 101 | 1 | 103 | 6 | 102 | 0 | | | | | | |
| JAVN | 497 | 89 | 524 | 120 | 262 | 105 | 198 | 118 | 225 | 103 | 202 | 117 | 376 | 101 | 603 | 111 | | | | |
| | 100 | 11 | 105 | -15 | 101 | -4 | 100 | -18 | 97 | -6 | 93 | -24 | 94 | -7 | 111 | 0 | | | | |
| CLIP | 596 | 91 | 634 | 122 | 321 | 111 | 236 | 121 | 274 | 105 | 237 | 114 | 447 | 103 | 576 | 108 | 735 | 160 | | |
| | 159 | 68 | 157 | 35 | 152 | 41 | 153 | 32 | 161 | 56 | 157 | 43 | 157 | 54 | 156 | 48 | 160 | 0 | | |
| CONU | 573 | 90 | 595 | 116 | 296 | 107 | 235 | 119 | 264 | 101 | 234 | 112 | 442 | 100 | 521 | 101 | 641 | 158 | 643 | 91 |
| | 90 | 0 | 91 | -25 | 89 | -18 | 88 | -31 | 88 | -13 | 84 | -28 | 82 | -18 | 90 | -11 | 91 | -67 | 91 | 0 |

**48-HOUR MEAN FORECAST ERROR (NM)**

| | JTWC | | NGPS | | EGRR | | AFW1 | | GFDN | | JGSM | | JTYM | | JAVN | | CLIP | | CONU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JTWC | 538 | 116 | | | | | | | | | | | | | | | | | | |
| | 116 | 0 | | | | | | | | | | | | | | | | | | |
| NGPS | 516 | 114 | 579 | 157 | | | | | | | | | | | | | | | | |
| | 153 | 39 | 157 | 0 | | | | | | | | | | | | | | | | |
| EGRR | 255 | 113 | 264 | 148 | 297 | 137 | | | | | | | | | | | | | | |
| | 140 | 27 | 135 | -13 | 137 | 0 | | | | | | | | | | | | | | |
| AFW1 | 211 | 110 | 212 | 147 | 199 | 134 | 212 | 149 | | | | | | | | | | | | |
| | 149 | 39 | 149 | 2 | 144 | 10 | 149 | 0 | | | | | | | | | | | | |
| GFDN | 224 | 111 | 225 | 151 | 6 | 156 | 0 | 0 | 244 | 139 | | | | | | | | | | |
| | 139 | 28 | 138 | -13 | 151 | -5 | 0 | 0 | 139 | 0 | | | | | | | | | | |
| JGSM | 210 | 106 | 210 | 137 | 201 | 130 | 175 | 140 | 2 | 71 | 215 | 137 | | | | | | | | |
| | 138 | 32 | 137 | 0 | 137 | 7 | 142 | 2 | 73 | 2 | 137 | 0 | | | | | | | | |
| JTYM | 401 | 106 | 401 | 146 | 198 | 130 | 173 | 140 | 186 | 134 | 191 | 118 | 407 | 138 | | | | | | |
| | 138 | 32 | 137 | -9 | 133 | 3 | 132 | -8 | 139 | 5 | 135 | 17 | 138 | 0 | | | | | | |
| JAVN | 443 | 111 | 469 | 155 | 241 | 127 | 177 | 146 | 197 | 134 | 185 | 140 | 337 | 135 | 544 | 137 | | | | |
| | 124 | 13 | 129 | -26 | 124 | -3 | 123 | -23 | 124 | -10 | 116 | -24 | 119 | -16 | 137 | 0 | | | | |
| CLIP | 537 | 116 | 576 | 157 | 293 | 137 | 211 | 149 | 243 | 139 | 214 | 138 | 405 | 138 | 519 | 134 | 675 | 216 | | |
| | 216 | 100 | 216 | 59 | 212 | 75 | 212 | 63 | 223 | 84 | 218 | 80 | 218 | 80 | 210 | 76 | 216 | 0 | | |
| CONU | 516 | 114 | 537 | 152 | 268 | 136 | 211 | 147 | 235 | 136 | 212 | 137 | 401 | 135 | 468 | 125 | 583 | 218 | 585 | 116 |
| | 114 | 0 | 115 | -37 | 111 | -25 | 113 | -34 | 110 | -26 | 106 | -31 | 105 | -30 | 113 | -12 | 116 | -102 | 116 | 0 |

**72-HOUR MEAN FORECAST ERROR (NM)**

| | JTWC | | NGPS | | EGRR | | AFW1 | | GFDN | | JGSM | | JTYM | | JAVN | | CLIP | | CONU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JTWC | 424 | 163 | | | | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 163 | 0 | | | | | | | | | | | | | | | | | | |
| NGPS | 404 | 159 | 462 | 216 | | | | | | | | | | | | | | | | |
| | 214 | 55 | 216 | 0 | | | | | | | | | | | | | | | | |
| EGRR | 197 | 162 | 204 | 202 | 238 | 208 | | | | | | | | | | | | | | |
| | 206 | 44 | 203 | 1 | 208 | 0 | | | | | | | | | | | | | | |
| AFW1 | 163 | 160 | 163 | 199 | 153 | 209 | 165 | 207 | | | | | | | | | | | | |
| | 207 | 47 | 204 | 5 | 198 | -11 | 207 | 0 | | | | | | | | | | | | |
| GFDN | 169 | 158 | 174 | 215 | 4 | 109 | 0 | 0 | 191 | 209 | | | | | | | | | | |
| | 212 | 54 | 212 | -3 | 176 | 67 | 0 | 0 | 209 | 0 | | | | | | | | | | |
| JGSM | 166 | 156 | 165 | 191 | 160 | 202 | 138 | 198 | 2 | 101 | 172 | 196 | | | | | | | | |
| | 197 | 41 | 196 | 5 | 196 | -6 | 209 | 11 | 157 | 56 | 196 | 0 | | | | | | | | |
| JTYM | 321 | 156 | 321 | 203 | 162 | 205 | 140 | 192 | 147 | 205 | 154 | 174 | 329 | 208 | | | | | | |
| | 207 | 51 | 209 | 6 | 196 | -9 | 198 | 6 | 211 | 6 | 198 | 24 | 208 | 0 | | | | | | |
| JAVN | 353 | 161 | 371 | 218 | 188 | 200 | 138 | 200 | 150 | 206 | 148 | 203 | 271 | 206 | 439 | 190 | | | | |
| | 178 | 17 | 180 | -38 | 172 | -28 | 178 | -22 | 184 | -22 | 167 | -36 | 177 | -29 | 190 | 0 | | | | |
| CLIP | 422 | 164 | 459 | 216 | 235 | 209 | 164 | 208 | 189 | 207 | 171 | 197 | 326 | 209 | 421 | 188 | 560 | 332 | | |
| | 336 | 172 | 331 | 115 | 333 | 124 | 336 | 128 | 343 | 136 | 345 | 148 | 347 | 138 | 323 | 135 | 332 | 0 | | |
| CONU | 407 | 161 | 426 | 212 | 211 | 205 | 165 | 207 | 184 | 208 | 169 | 195 | 326 | 207 | 376 | 182 | 471 | 336 | 474 | 168 |
| | 166 | 5 | 164 | -48 | 160 | -45 | 164 | -43 | 158 | -50 | 156 | -39 | 155 | -52 | 165 | -17 | 168 | -168 | 168 | 0 |

**96-HOUR MEAN FORECAST ERROR (NM)**

| | JTWC | | NGPS | | EGRR | | JGSM | | JTYM | | JAVN | | CONU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JTWC | 290 | 225 | | | | | | | | | | | | |
| | 225 | 0 | | | | | | | | | | | | |
| NGPS | 267 | 225 | 338 | 257 | | | | | | | | | | |
| | 251 | 26 | 257 | 0 | | | | | | | | | | |
| EGRR | 131 | 223 | 146 | 252 | 177 | 273 | | | | | | | | |
| | 271 | 48 | 264 | 12 | 273 | 0 | | | | | | | | |
| JGSM | 2 | 163 | 2 | 152 | 1 | 187 | 2 | 319 | | | | | | |
| | 319 | 156 | 319 | 167 | 510 | 323 | 319 | 0 | | | | | | |
| JTYM | 3 | 182 | 2 | 244 | 2 | 209 | 1 | 510 | 3 | 509 | | | | |
| | 509 | 327 | 487 | 243 | 487 | 278 | 500 | -10 | 509 | 0 | | | | |
| JAVN | 246 | 225 | 280 | 264 | 138 | 273 | 1 | 510 | 2 | 487 | 342 | 263 | | |
| | 251 | 26 | 247 | -17 | 244 | -29 | 144 | -366 | 146 | -341 | 263 | 0 | | |
| CONU | 277 | 226 | 294 | 251 | 150 | 262 | 2 | 319 | 3 | 509 | 276 | 251 | 342 | 220 |
| | 217 | -9 | 214 | -37 | 214 | -48 | 229 | -90 | 240 | -269 | 222 | -29 | 220 | 0 |

**120-HOUR MEAN FORECAST ERROR (NM)**

| | JTWC | | NGPS | | EGRR | | JGSM | | JTYM | | JAVN | | CONU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JTWC | 229 | 278 | | | | | | | | | | | | |
| | 278 | 0 | | | | | | | | | | | | |
| NGPS | 204 | 271 | 257 | 291 | | | | | | | | | | |
| | 293 | 22 | 291 | 0 | | | | | | | | | | |
| EGRR | 98 | 277 | 105 | 287 | 130 | 327 | | | | | | | | |
| | 331 | 54 | 317 | 30 | 327 | 0 | | | | | | | | |
| JGSM | 1 | 613 | 1 | 481 | 1 | 584 | 1 | 877 | | | | | | |
| | 877 | 264 | 877 | 396 | 877 | 293 | 877 | 0 | | | | | | |
| JTYM | 2 | 397 | 1 | 481 | 1 | 584 | 1 | 877 | 2 | 650 | | | | |
| | 650 | 253 | 796 | 315 | 796 | 212 | 796 | -81 | 650 | 0 | | | | |
| JAVN | 181 | 279 | 201 | 297 | 101 | 323 | 1 | 877 | 1 | 796 | 260 | 326 | | |
| | 307 | 28 | 303 | 6 | 298 | -25 | 534 | -343 | 534 | -262 | 326 | 0 | | |
| CONU | 214 | 272 | 218 | 285 | 110 | 314 | 1 | 877 | 2 | 650 | 201 | 312 | 258 | 262 |
| | 260 | -12 | 245 | -40 | 273 | -41 | 600 | -277 | 393 | -257 | 266 | -46 | 262 | 0 |

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4.1 ANNUAL FORECAST VERIFICATION

4.2 TESTING AND RESULTS

## 4.1.4 SOUTH PACIFIC AND SOUTH INDIAN OCEANS (SOUTHERN HEMISPHERE)

Table 4-3 includes mean track, along-track and cross-track errors for a 16-year period. Figure 4-5 shows mean track errors and a 5-year running mean of track errors at 24- and 48-hours since 1981, and at 72-hours since 1995.

**Table 4-3**

**JTWC INITIAL POSITION AND FORECAST ERRORS (NM) FOR THE**

**SOUTHERN HEMISPHERE 1985-2002**

| | Initial Position | | 24-Hour | | | | 48-Hour | | | | 72-Hour | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number | Error | Number | Track | Along | Cross | Number | Track | Along | Cross | Number | Track | Along | Cross |
| **1985** | 306 | 36 | 257 | 134 | 92 | 79 | 193 | 236 | 169 | 132 | | | | |
| **1986** | 279 | 40 | 227 | 129 | 86 | 77 | 171 | 262 | 169 | 164 | | | | |
| **1987** | 189 | 46 | 138 | 145 | 94 | 90 | 101 | 280 | 153 | 138 | | | | |
| **1988** | 204 | 34 | 99 | 146 | 98 | 83 | 48 | 290 | 246 | 144 | | | | |
| **1989** | 287 | 31 | 242 | 124 | 84 | 73 | 186 | 240 | 166 | 136 | | | | |
| **1990** | 272 | 27 | 228 | 143 | 105 | 74 | 177 | 263 | 178 | 152 | | | | |
| **1991** | 264 | 24 | 231 | 115 | 75 | 69 | 185 | 220 | 152 | 129 | | | | |
| **1992** | 267 | 28 | 230 | 124 | 91 | 64 | 208 | 240 | 177 | 129 | | | | |
| **1993** | 257 | 21 | 225 | 102 | 74 | 57 | 176 | 199 | 142 | 114 | | | | |
| **1994** | 386 | 28 | 345 | 115 | 77 | 68 | 282 | 224 | 147 | 134 | | | | |
| **1995** | 245 | 24 | 222 | 108 | 82 | 55 | 175 | 198 | 144 | 108 | 53 | 291 | 169 | 190 |
| **1996** | 343 | 24 | 298 | 125 | 90 | 67 | 237 | 240 | 174 | 129 | 46 | 277 | 221 | 133 |
| **1997** | 561 | 24 | 499 | 109 | 82 | 72 | 442 | 210 | 163 | 135 | 150 | 288 | 248 | 175 |
| **1998** | 329 | 26 | 305 | 111 | 85 | 52 | 245 | 219 | 169 | 108 | 81 | 349 | 261 | 171 |
| **1999** | 348 | 17 | 322 | 113 | 80 | 64 | 245 | 226 | 159 | 132 | 59 | 286 | 198 | 164 |
| **2000** | 384 | 12 | 313 | 72 | 47 | 45 | 245 | 135 | 84 | 86 | 58 | 180 | 94 | 139 |
| **2001** | 187 | 13 | 147 | 84 | 61 | 44 | 113 | 148 | 105 | 86 | 11 | 248 | 132 | 197 |
| **2002** | 223 | 16 | 200 | 82 | 60 | 43 | 146 | 133 | 93 | 75 | 5 | 102 | 91 | 41 |
| **(1985-2002)** | | | | | | | | | | | | | | |
| **Avg** | 296 | 26 | 252 | 116 | 82 | 65 | 199 | 220 | 155 | 124 | 58* | 253* | 177* | 151* |
| ***8-year average** | | | | | | | | | | | | | | |

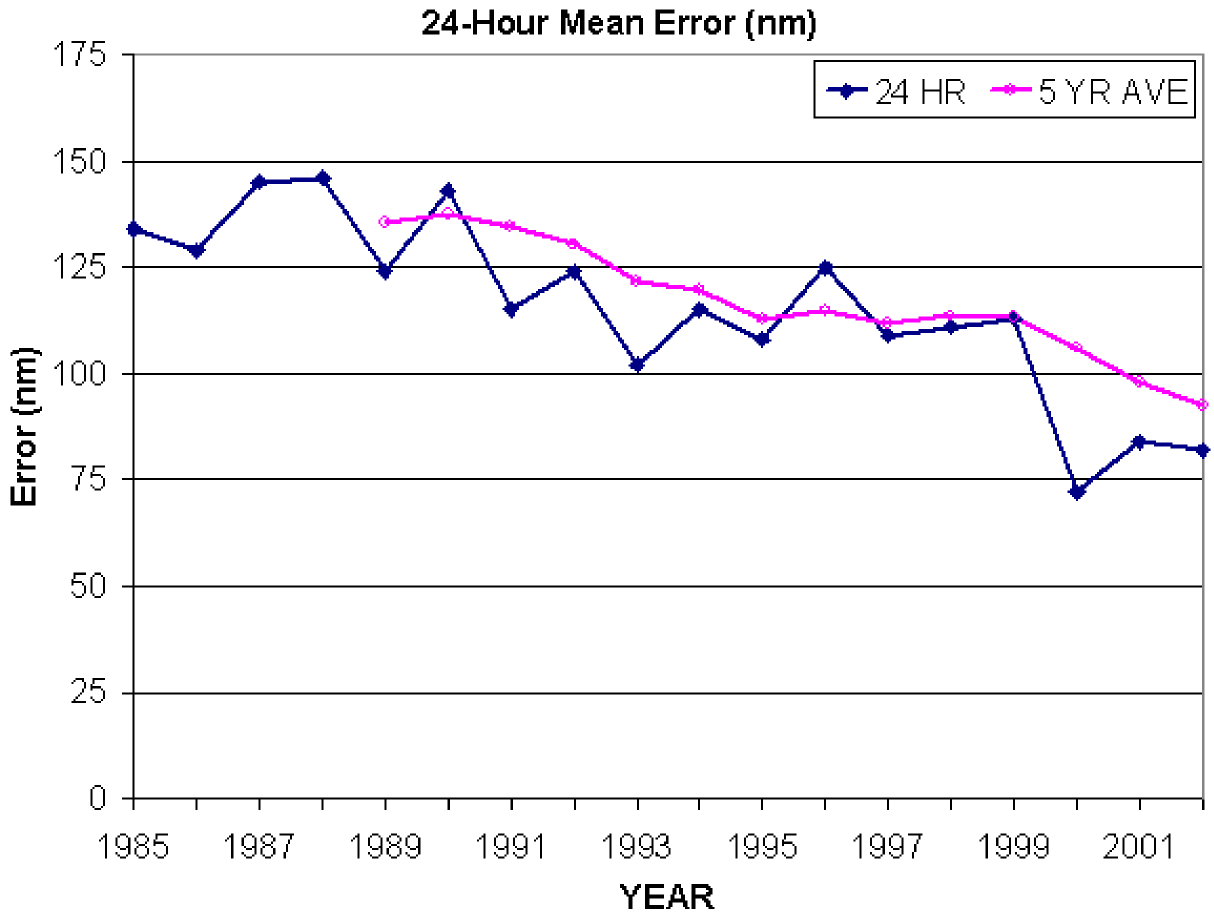


Figure 4-5a. Mean track forecast error (nm) and 5-year running mean for 24 hours for Southern Hemisphere (Africa to 180 degrees) tropical cyclones from 1981-2002.

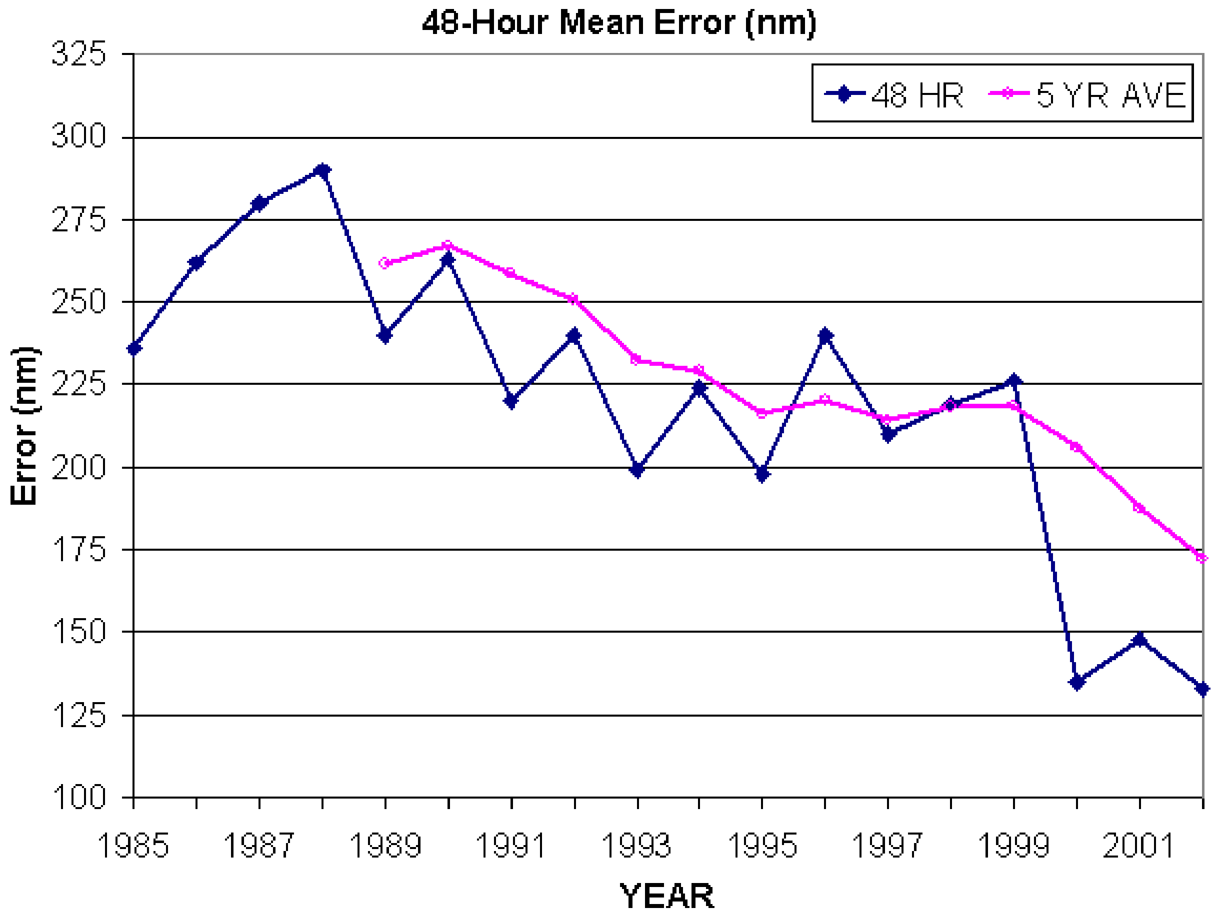


Figure 4-5b. Mean track forecast error (nm) and 5-year running mean for 48 hours for Southern Hemisphere (Africa to 180 degrees) tropical cyclones from 1981-2002.

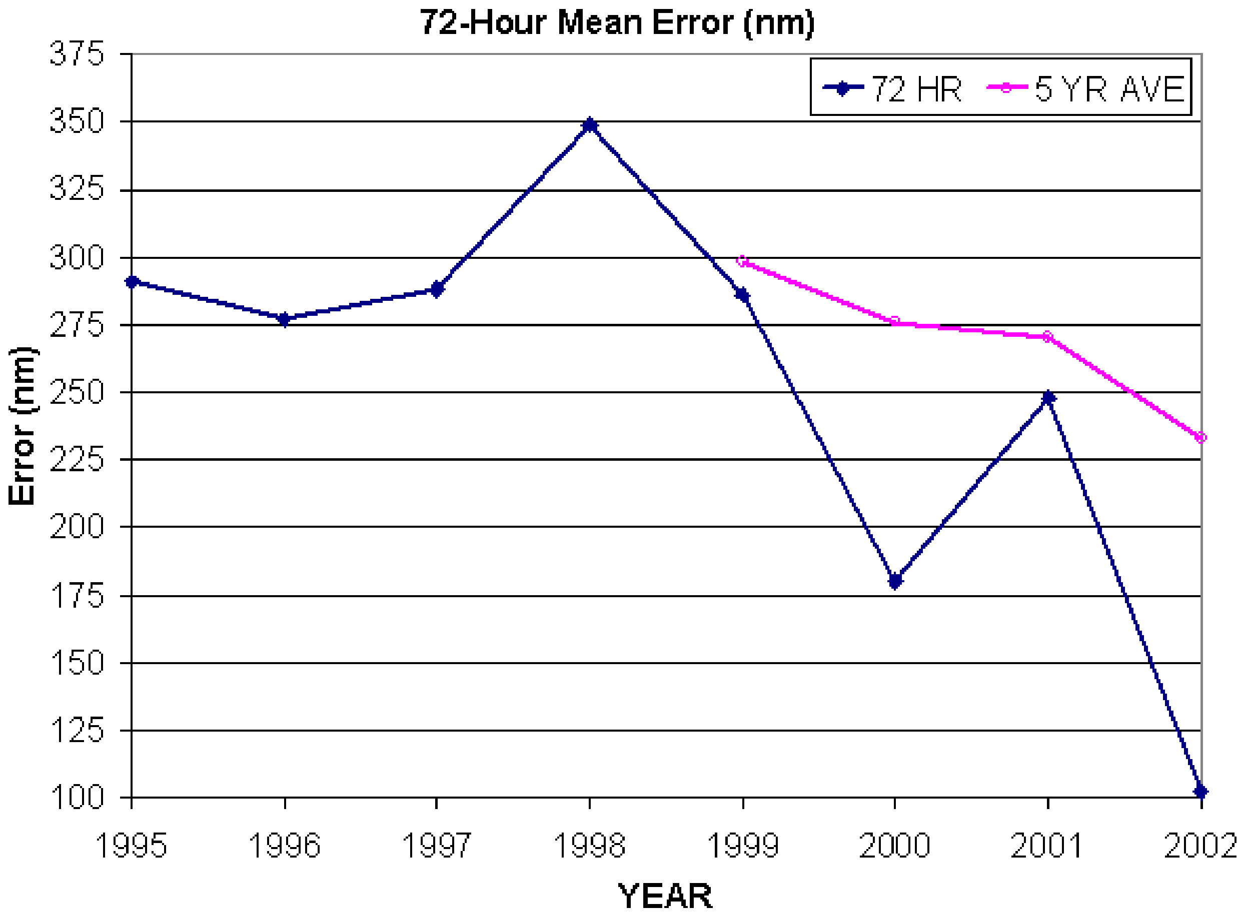


Figure 4-5c. Mean track forecast error (nm) at 72 hours for Southern Hemisphere (Africa to 180 degrees) tropical cyclones from 1995-2002.

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4.1 ANNUAL FORECAST VERIFICATION

4.2 TESTING AND RESULTS

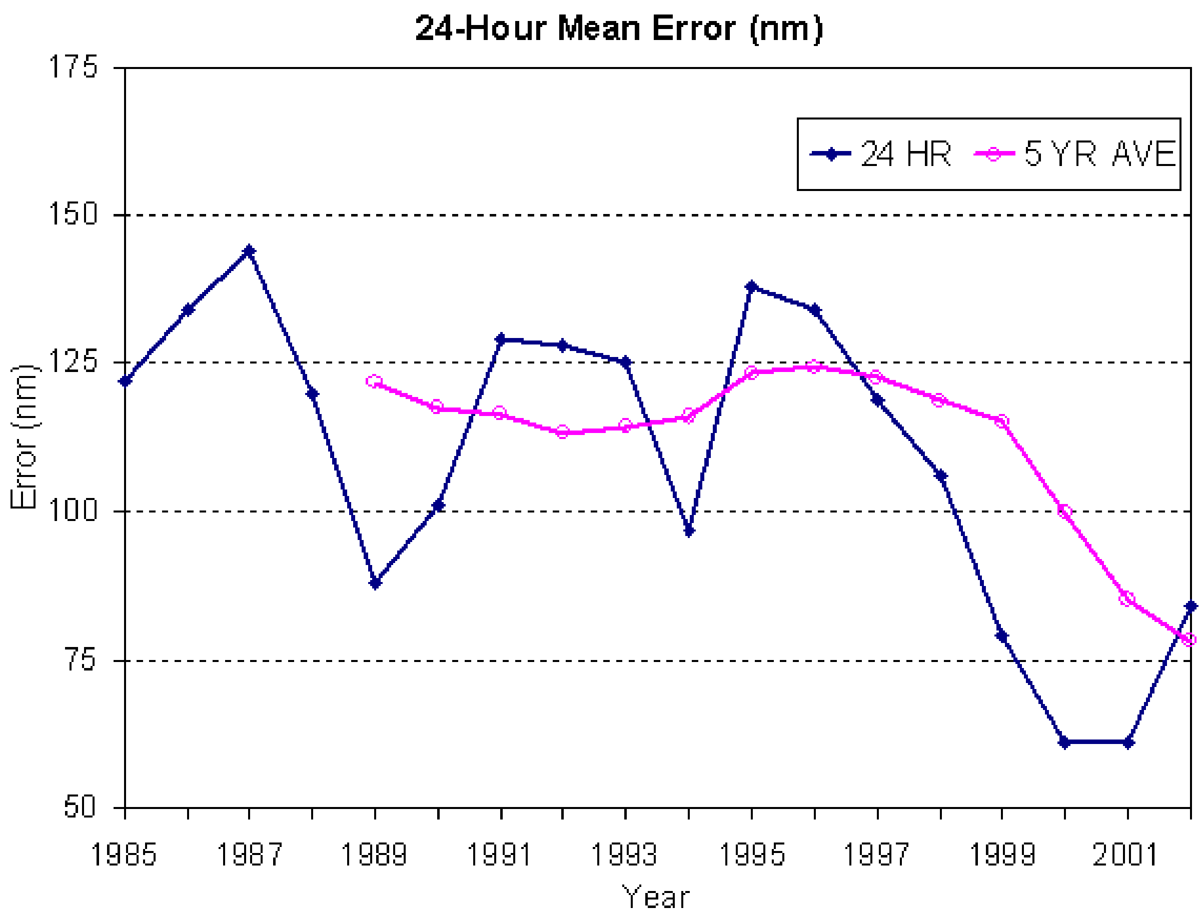


Figure 4-4a. Mean track forecast error (nm) and 5-year running mean for 24 hours for North Indian Ocean tropical cyclones from 1985-2002.

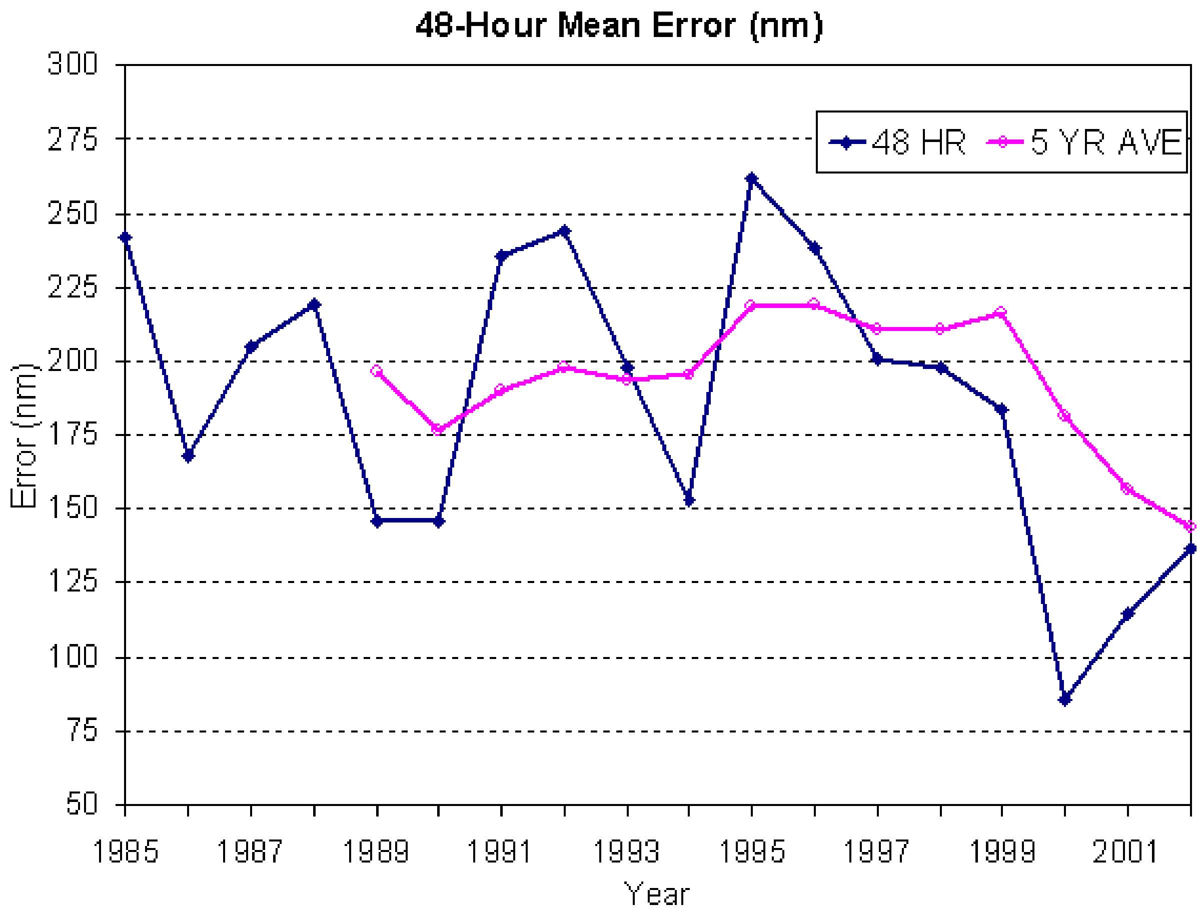


Figure 4-4b. Mean track forecast error (nm) and 5-year running mean for 48 hours, for North Indian Ocean tropical cyclones from 1985-2002.

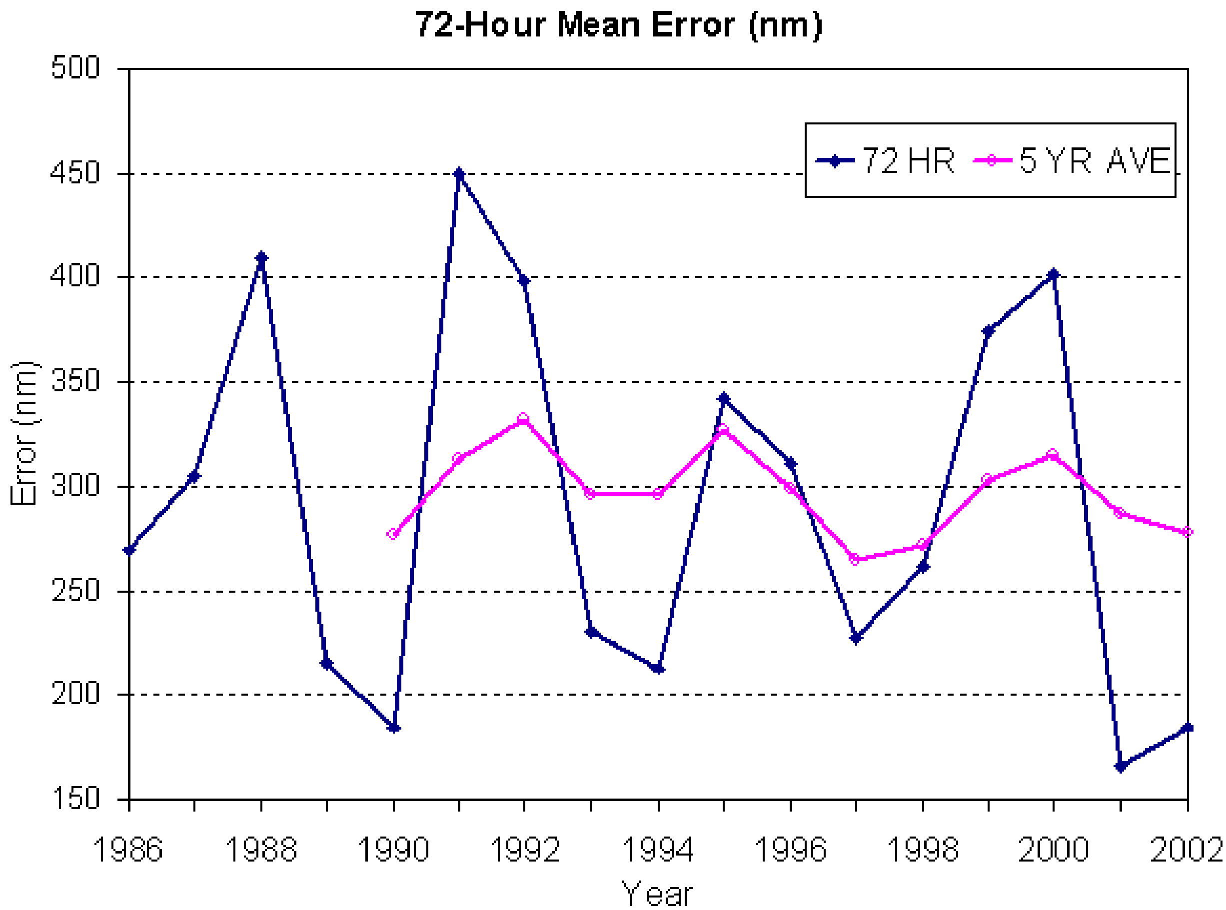


Figure 4-4c. Mean track forecast error (nm) and 5-year running mean for 72 hours for North Indian Ocean tropical cyclones from 1986-2002.

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## 4.1.3 NORTH INDIAN OCEAN

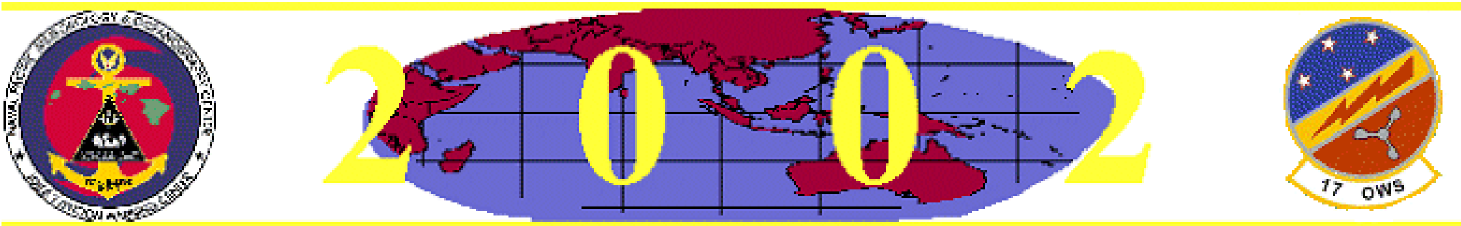
Table 4-2 includes mean track, along-track and cross-track errors for a 16-year period. Figure 4-4 shows mean track errors and a 5-year running mean of track errors at 24- and 48-hours since 1985, and at 72-hours since 1986.

**Table 4-2**

**JTWC INITIAL POSITION AND FORECAST ERRORS (NM) FOR THE NORTH INDIAN OCEAN 1985-2002**

| | Initial Position | | 24-Hour | | | | 48-Hour | | | | 72-Hour | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Number** | **Error** | **Number** | **Track** | **Along** | **Cross** | **Number** | **Track** | **Along** | **Cross** | **Number** | **Track** | **Along** | **Cross** |
| **1985** | 53 | 31 | 30 | 122 | 102 | 53 | 8 | 242 | 119 | 194 | 0 | | | |
| **1986** | 28 | 52 | 16 | 134 | 118 | 53 | 7 | 168 | 131 | 80 | 5 | 269 | 189 | 180 |
| **1987** | 83 | 42 | 54 | 144 | 97 | 100 | 25 | 205 | 125 | 140 | 21 | 305 | 219 | 188 |
| **1988** | 44 | 34 | 30 | 120 | 89 | 63 | 18 | 219 | 112 | 176 | 12 | 409 | 227 | 303 |
| **1989** | 44 | 19 | 33 | 88 | 62 | 50 | 17 | 146 | 94 | 86 | 12 | 216 | 164 | 11 |
| **1990** | 46 | 31 | 36 | 101 | 85 | 43 | 24 | 146 | 117 | 67 | 17 | 185 | 130 | 104 |
| **1991** | 56 | 38 | 43 | 129 | 107 | 54 | 27 | 235 | 200 | 89 | 14 | 450 | 356 | 178 |
| **1992** | 191 | 35 | 149 | 128 | 73 | 86 | 100 | 244 | 141 | 166 | 62 | 398 | 276 | 218 |
| **1993** | 36 | 27 | 28 | 125 | 87 | 79 | 20 | 198 | 171 | 74 | 12 | 231 | 176 | 116 |
| **1994** | 60 | 25 | 44 | 97 | 80 | 44 | 28 | 153 | 124 | 63 | 13 | 213 | 177 | 92 |
| **1995** | 54 | 30 | 47 | 138 | 119 | 58 | 32 | 262 | 247 | 77 | 20 | 342 | 304 | 109 |
| **1996** | 135 | 33 | 123 | 134 | 94 | 80 | 85 | 238 | 181 | 127 | 58 | 311 | 172 | 237 |
| **1997** | 56 | 29 | 42 | 119 | 87 | 49 | 29 | 201 | 168 | 92 | 17 | 228 | 195 | 110 |
| **1998** | 80 | 20 | 55 | 106 | 84 | 51 | 34 | 198 | 135 | 106 | 17 | 262 | 188 | 144 |
| **1999** | 49 | 8 | 41 | 79 | 59 | 38 | 22 | 184 | 130 | 116 | 10 | 374 | 309 | 177 |
| **2000** | 31 | 15 | 24 | 61 | 47 | 26 | 16 | 85 | 69 | 37 | 1 | 401 | 399 | 38 |
| **2001** | 50 | 12 | 41 | 61 | 40 | 37 | 31 | 115 | 71 | 71 | 22 | 166 | 44 | 154 |
| **2002** | 39 | 53 | 30 | 84 | 41 | 63 | 18 | 137 | 92 | 83 | 10 | 185 | 92 | 133 |
| **(1985-2002)** | | | | | | | | | | | | | | |
| **Avg** | 63 | 29 | 48 | 110 | 82 | 57 | 30 | 188 | 135 | 103 | 19 | 291* | 213* | 146* |

*17 year average (1985 not available)





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4.2 TESTING AND RESULTS

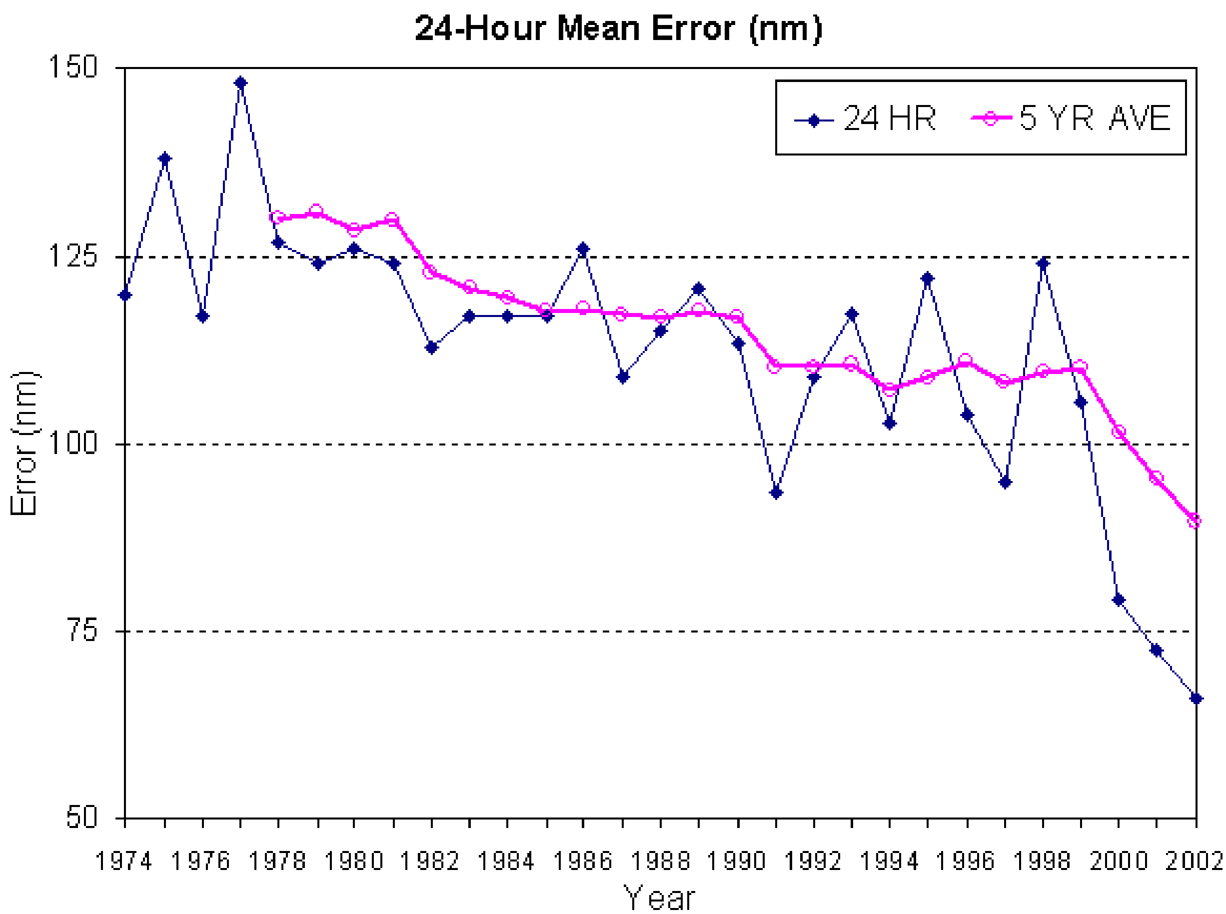


Figure 4-2a. Mean track forecast error (nm) and 5-year running mean for 24 hours for western North Pacific Ocean tropical cyclones from 1974-2002.

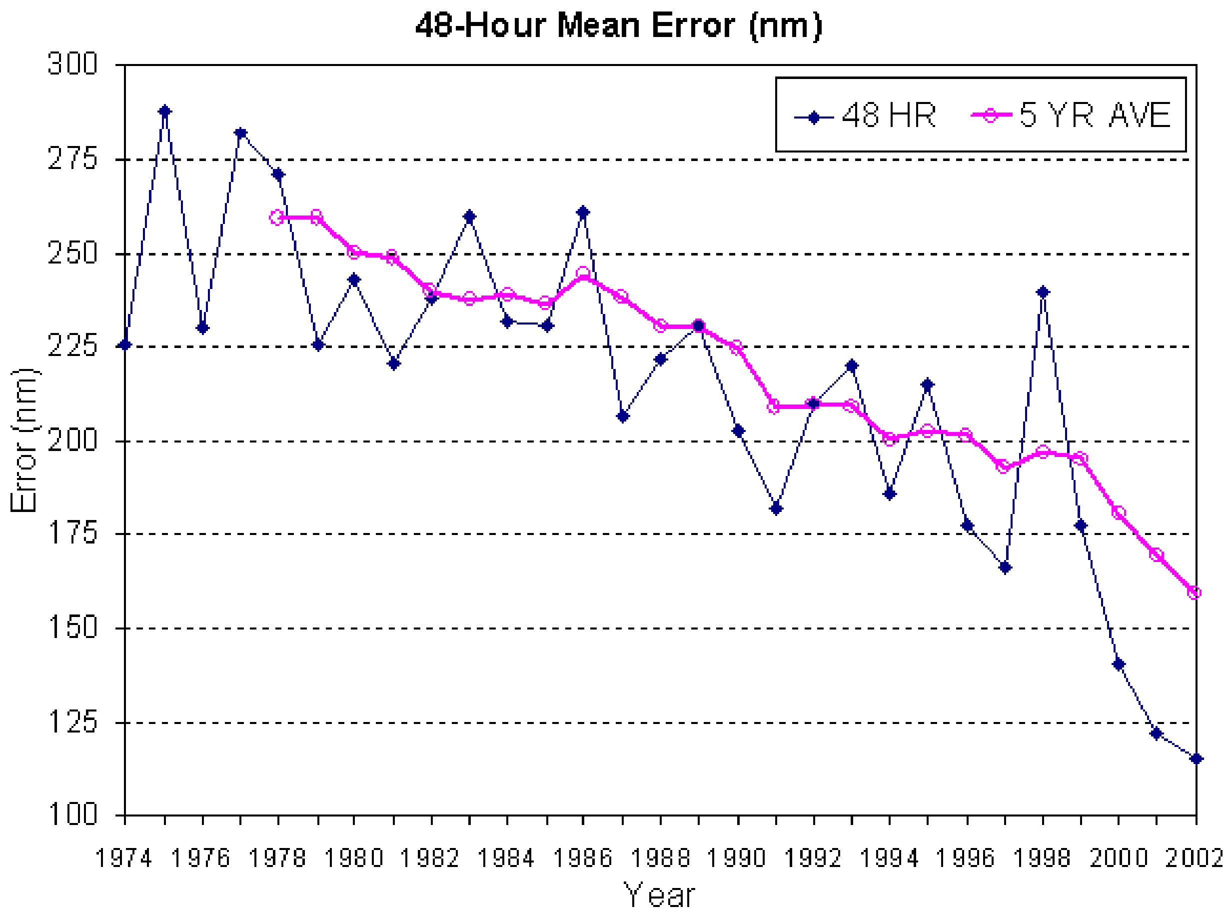


Figure 4-2b. Mean track forecast error (nm) and 5-year running mean for 48 hours for western North Pacific Ocean tropical cyclones from 1974-2002.

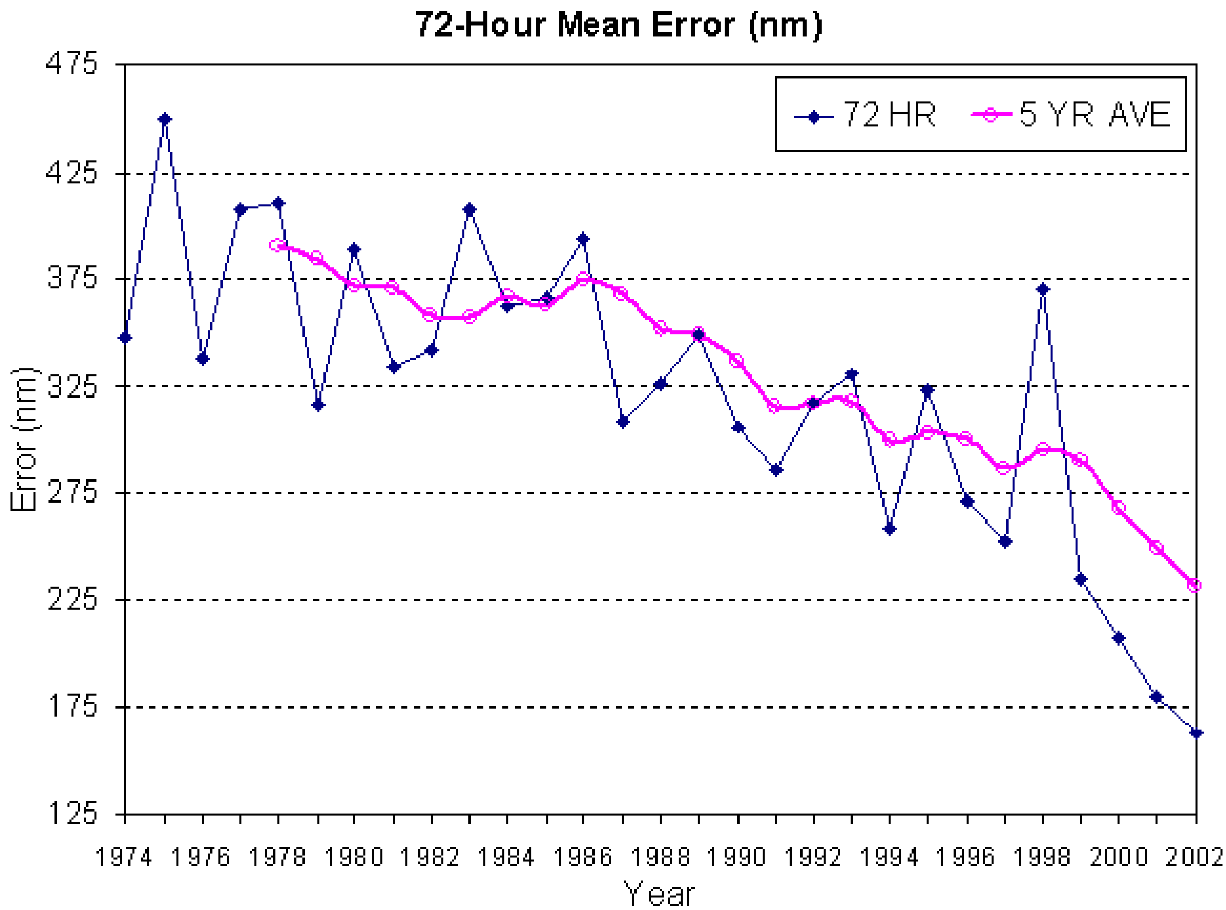


Figure 4-2c. Mean track forecast error (nm) and 5-year running mean for 72 hours for western North Pacific Ocean tropical cyclones from 1974-2002.

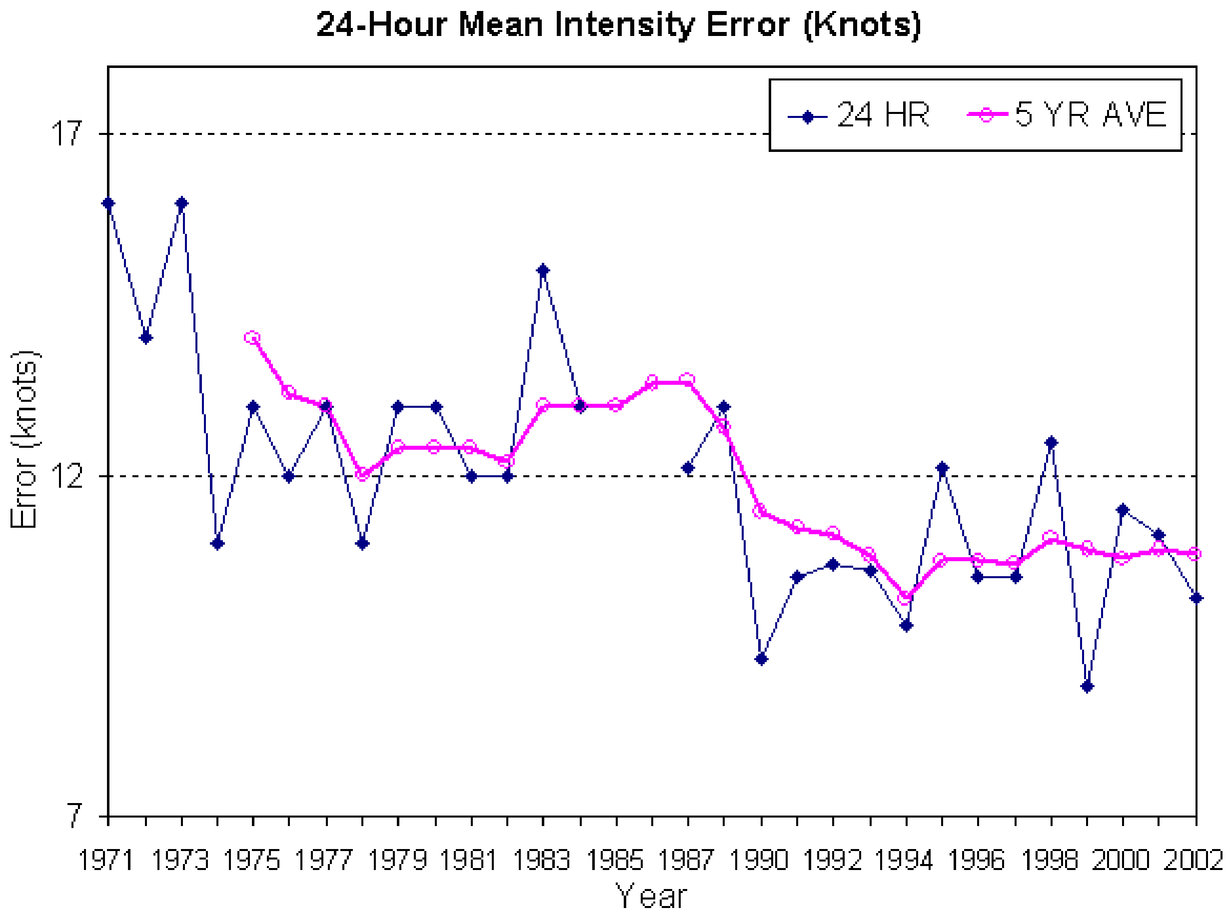


Figure 4-3a. Mean intensity forecast error (kts) and 5-year running mean for 24 hours for western North Pacific tropical cyclones from 1971-2002. Data not available for 1985 and 1986.

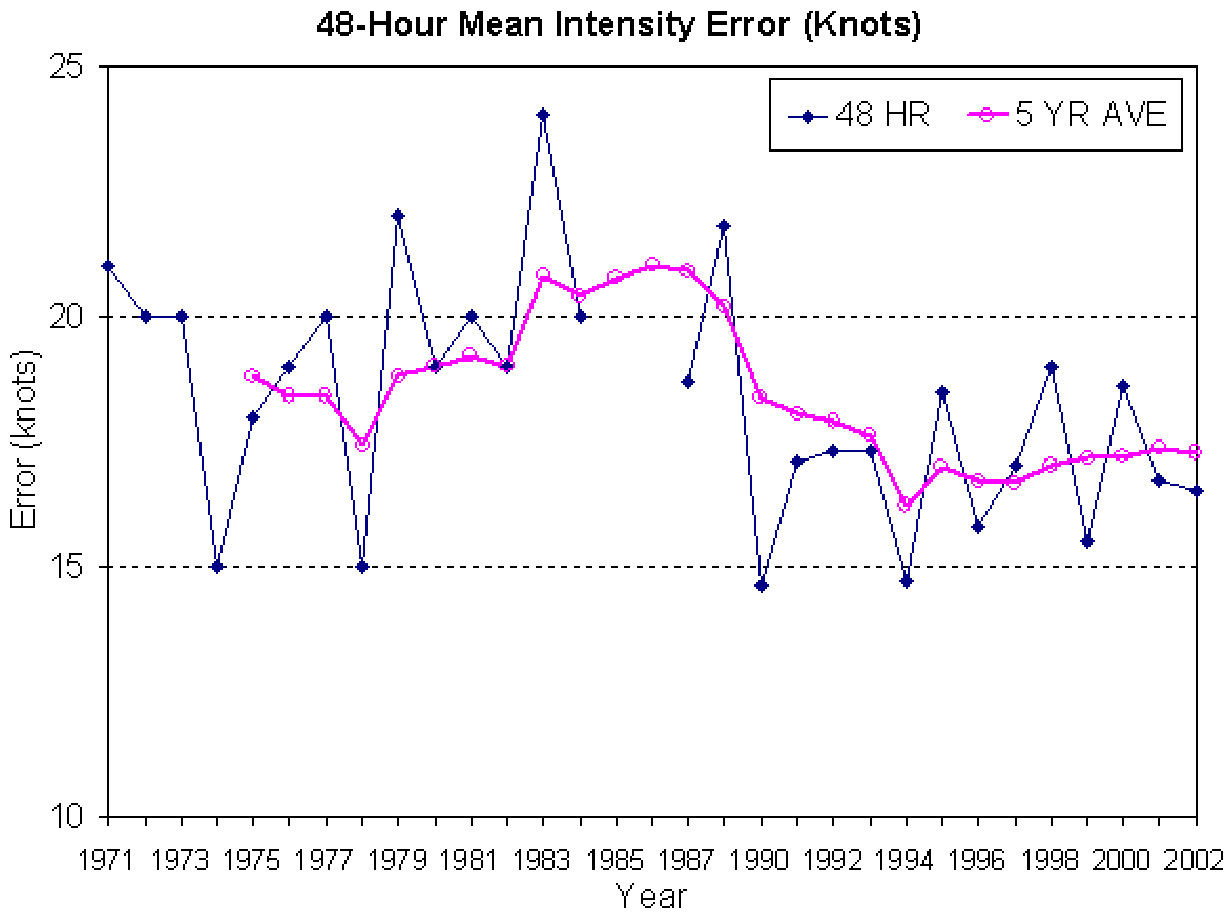


Figure 4-3b. Mean intensity forecast error (kts) and 5-year running mean for 48 hours for western North Pacific tropical cyclones from 1971-2002. Data not available for 1985 and 1986.

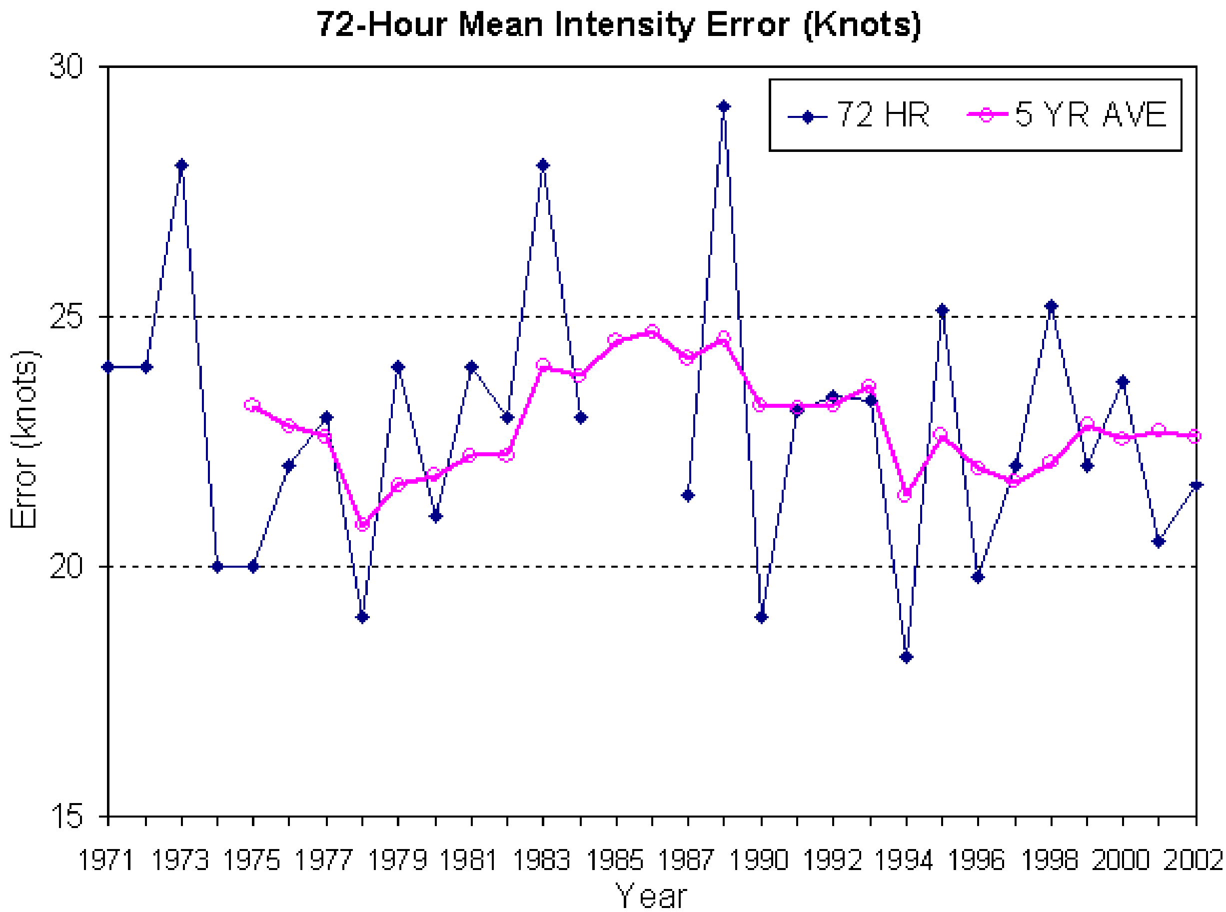


Figure 4-3c. Mean intensity forecast error (kts) and 5-year running mean for 72 hours for western North Pacific tropical cyclones from 1971-2002. Data not available for 1985 and 1986.

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# Table 4-5 Error Statistics for Selected Objective Techniques

## North Indian Ocean

**12-HOUR MEAN FORECAST ERROR (NM)**

| | JTWC | | NGPS | | EGRR | | AFW1 | | GFDN | | JAVN | | CLIP | | CONU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JTWC | 37 | 53 | | | | | | | | | | | | | | |
| | 53 | 0 | | | | | | | | | | | | | | |
| NGPS | 34 | 53 | 62 | 106 | | | | | | | | | | | | |
| | 71 | 18 | 106 | 0 | | | | | | | | | | | | |
| EGRR | 15 | 49 | 22 | 87 | 27 | 91 | | | | | | | | | | |
| | 74 | 25 | 83 | -4 | 91 | 0 | | | | | | | | | | |
| AFW1 | 13 | 59 | 14 | 82 | 13 | 70 | 16 | 94 | | | | | | | | |
| | 100 | 41 | 102 | 20 | 72 | 2 | 94 | 0 | | | | | | | | |
| GFDN | 18 | 53 | 18 | 61 | 1 | 97 | 0 | 0 | 18 | 70 | | | | | | |
| | 70 | 17 | 70 | 9 | 75 | -22 | 0 | 0 | 70 | 0 | | | | | | |
| JAVN | 33 | 54 | 58 | 107 | 22 | 85 | 14 | 99 | 17 | 72 | 69 | 88 | | | | |
| | 84 | 30 | 88 | -19 | 89 | 4 | 91 | -8 | 79 | 7 | 88 | 0 | | | | |
| CLIP | 37 | 53 | 61 | 105 | 26 | 90 | 16 | 94 | 18 | 70 | 67 | 89 | 74 | 101 | | |
| | 64 | 11 | 107 | 2 | 67 | -23 | 66 | -28 | 61 | -9 | 102 | 13 | 101 | 0 | | |
| CONU | 37 | 53 | 53 | 100 | 23 | 93 | 16 | 94 | 18 | 70 | 57 | 87 | 62 | 82 | 62 | 71 |
| | 62 | 9 | 70 | -30 | 71 | -22 | 72 | -22 | 55 | -15 | 70 | -17 | 71 | -11 | 71 | 0 |

**24-HOUR MEAN FORECAST ERROR (NM)**

| | JTWC | | NGPS | | EGRR | | AFW1 | | GFDN | | JAVN | | CLIP | | CONU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JTWC | 30 | 83 | | | | | | | | | | | | | | |
| | 83 | 0 | | | | | | | | | | | | | | |
| NGPS | 27 | 86 | 52 | 136 | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 89 | 3 | 136 | 0 | | | | | | | | | | | | |
| EGRR | 14 | 98 | 20 | 122 | 24 | 131 | | | | | | | | | | |
| | 126 | 28 | 129 | 7 | 131 | 0 | | | | | | | | | | |
| AFW1 | 10 | 97 | 10 | 87 | 11 | 117 | 12 | 103 | | | | | | | | |
| | 102 | 5 | 102 | 15 | 107 | -10 | 103 | 0 | | | | | | | | |
| GFDN | 14 | 75 | 14 | 89 | 1 | 158 | 0 | 0 | 14 | 93 | | | | | | |
| | 93 | 18 | 93 | 4 | 138 | -20 | 0 | 0 | 93 | 0 | | | | | | |
| JAVN | 27 | 88 | 49 | 138 | 20 | 130 | 11 | 103 | 13 | 93 | 60 | 123 | | | | |
| | 129 | 41 | 127 | -11 | 136 | 6 | 129 | 26 | 114 | 21 | 123 | 0 | | | | |
| CLIP | 30 | 83 | 51 | 134 | 24 | 131 | 12 | 103 | 14 | 93 | 59 | 124 | 65 | 166 | | |
| | 111 | 28 | 152 | 18 | 125 | -6 | 120 | 17 | 98 | 5 | 168 | 44 | 166 | 0 | | |
| CONU | 30 | 83 | 43 | 123 | 21 | 139 | 12 | 103 | 14 | 93 | 50 | 126 | 54 | 141 | 54 | 98 |
| | 85 | 2 | 97 | -26 | 111 | -28 | 100 | -3 | 80 | -13 | 99 | -27 | 98 | -43 | 98 | 0 |

**36-HOUR MEAN FORECAST ERROR (NM)**

| | JTWC | | NGPS | | EGRR | | AFW1 | | GFDN | | JAVN | | CLIP | | CONU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JTWC | 24 | 116 | | | | | | | | | | | | | | |
| | 116 | 0 | | | | | | | | | | | | | | |
| NGPS | 21 | 119 | 45 | 159 | | | | | | | | | | | | |
| | 108 | -11 | 159 | 0 | | | | | | | | | | | | |
| EGRR | 11 | 127 | 16 | 155 | 20 | 175 | | | | | | | | | | |
| | 171 | 44 | 175 | 20 | 175 | 0 | | | | | | | | | | |
| AFW1 | 8 | 139 | 8 | 105 | 9 | 162 | 10 | 132 | | | | | | | | |
| | 109 | -30 | 109 | 4 | 131 | -31 | 132 | 0 | | | | | | | | |
| GFDN | 11 | 108 | 11 | 118 | 1 | 228 | 0 | 0 | 11 | 131 | | | | | | |
| | 131 | 23 | 131 | 13 | 198 | -30 | 0 | 0 | 131 | 0 | | | | | | |
| JAVN | 23 | 119 | 43 | 159 | 17 | 176 | 10 | 132 | 11 | 131 | 53 | 135 | | | | |
| | 144 | 25 | 136 | -23 | 147 | -29 | 141 | 9 | 133 | 2 | 135 | 0 | | | | |
| CLIP | 24 | 116 | 44 | 155 | 20 | 175 | 10 | 132 | 11 | 131 | 52 | 134 | 57 | 232 | | |
| | 147 | 31 | 219 | 64 | 172 | -3 | 181 | 49 | 130 | -1 | 231 | 97 | 232 | 0 | | |
| CONU | 24 | 116 | 36 | 141 | 17 | 188 | 10 | 132 | 11 | 131 | 43 | 137 | 46 | 193 | 46 | 125 |
| | 104 | -12 | 121 | -20 | 147 | -41 | 141 | 9 | 90 | -41 | 125 | -12 | 125 | -68 | 125 | 0 |

**48-HOUR MEAN FORECAST ERROR (NM)**

| | JTWC | | NGPS | | EGRR | | AFW1 | | GFDN | | JAVN | | CLIP | | CONU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JTWC | 18 | 137 | | | | | | | | | | | | | | |
| | 137 | 0 | | | | | | | | | | | | | | |
| NGPS | 15 | 135 | 37 | 194 | | | | | | | | | | | | |
| | 127 | -8 | 194 | 0 | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EGRR | 7 | 129 | 11 | 213 | 15 | 213 | | | | | | | | | | |
| | 207 | 78 | 207 | -6 | 213 | 0 | | | | | | | | | | |
| AFW1 | 5 | 138 | 6 | 159 | 7 | 221 | 7 | 183 | | | | | | | | |
| | 109 | -29 | 141 | -18 | 183 | -38 | 183 | 0 | | | | | | | | |
| GFDN | 8 | 127 | 8 | 130 | 0 | 0 | 0 | 0 | 8 | 187 | | | | | | |
| | 187 | 60 | 187 | 57 | 0 | 0 | 0 | 0 | 187 | 0 | | | | | | |
| JAVN | 17 | 142 | 36 | 193 | 12 | 213 | 7 | 183 | 8 | 187 | 44 | 140 | | | | |
| | 133 | -9 | 127 | -66 | 115 | -98 | 125 | -58 | 96 | -91 | 140 | 0 | | | | |
| CLIP | 18 | 137 | 36 | 186 | 15 | 213 | 7 | 183 | 8 | 187 | 43 | 138 | 47 | 383 | | |
| | 176 | 39 | 348 | 162 | 209 | -4 | 223 | 40 | 157 | -30 | 395 | 257 | 383 | 0 | | |
| CONU | 18 | 137 | 28 | 168 | 12 | 222 | 7 | 183 | 8 | 187 | 34 | 146 | 36 | 273 | 36 | 145 |
| | 128 | -9 | 139 | -29 | 161 | -61 | 166 | -17 | 118 | -69 | 147 | 1 | 145 | -128 | 145 | 0 |

**72-HOUR MEAN FORECAST ERROR (NM)**

| | JTWC | | NGPS | | EGRR | | AFW1 | | GFDN | | JAVN | | CLIP | | CONU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JTWC | 10 | 185 | | | | | | | | | | | | | | |
| | 185 | 0 | | | | | | | | | | | | | | |
| NGPS | 9 | 180 | 20 | 222 | | | | | | | | | | | | |
| | 150 | -30 | 222 | 0 | | | | | | | | | | | | |
| EGRR | 5 | 189 | 7 | 240 | 9 | 318 | | | | | | | | | | |
| | 307 | 118 | 334 | 94 | 318 | 0 | | | | | | | | | | |
| AFW1 | 3 | 202 | 3 | 175 | 3 | 346 | 3 | 180 | | | | | | | | |
| | 180 | -22 | 180 | 5 | 180 | -166 | 180 | 0 | | | | | | | | |
| GFDN | 5 | 180 | 5 | 136 | 0 | 0 | 0 | 0 | 5 | 309 | | | | | | |
| | 309 | 129 | 309 | 173 | 0 | 0 | 0 | 0 | 309 | 0 | | | | | | |
| JAVN | 10 | 185 | 20 | 222 | 8 | 310 | 3 | 180 | 5 | 309 | 26 | 155 | | | | |
| | 165 | -20 | 149 | -73 | 165 | -145 | 204 | 24 | 127 | -182 | 155 | 0 | | | | |
| CLIP | 10 | 185 | 20 | 222 | 9 | 318 | 3 | 180 | 5 | 309 | 26 | 155 | 28 | 265 | | |
| | 208 | 23 | 249 | 27 | 238 | -80 | 235 | 55 | 210 | -99 | 271 | 116 | 265 | 0 | | |
| CONU | 10 | 185 | 16 | 207 | 8 | 314 | 3 | 180 | 5 | 309 | 18 | 162 | 20 | 222 | 20 | 150 |
| | 158 | -27 | 151 | -56 | 174 | -140 | 160 | -20 | 155 | -154 | 153 | -9 | 150 | -72 | 150 | 0 |

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4.1 ANNUAL FORECAST VERIFICATION

4.2 TESTING AND RESULTS

# Table 4-6 Error Statistics for Selected Objective Techniques

## Southern Hemisphere

**12-HOUR MEAN FORECAST ERROR (NM)**

| | JTWC | | NGPS | | EGRR | | AFW1 | | GFDN | | JAVN | | TCLP | | TLAP | | CLIP | | CONU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JTWC | 225 | 47 | | | | | | | | | | | | | | | | | | |
| | 47 | 0 | | | | | | | | | | | | | | | | | | |
| NGPS | 112 | 52 | 323 | 75 | | | | | | | | | | | | | | | | |
| | 70 | 18 | 75 | 0 | | | | | | | | | | | | | | | | |
| EGRR | 62 | 45 | 205 | 72 | 233 | 66 | | | | | | | | | | | | | | |
| | 61 | 16 | 63 | -9 | 66 | 0 | | | | | | | | | | | | | | |
| AFW1 | 22 | 45 | 95 | 68 | 89 | 58 | 96 | 105 | | | | | | | | | | | | |
| | 109 | 64 | 106 | 38 | 107 | 49 | 105 | 0 | | | | | | | | | | | | |
| GFDN | 129 | 46 | 78 | 66 | 2 | 29 | 0 | 0 | 170 | 46 | | | | | | | | | | |
| | 46 | 0 | 51 | -15 | 49 | 20 | 0 | 0 | 46 | 0 | | | | | | | | | | |
| JAVN | 93 | 49 | 252 | 72 | 194 | 62 | 86 | 101 | 46 | 51 | 281 | 86 | | | | | | | | |
| | 76 | 27 | 84 | 12 | 82 | 20 | 81 | -20 | 80 | 29 | 86 | 0 | | | | | | | | |
| TCLP | 27 | 44 | 81 | 69 | 82 | 66 | 48 | 117 | 0 | 0 | 73 | 88 | 82 | 64 | | | | | | |
| | 66 | 22 | 64 | -5 | 64 | -2 | 64 | -53 | 0 | 0 | 64 | -24 | 64 | 0 | | | | | | |
| TLAP | 24 | 43 | 58 | 66 | 57 | 60 | 36 | 112 | 1 | 24 | 53 | 82 | 53 | 60 | 59 | 109 | | | | |
| | 93 | 50 | 110 | 44 | 111 | 51 | 112 | 0 | 35 | 11 | 102 | 20 | 111 | 51 | 109 | 0 | | | | |
| CLIP | 224 | 47 | 314 | 74 | 217 | 64 | 95 | 106 | 169 | 46 | 267 | 85 | 80 | 64 | 58 | 110 | 492 | 106 | | |
| | 81 | 34 | 100 | 26 | 112 | 48 | 66 | -40 | 74 | 28 | 102 | 17 | 68 | 4 | 55 | -55 | 106 | 0 | | |
| CONU | 159 | 45 | 242 | 71 | 148 | 60 | 67 | 109 | 131 | 43 | 197 | 80 | 70 | 62 | 50 | 117 | 319 | 64 | 319 | 51 |
| | 51 | 6 | 52 | -19 | 50 | -10 | 51 | -58 | 48 | 5 | 50 | -30 | 55 | -7 | 49 | -68 | 51 | -13 | 51 | 0 |

**24-HOUR MEAN FORECAST ERROR (NM)**

| | JTWC | | NGPS | | EGRR | | AFW1 | | GFDN | | JAVN | | TCLP | | TLAP | | CLIP | | CONU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JTWC | 200 | 83 | | | | | | | | | | | | | | | | | | |
| | 83 | 0 | | | | | | | | | | | | | | | | | | |
| NGPS | 99 | 93 | 292 | 110 | | | | | | | | | | | | | | | | |
| | 109 | 16 | 110 | 0 | | | | | | | | | | | | | | | | |
| EGRR | 56 | 79 | 188 | 106 | 215 | 100 | | | | | | | | | | | | | | |
| | 94 | 15 | 99 | -7 | 100 | 0 | | | | | | | | | | | | | | |
| AFW1 | 20 | 85 | 86 | 100 | 82 | 96 | 87 | 140 | | | | | | | | | | | | |
| | 144 | 59 | 141 | 41 | 142 | 46 | 140 | 0 | | | | | | | | | | | | |
| GFDN | 116 | 81 | 70 | 104 | 2 | 46 | 0 | 0 | 154 | 83 | | | | | | | | | | |
| | 82 | 1 | 95 | -9 | 71 | 25 | 0 | 0 | 83 | 0 | | | | | | | | | | |
| JAVN | 82 | 85 | 228 | 106 | 179 | 97 | 78 | 140 | 41 | 98 | 258 | 106 | | | | | | | | |
| | 98 | 13 | 105 | -1 | 102 | 5 | 105 | -35 | 107 | 9 | 106 | 0 | | | | | | | | |
| TCLP | 24 | 78 | 71 | 104 | 72 | 115 | 43 | 157 | 0 | 0 | 64 | 113 | 72 | 101 | | | | | | |
| | 77 | -1 | 101 | -3 | 101 | -14 | 102 | -55 | 0 | 0 | 99 | -14 | 101 | 0 | | | | | | |
| TLAP | 23 | 84 | 54 | 102 | 53 | 109 | 33 | 147 | 1 | 120 | 48 | 103 | 49 | 95 | 55 | 189 | | | | |
| | 166 | 82 | 191 | 89 | 193 | 84 | 168 | 21 | 131 | 11 | 168 | 65 | 197 | 102 | 189 | 0 | | | | |
| CLIP | 200 | 83 | 286 | 109 | 202 | 99 | 87 | 140 | 153 | 83 | 246 | 106 | 71 | 101 | 54 | 191 | 449 | 156 | | |
| | 125 | 42 | 152 | 43 | 158 | 59 | 116 | -24 | 122 | 39 | 148 | 42 | 111 | 10 | 99 | -92 | 156 | 0 | | |
| CONU | 142 | 78 | 218 | 108 | 136 | 97 | 59 | 150 | 120 | 80 | 178 | 101 | 62 | 99 | 47 | 203 | 289 | 112 | 289 | 81 |
| | 82 | 4 | 85 | -23 | 80 | -17 | 85 | -65 | 80 | 0 | 80 | -21 | 88 | -11 | 84 | -119 | 81 | -31 | 81 | 0 |

**36-HOUR MEAN FORECAST ERROR (NM)**

| | JTWC | | NGPS | | EGRR | | AFW1 | | GFDN | | JAVN | | TCLP | | TLAP | | CLIP | | CONU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JTWC | 173 | 113 | | | | | | | | | | | | | | | | | | |
| | 113 | 0 | | | | | | | | | | | | | | | | | | |
| NGPS | 83 | 125 | 257 | 139 | | | | | | | | | | | | | | | | |
| | 141 | 16 | 139 | 0 | | | | | | | | | | | | | | | | |
| EGRR | 47 | 107 | 164 | 135 | 190 | 133 | | | | | | | | | | | | | | |
| | 120 | 13 | 132 | -3 | 133 | 0 | | | | | | | | | | | | | | |
| AFW1 | 13 | 117 | 72 | 126 | 68 | 138 | 73 | 166 | | | | | | | | | | | | |
| | 172 | 55 | 165 | 39 | 167 | 29 | 166 | 0 | | | | | | | | | | | | |
| GFDN | 99 | 112 | 60 | 133 | 1 | 90 | 0 | 0 | 132 | 112 | | | | | | | | | | |
| | 113 | 1 | 132 | -1 | 129 | 39 | 0 | 0 | 112 | 0 | | | | | | | | | | |
| JAVN | 72 | 112 | 201 | 133 | 160 | 132 | 65 | 162 | 36 | 138 | 229 | 125 | | | | | | | | |
| | 116 | 4 | 122 | -11 | 120 | -12 | 135 | -27 | 128 | -10 | 125 | 0 | | | | | | | | |
| TCLP | 20 | 105 | 61 | 134 | 62 | 153 | 34 | 185 | 0 | 0 | 55 | 141 | 62 | 146 | | | | | | |
| | 101 | -4 | 148 | 14 | 146 | -7 | 148 | -37 | 0 | 0 | 141 | 0 | 146 | 0 | | | | | | |
| TLAP | 20 | 112 | 45 | 134 | 44 | 148 | 23 | 176 | 1 | 240 | 41 | 138 | 41 | 135 | 46 | 238 | | | | |
| | 166 | 54 | 240 | 106 | 243 | 95 | 244 | 68 | 216 | -24 | 239 | 101 | 248 | 113 | 238 | 0 | | | | |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CLIP | 173 | 113 | 251 | 138 | 177 | 132 | 73 | 166 | 131 | 112 | 217 | 123 | 61 | 148 | 45 | 240 | 401 | 217 | | |
| | 181 | 68 | 212 | 74 | 224 | 92 | 173 | 7 | 176 | 64 | 200 | 77 | 155 | 7 | 151 | -89 | 217 | 0 | | |
| CONU | 123 | 104 | 191 | 138 | 119 | 128 | 47 | 172 | 105 | 110 | 159 | 120 | 53 | 145 | 40 | 253 | 257 | 161 | 257 | 105 |
| | 105 | 1 | 108 | -30 | 102 | -26 | 113 | -59 | 103 | -7 | 102 | -18 | 110 | -35 | 105 | -148 | 105 | -56 | 105 | 0 |

**48-HOUR MEAN FORECAST ERROR (NM)**

| | JTWC | | NGPS | | EGRR | | AFW1 | | GFDN | | JAVN | | TCLP | | TLAP | | CLIP | | CONU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JTWC | 146 | 133 | | | | | | | | | | | | | | | | | | |
| | 133 | 0 | | | | | | | | | | | | | | | | | | |
| NGPS | 68 | 144 | 223 | 164 | | | | | | | | | | | | | | | | |
| | 164 | 20 | 164 | 0 | | | | | | | | | | | | | | | | |
| EGRR | 40 | 123 | 145 | 162 | 170 | 155 | | | | | | | | | | | | | | |
| | 130 | 7 | 157 | -5 | 155 | 0 | | | | | | | | | | | | | | |
| AFW1 | 10 | 150 | 59 | 154 | 58 | 165 | 60 | 161 | | | | | | | | | | | | |
| | 165 | 15 | 160 | 6 | 159 | -6 | 161 | 0 | | | | | | | | | | | | |
| GFDN | 84 | 134 | 51 | 159 | 1 | 161 | 0 | 0 | 113 | 138 | | | | | | | | | | |
| | 138 | 4 | 153 | -6 | 249 | 88 | 0 | 0 | 138 | 0 | | | | | | | | | | |
| JAVN | 60 | 127 | 176 | 156 | 143 | 150 | 55 | 154 | 30 | 158 | 203 | 142 | | | | | | | | |
| | 132 | 5 | 138 | -18 | 136 | -14 | 144 | -10 | 142 | -16 | 142 | 0 | | | | | | | | |
| TCLP | 16 | 120 | 50 | 162 | 50 | 190 | 25 | 170 | 0 | 0 | 45 | 144 | 50 | 196 | | | | | | |
| | 131 | 11 | 196 | 34 | 196 | 6 | 205 | 35 | 0 | 0 | 176 | 32 | 196 | 0 | | | | | | |
| TLAP | 17 | 130 | 39 | 164 | 37 | 184 | 18 | 157 | 1 | 337 | 35 | 144 | 33 | 176 | 39 | 264 | | | | |
| | 190 | 60 | 264 | 100 | 267 | 83 | 324 | 167 | 338 | 1 | 250 | 106 | 279 | 103 | 264 | 0 | | | | |
| CLIP | 145 | 131 | 218 | 161 | 158 | 155 | 60 | 161 | 112 | 137 | 191 | 140 | 50 | 196 | 39 | 264 | 354 | 286 | | |
| | 229 | 98 | 289 | 128 | 292 | 137 | 235 | 74 | 223 | 86 | 265 | 125 | 203 | 7 | 198 | -66 | 286 | 0 | | |
| CONU | 106 | 120 | 168 | 163 | 105 | 154 | 37 | 165 | 92 | 135 | 139 | 135 | 43 | 191 | 33 | 277 | 227 | 220 | 227 | 124 |
| | 122 | 2 | 128 | -35 | 124 | -30 | 132 | -33 | 120 | -15 | 119 | -16 | 135 | -56 | 130 | -147 | 124 | -96 | 124 | 0 |

**72-HOUR MEAN FORECAST ERROR (NM)**

| | JTWC | | NGPS | | EGRR | | AFW1 | | GFDN | | JAVN | | TCLP | | TLAP | | CLIP | | CONU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JTWC | 5 | 102 | | | | | | | | | | | | | | | | | | |
| | 102 | 0 | | | | | | | | | | | | | | | | | | |
| NGPS | 4 | 107 | 167 | 210 | | | | | | | | | | | | | | | | |
| | 117 | 10 | 210 | 0 | | | | | | | | | | | | | | | | |
| EGRR | 4 | 107 | 105 | 207 | 127 | 202 | | | | | | | | | | | | | | |
| | 115 | 8 | 202 | -5 | 202 | 0 | | | | | | | | | | | | | | |
| AFW1 | 0 | 0 | 36 | 209 | 33 | 178 | 37 | 184 | | | | | | | | | | | | |
| | 0 | 0 | 180 | -29 | 186 | 8 | 184 | 0 | | | | | | | | | | | | |
| GFDN | 1 | 86 | 37 | 223 | 1 | 116 | 0 | 0 | 82 | 191 | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 232 | 146 | 186 | -37 | 565 | 449 | 0 | 0 | 191 | 0 | | | | | | | | | | |
| JAVN | 4 | 107 | 133 | 208 | 108 | 202 | 35 | 184 | 22 | 215 | 157 | 186 | | | | | | | | |
| | 92 | -15 | 177 | -31 | 173 | -29 | 177 | -7 | 178 | -37 | 186 | 0 | | | | | | | | |
| TCLP | 0 | 0 | 26 | 222 | 26 | 269 | 8 | 200 | 0 | 0 | 24 | 196 | 27 | 245 | | | | | | |
| | 0 | 0 | 239 | 17 | 227 | -42 | 252 | 52 | 0 | 0 | 227 | 31 | 245 | 0 | | | | | | |
| TLAP | 0 | 0 | 2 | 148 | 2 | 40 | 2 | 254 | 0 | 0 | 2 | 182 | 1 | 124 | 2 | 242 | | | | |
| | 0 | 0 | 242 | 94 | 242 | 202 | 242 | -12 | 0 | 0 | 242 | 60 | 330 | 206 | 242 | 0 | | | | |
| CLIP | 5 | 102 | 165 | 210 | 117 | 199 | 37 | 184 | 82 | 191 | 146 | 179 | 27 | 245 | 2 | 242 | 265 | 386 | | |
| | 247 | 145 | 394 | 184 | 362 | 163 | 314 | 130 | 316 | 125 | 363 | 184 | 289 | 44 | 115 | -127 | 386 | 0 | | |
| CONU | 4 | 107 | 129 | 214 | 80 | 206 | 21 | 167 | 68 | 189 | 109 | 177 | 26 | 227 | 1 | 330 | 176 | 347 | 176 | 158 |
| | 100 | -7 | 162 | -52 | 152 | -54 | 194 | 27 | 145 | -44 | 155 | -22 | 193 | -34 | 134 | -196 | 158 | -189 | 158 | 0 |

6.1.6 Recommendations for Future Needs.

A tool or method is needed to calculate and display differences in the model analysis along with a method to create an independent analysis of satellite data. This method will aid forecasters in adding value to the consensus forecast. An independent analysis of satellite-derived data should be compared with the various model analyses to identify potential track errors resulting from poorly analyzed features that are evident in satellite data. Post-analysis at JTWC often reveals poor model initial conditions based on satellite imagery were present when the model produced poor quality track forecasts.

A method is needed to rapidly assess the model impacts resulting from warning position and past track fluctuations. Consensus forecasts are contaminated by rapid fluctuations in TC direction and speed of movement as represented in the initial position and must be accounted for when using the consensus forecasts.

It is recommended that numerical models be improved to more accurately depict expected tracks of weak tropical cyclones. Errors in the tracks forecasts by dynamical models are larger for less intense cyclones (tropical storm stage and weaker) than for hurricane stage cyclones. Some of this error may be from poorly defined initial conditions. Based on JTWC’s results using consensus forecasting, it is suggested that efforts be made to share skillful model TC tracks to ensure availability of five or more tracks for use in consensus forecasting in other basins.

6.1.7 Summary

The missing ingredient for implementation of consensus forecasting in the 1990’s was proper training on the systematic use of consensus guidance. The development of SAFA was needed to engineer a systematic process to incorporate consensus forecasts into the TC warning process. The use of the consensus forecast approach has helped JTWC track forecasting in the Pacific and Indian Ocean. During the forecast development process, the tropical cyclone forecaster gains needed information on the temporal and spatial evolution of model forecasts, erroneous model features, and the strengths and weaknesses of these models. This information can be applied within the time constraints of the TC warning cycle to improve the official forecast. Based on the positive results since the 2000 forecast season, JTWC will continue to explore and improve the use of systematic field review and consensus forecasts to produce TC warnings.

6.1.8 Acknowledgments:

Mr. Charles R. Sampson and Dr. Jim Gross assisted with the post-analysis of consensus forecasts for 1998 and 1999. LT Dave Roberts assisted in producing figures. Captain Chris Cantrell and Captain Steve Vilpors assisted in creating statistics and Lt Colonel Greg Engel provided a review and helpful suggestions to improve this manuscript. Additionally, we want to thank Dr. Johnny Chan and Dr. Russ Elsberry for research assistance, review of the manuscript, and suggestions for improvement.

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## 6.2 A SEMI-OPERATIONAL, EXPERIMENTAL AMSU-BASED INTENSITY AND WIND RADII ESTIMATION ALGORITHM. (John A. Knaff,CIRA/Colorado State University, Mark Demaria NOAA/NESDIS, and Julie L. Demuth, Dept. of Atmospheric Science, Colorado State University)

Upon discontinuation of aircraft reconnaissance in the western north Pacific in 1987, the Atlantic became the only tropical cyclone basin with routine in situ tropical cyclone (TC) observations. Accordingly, the worldwide standard for TC intensity monitoring, especially when reconnaissance data are not available, is based on a method developed by Dvorak (1975) in the mid-1970s and enhanced in the mid-80s (Dvorak 1984). The technique generally is successful, but large errors sometimes are possible and there is a need for alternative tropical cyclone intensity estimation methods.

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| | 24h | 48h | 72h |
|---|---|---|---|
| 1997 | 128 | 204 | 309 |
| 1998 | 165 | 330 | 530 |
| 1999 | 131 | 207 | 272 |
| 2000 | 96 | 180 | 272 |
| 2001 | 81 | 144 | 189 |
| 2002 | 85 | 143 | 181 |

Table 6-7: JTWC western North Pacific 24h, 48h, and 72h track forecast error standard deviation for 1998 thru 16 September 2002. Error (km).

6.1.4: Limitations With Consensus TC Track Guidance

As shown in Figure 6-1, there are limitations with the application of consensus track forecast guidance. Incorrect synoptic pattern depiction, incorrect numerical model representation of incipient or mature tropical cyclones, and the erroneous development or poor initialization of adjacent cyclonic circulations are three major causes of error in current numerical model solutions.

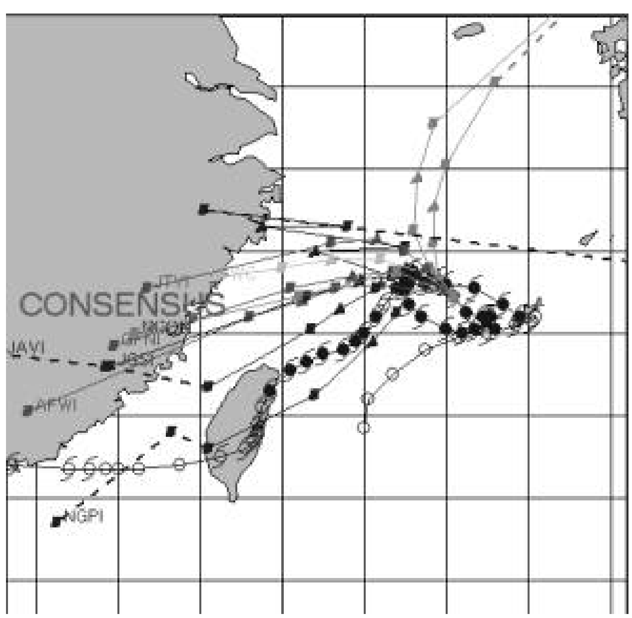

Figure 6-1: Typhoon Nari as it finished a second loop near Okinawa. The consensus forecast predicts Typhoon Nari will move onshore on mainland China north of Fuzhou when in fact Typhoon Nari moved over Taiwan. This is just one example of potential failure using consensus forecasts.

When tropical cyclones begin to move into high vertical wind shear regions, over colder water, or begin to interact with mid-latitude systems, varying solutions will occur in the numerical models contained in the consensus. This situation can result in major divergence in model solutions and can result in poor consensus forecasts.

Weak tropical cyclones and tropical depressions usually are not well analyzed in the numerical models. Additionally, small tropical cyclones are often portrayed as being too large in the numerical models, which results in incorrect poleward bias in the model track predictions. Often, the large size of the vortex in the model initialization is due to effects of the synthetic TC observations as they are assimulated into the dynamic models. Goerss suggests that the combination of model resolution and model physics controls the vortex size. For example a T239 model can maintain a smaller vortex than a T159 model. If you insert synthetic observations into the T239 a small vortex will be maintained. The same synthetic observation inserted in a T159 model will quickly be modified to something the model can maintain. Regardless of the source of these too large tropical cyclone vortices, when the majority of the model tracks are poleward-biased, the resulting consensus forecast is of low quality.

Occasionally, the numerical models will forecast development of a cyclonic circulation near the location of a developing tropical cyclone or will show multiple cyclonic circulations along the monsoon trough. These adjacent, sometimes erroneous circulations have a tendency to interact in the model fields and degrade the quality of the consensus.

6.1.5: Experimental TC Track Forecast Products.

In 2001, JTWC began a three-year evaluation of 96 h and 120 h track forecasts. Goerss (2000b) had provided evidence that skillful 96 h and 120 h TC forecasts were being produced by the GFDL, NOGAPS, UKMO, and the European Centre for Medium-range Weather Forecast (ECMWF) models. Based on Goerss (2000b and 2001), independent analysis of CONU at JTWC, and lessons learned in 2000 and 2001 during the SAFA test, consensus forecast techniques are used for creation of these 96 h and 120 h forecasts. Table 6-8 gives a comparison of the 2002 JTWC 96 h and 120 h forecasts and the consensus guidance used to create these forecasts. Note that JTWC has not extended NCON and SCON tracks in SAFA to 96 h and 120 h because of the significant costs to update the SAFA computer code when a similar capability existed on ATCF. Table 6-9 shows the results of the JTWC 96 and 120 h test through 16 September 2002. These results suggest that relatively skillful consensus guidance extends to 120 h and the experimental 96 h and 120 h JTWC forecasts improved significantly through use of CONU as the primary guidance.

Table 6-8: Homogeneous comparison of JTWC, CONG, CONU, and NCON forecast errors (km) at 24, 48, 72, 96, and 120 h for the western North Pacific.

| FCST | 24h | 48h | 72h | 96h | 120h |
|---|---|---|---|---|---|
| JTWC | 124 | 213 | 283 | 385 | 507 |

| | | | | | |
|---|---|---|---|---|---|
| CONG | 130 | 226 | 298 | 367 | 487 |
| CONU | 124 | 213 | 294 | 369 | 489 |
| NCON | 139 | 244 | 335 | | |
| SCON | 139 | 239 | 328 | | |

Table 6-9: Homogeneous comparison of JTWC and CLIP western North Pacific forecast errors (km) for 2000 thru 16 September 2002.

| Year | 24h | 48h | 72h | 96h | 120h |
|---|---|---|---|---|---|
| 2000(JTWC) | 146 | 261 | 385 | 428 | 600 |
| 2000(CLIP) | 222 | 454 | 661 | 772 | 991 |
| 2001(JTWC) | 135 | 226 | 333 | 535 | 774 |
| 2001(CLIP) | 200 | 409 | 609 | 739 | 865 |
| 2002(JTWC) | 120 | 209 | 283 | 380 | 494 |
| 2002(CLIP) | 202 | 428 | 637 | 907 | 1113 |

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Since Table 6-2 and Goerss (1999) demonstrate the value of having more consensus members, the Naval Research Laboratory (NRL) Automated Tropical Cyclone Forecast (ATCF) system development team then assisted JTWC in testing and development of consensus combinations other than NCON and SCON. As a result, the ATCF system was revised to allow JTWC to create additional consensus combinations. A version of the NHC interpolation and consensus track forecast code (GUNS) was installed by NRL at JTWC during July 2001.

Using the revised ATCF consensus forecasting capability, JTWC applied two new model combinations to determine the effects of the regional models on the consensus forecast. Consensus forecasts using the four global models (CONG ) were compared to consensus forecasts produced by all available dynamic models (CONU ). A homogeneous comparison of CONG, CONU, NCON and the JTWC forecasts for the 2001 western North Pacific season (Table 6-3) seems to indicate that the greatest TC track forecasting skill lies with the consensus of all numerical models (CONU).

| FCST | 24h | 48h | 72h |
|---|---|---|---|
| JTWC | 113 | 189 | 324 |
| CONU | 128 | 224 | 324 |
| CONG | 117 | 213 | 367 |
| NCON | 119 | 219 | 381 |

Table 6-3: Homogeneous comparison for the 2001 western North Pacific season of the JTWC, CONU, CONG, and NCON errors (km).

6.1.3 Fusion of Consensus TC Track Guidance into the Track Forecast Process at the JTWC.

U. S. military personnel rotation policy causes the JTWC TC forecasters to completely change every 2 to 3 years. Consistent application and development of consensus forecasting techniques and application of the SAFA systematic field review process has provided the JTWC with tools to mitigate the routine loss of these skilled forecasters.

Consensus forecasts are used as the initial first guess for all JTWC TC track forecasts. Through continuous process refinement, JTWC shifted the focus away from creation of SCON forecasts to a more conservative goal of consistently adding value to the consensus forecast by better understanding of the numerical model output. The new focus at JTWC is on fine-tuning the consensus by systematically analyzing the model field and rapidly creating a mental picture of the model field evolution with time for the forecast period. This picture must accurately assess differences in steering, intensity and structure among the model solutions. Known model biases, departures from satellite-derived intensity and structure assessments, and current model trends are then subjectively applied to the track forecast.

With constantly changing models and the availability of new remotely sensed data, continuous training is required to enable forecasters to improve on the consensus forecast. JTWC routinely monitors the forecast process in the near-real time through statistical analysis to improve forecast quality. Twice-monthly statistical analyses of the CONU, CONG, NCON, and SCON performance, along with performance statistics for each consensus member, are also conducted. These analyses are presented when the situation requires and at monthly forecaster meetings. The objective is to standardize procedures, build forecaster confidence and improve on systematic procedures to add value over the consensus when developing the JTWC track forecast.

| Year | 24h | 48h | 72h |
|---|---|---|---|
| 2000 | 146 | 261 | 385 |
| 2001 | 135 | 226 | 333 |
| 2002 | 122 | 209 | 283 |

Table 6-4: Mean JTWC western North Pacific track forecast errors (km) for 2000 through 16 September 2002.

Table 6-4 shows the decrease in JTWC track forecast errors since beginning the systematic use of consensus forecast guidance in 2000, and the error reductions due to improvements to the consensus forecast process in 2001 and 2002. Even though a 100% turnover in forecast staff occurred late in 2001, a preliminary review indicates that the quality of the JTWC forecasts continues to improve. The data presented in Table 6-4 supports the premise that persistent consensus forecast application can prevent degradation of the forecast process due to routine changes in the forecast staff. Table 6-5 indicates JTWC's skill compared to CLIPER improved 4 to 5% from 1997-2000 with the exception of the 1998 season. In 1998, JTWC did not systematically use consensus forecast guidance but shifted to using the best performing model as the starting point for the official forecast. The poor performance of all the numerical models in 1998 resulted in degradation in quality of the JTWC forecasts. Table 6-6 suggests that had JTWC used consensus model guidance in 1998 substantial improvements would have occurred.

| Year | JTWC | CLIP | Improvement(%) |
|---|---|---|---|
| 1997 | 454 | 656 | 31 |
| 1998 | 685 | 778 | 12 |
| 1999 | 433 | 663 | 36 |

| | | | |
|---|---|---|---|
| 2000 | 387 | 648 | 40 |
| 2001 | 337 | 637 | 47 |
| 2002 | 283 | 580 | 51 |

Table 6-5: JTWC and CLIP forecast errors (km) 1998-2002 and JTWC % improvement over CLIP.

| FCST | 24h | 48h | 72h |
|---|---|---|---|
| JTWC(1998) | 226 | 448 | 548 |
| CON_(1998) | 185 | 352 | 548 |
| JTWC(1999) | 193 | 315 | 411 |
| CON_(1999) | 185 | 302 | 356 |

Table 6-6: Homogeneous comparison of forecast errors (km) by JTWC and a post-analysis of CON_ developed using the ATCF consensus code provided by NRL Monterey, CA and TPC for the 1998 and 1999 western North Pacific seasons.

Table 6-5 shows a steady improvement in JTWC performance since 1997 with the exception of 1998. Based on these results and the findings of Goerss (2000 and 2001) and Aberson (2001), it can be suggested that some of the forecast improvement was the result of improved model performance. Additionally, these model improvements resulted in improved consensus forecasts that were used in the JTWC forecast process during the 2000, 2001 and 2002 western North Pacific seasons. Table 6-7 shows a significant reduction in track forecast error standard deviation for 2001 and 2002 which the authors believe is a direct result of the systematic use of consensus forecast aids and review of model fields. Further studies are needed and will be conducted to verify these deductions.

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6.1.2 Evolution of Consensus Track Forecasting at JTWC

The JTWC began to use consensus forecasts in the early 1990's but the persistent and methodical development of this forecast tool did not occur until the late 1990's.

In 1991, JTWC began use of what was then labeled as Hybrid Forecast Aids to reduce very large track forecast errors (JTWC 1993). These hybrid aids BLND and WGTD consisted of six forecasts that were developed through simple and weighted averages. These early aids were heavily weighted toward climatology but still produced the lowest overall track errors when compared to individual numerical model performance. Operational experience with these aids revealed that the aids were not consistently used because they required manual data entry and were too time consuming.

In 1993, JTWC began using the Dynamic AVErage (DAVE), which was a simple average of all available dynamic model guidance. Statistics for 1993 indicated that DAVE out-performed JTWC by approximately 8 – 10% at 48 h and 72 h (JTWC 1993). A homogeneous comparison with the individual dynamic models included in DAVE shows most individual models out-performed both JTWC and DAVE by approximately 10 to 30%. These results were not encouraging and only sporadic JTWC use of DAVE continued until 2000.

In 1998, two forecast aids proposed by Goerss (2000), the Global AVerage (GLAV) and the Regional model AVerage (RGAV) were installed as an upgrade to the previous simple ensemble or consensus forecast efforts. Tables 6-1 (a) and (b) show the 1998 and 1999 forecast performance for GLAV and RGAV based on the data set available in the JTWC operational database. Since GLAV was produced at 0000 and 1200 UTC and RGAV was produced at 0600 and 1800 UTC, no homogeneous comparison is made.

| (a) FCST | 24-h | 48-h | 72-h |
|---|---|---|---|
| JTWC | 229(375) | 443(273) | 685(202) |
| CLIP | 248(375) | 513(273) | 778(202) |
| GLAV | 181(115) | 341(89) | 530(67) |
| RGAV | 154(78) | 294(61) | 515(45) |

| (b) FCST | 24-h | 48-h | 72-h |
|---|---|---|---|

| | | | |
|---|---|---|---|
| JTWC | 196(433) | 330(300) | 435(193) |
| CLIP | 232(433) | 463(300) | 667(193) |
| GLAV | 169(100) | 252(58) | 374(91) |
| RGAV | 156(55) | 267(35) | 344(21) |

Table 6-1: Non-homogeneous comparison of JTWC, CLIP, GLAV, and RGAV at 24, 48, and 72h for the 1998(a) and 1999 (b) western North Pacific seasons. Error in kilometers (number of forecasts created in brackets).

Although GLAV and RGAV consensus forecasts showed skill, they were not consistently used to develop forecasts during the 1998 and 1999 seasons. Discussion with the JTWC forecasters indicate that the products were not used for two primary reasons: (1) a lack of appreciation for the skill of the consensus products; and (2) the product was not fully automated until the 1999 season.

In 2000, JTWC began operational evaluation of a prototype rules-based consensus forecast process called the Systematic Approach to TC Forecasting Aid (SAFA), which was developed by Carr and Elsberry (2000a, b). The SAFA is applied at the JTWC using a five-step process:

1). A Non-selective Consensus (NCON) is created and objective model error mechanism assignments are made based on the spread of the 72-h model track predictions (generally only for track spreads > 417 km).

2). A systematic review of previous model error assignments and model fields is then completed to gain understanding of previously identified model errors.

3). The temporal continuity or trend of dynamic model track predictions is evaluated to identify large standard deviations in track predictions or trends in model predictions.

4). Dynamic model fields are then reviewed to identify initialization or synoptic pattern depiction errors within a particular model.

5). If significant model errors are identified, a Selective Consensus (SCON) track forecast is then created by eliminating erroneous models from the NCON.

JTWC used the SAFA process during 2000 forecast seasons and post-analysis of the 2000 data indicated that NCON was the top contributor to the JTWC forecast improvement. The systematic review process was also identified by the JTWC Typhoon Duty Officers (TDO) as a major aid to understanding the evolution of the predicted steering flow depicted in the numerical models. The systematic field review enabled rapid identification of key differences in steering features between the numerical models used, and improved the TDO’s understanding of the meteorological patterns affecting the track forecast.

One of the objectives of SAFA is for the forecaster to detect likely erroneous forecast(s) and reject that forecast to form a SCON that is an improvement over NCON. The error statistics in Table 6-2 from the first season SAFA was applied indicate the JTWC forecasters were not able to consistently develop SCON forecasts that improved over the NCON forecast. Table 6-2 shows the 2000 SAFA, NCON and SCON forecast statistics as compared to JTWC forecast accuracy. These statistics indicate that JTWC was not able to produce a SCON that improved on the NCON especially when 4 or 5 models were available in the consensus. Table 6-2 also shows that the number of dynamic models used in the NCON and SCON improved the quality of both consensus forecasts, which is consistent with the Goerss (2000b) study on the impact of adding more members to the consensus.

| FCST | Two Models | Three Models | Four Models | Five Models |
|---|---|---|---|---|
| JTWC | 695 | 470 | 394 | 382 |
| NCON | 689 | 548 | 320 | 320 |
| SCON | 839 | 552 | 400 | 387 |

Table 6-2: Homogeneous comparison of JTWC, NCON and SCON 72-h forecast errors (km) for the 2000 western North Pacific season based on the number of dynamic models included in the NCON ensemble. Note the significant improvement in NCON skill when four and five models were available.

Using the findings from the 2000 season together with counseling and advice from Les Carr, JTWC attempted to improve the TDO's skill in deriving SCON forecasts. Training was conducted to improve the understanding of the forecasters of the numerical depictions of the meteorological patterns that govern tropical cyclone motion. Additionally, the forecasters were encouraged to be more conservative when creating SCON forecasts as post-analysis by Carr determined that the JTWC on numerous occasions had created SCON forecasts when none were required. Forecasters were encouraged to decrease the number of SCON forecasts and minimize the variance from the NCON.

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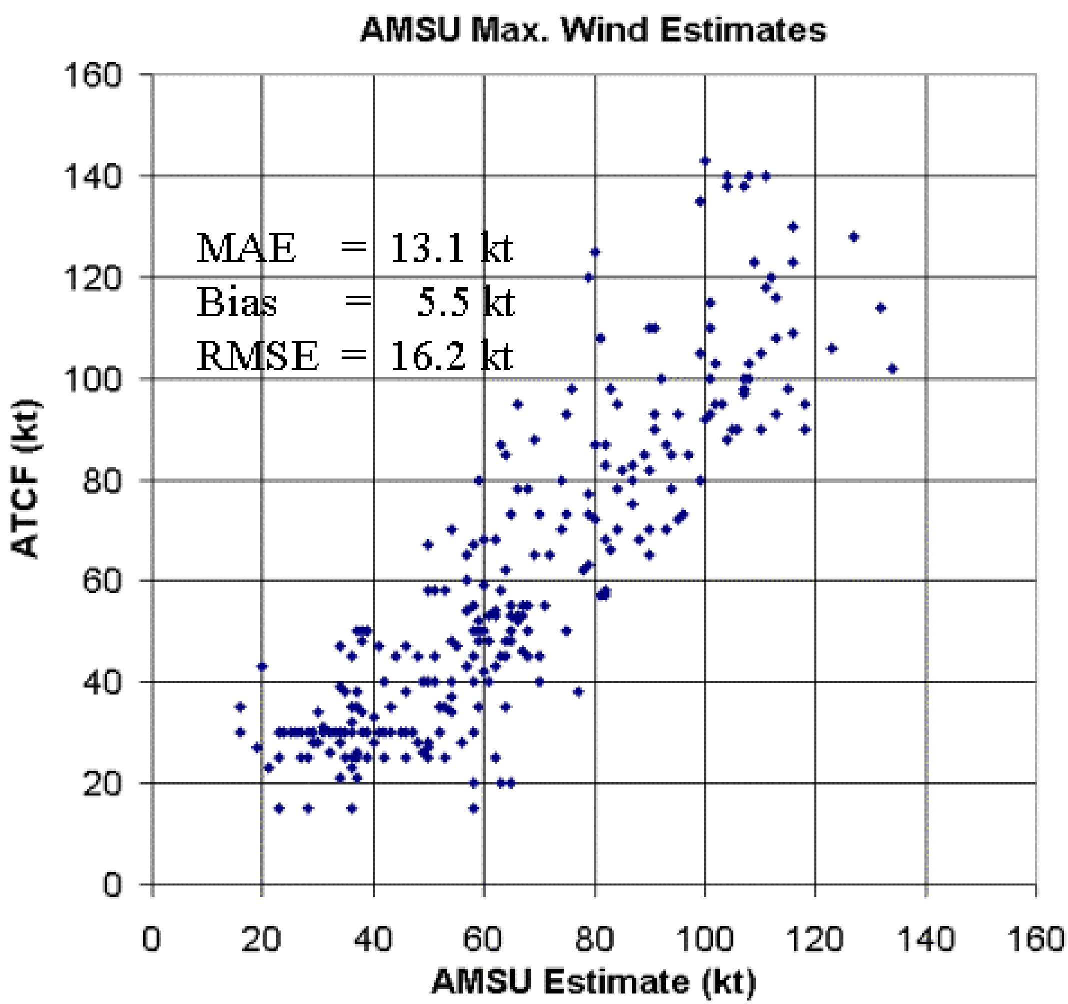

Fig 6-3. Example of a TC-specific analysis and display using WxMAP.

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## 6.3 THE STATISTICAL TYPHOON INTENSITY PREDICTION SCHEME (STIPS). (John A. Knaff,CIRA/Colorado State University, Mark Demaria NOAA/NESDIS, and Charles R. Sampson, Naval Research Laboratory)

With the complexities involved in tropical cyclone intensity change and the inability for numerical models to be run at the resolutions needed to explicitly resolve convection in a real-time and operational manner, there exist an underlying need for alternative intensity forecast methods to gap the shortcomings of existing numerical and statistical intensity forecast models. These alternative intensity forecast models would ideally use the strengths of both statistical models and numerical models. Such an approach would combine the statistical methodology with environmental predictors derived from numerical weather forecasts. This methodology is commonly called the statistical-dynamical approach. The Statistical Hurricane Prediction Scheme or SHIPS (Demaria and Kaplin 1999) has been developed for use in the North Atlantic and eastern North Pacific and is a good example of a statistical model developed using this approach. The operational use of SHIPS model has been successful

**6.7 SATELLITE APPLICATIONS AT THE JOINT TYPHOON WARNING CENTER (Lt Col Greg Engel, NPMOC/JTWC)**

as it produces skillful (better than those made using the climatology and persistence (CLIPER) approach) intensity forecast guidance in the North Atlantic.

Operational statistical-dynamic intensity guidance models like SHIPS were unavailable to the forecasters at JTWC prior to July 2002. Intensity guidance used at JTWC prior to that time included analog techniques (Sampson et al. 1990), STIFOR (Chu 1994), ST5D (Knaff et al. 2003), and a few numerical models such as the Japanese typhoon model, and the Navy's version of the Geophysical Fluid Dynamics Lab model (GFDN). As a result, the intensity forecasting at JTWC relied heavily upon the simplest statistical models. In response to the need to move toward more physically based intensity forecasts, a Statistical Typhoon Intensity Predition Scheme (STIPS) was developed for use in the western North Pacific.

The development of the STIPS model closely follows the development of the SHIPS model in the Atlantic and Eastern Pacific tropical cyclone basins as described in DeMaria and Kaplan (1999). The inland decay of tropical cyclone intensity at landfall is handled by the inland decay model discussed in Kaplan and Demaria (1995) south of 36 N and that of Kaplan and DeMaria (2001) north of 40 N. As a result, STIPS (STIP in the ATCF)is a multiple linear regression model and decay STIPS (STID) adjust STIPS forecasts for landfall effects. The dependent variables used in STIPS (predictand) are the intensity change from the initial forecast time (DELV) at 12-hour intervals. Four and a half years of Navy Operational Global Atmospheric Prediction System (NOGAPS) (Baker, cited 2002, Hogan and Rosmond 1991) analyses were time averaged and used in the development of STIPS. The tropical cyclone position and intensity information used in this study came from the JTWC's best track (JTWC, cited 2002). STIPS output includes the intensity forecasts as well as physical parameters (shear, SST, Relative Humidity, Divergence etc) along the storm track.

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Estimates of TC structure via the extent of 34-, 50-, and 64-kt surface winds also are challenging but necessary, as military users need accurate measurements of surface winds near TCs. As such, the JTWC estimates and reports these statistics at six-hour intervals for every tropical system in their area of responsibility. Wind radii observations are obtained from reconnaissance data, ship reports, buoys, or satellite-borne instruments (scatterometers and passive microwave radiometers), but many of these data sources have spatial limitations or occur opportunistically. In their absence, conservative overestimates of the wind radii commonly are reported as symmetric circular and semi-circular advisories when, in fact, large asymmetries may exist. The applicability of scatterometers for wind observations has led to a surge in its usage, yet Jones et al. (1999) note many effects that degrade the wind retrieval accuracy, especially near the region of peak winds. As with intensity, alternative methods to operationally estimate wind structure are needed

In response to these two needs, a method has been developed for estimating TC intensity measured by one- minute maximum sustained winds and minimum sea level pressure and size (via the wind radii) utilizing AMSU-A data from 1999 - 2001 in the Atlantic and eastern North Pacific. AMSU-A temperature retrievals are used to determine the geopotential height and surface pressure fields from the hydrostatic equation, and the gradient wind equation is used to estimate the azimuthally averaged tangential wind. Parameters from these fields are used as input to statistical relationships for estimation of the maximum surface wind, minimum sea-level pressure, and azimuthally averaged radii of 34-, 50-, and 64-kt winds. Additionally, the asymmetric wind radii are determined by fitting the mean wind radii to an idealized symmetric vortex with an added asymmetry factor related to the storm motion vector.

In May of 2002 the Demuth, Demaria and Knaff (DDK) method (Demuth et al. 2003) was used to produce experimental, yet semi-operational estimates of tropical cyclone intensity and wind structure in both the National Hurricane Center’s and JTWC’s areas of responsibility via input from the ATCF (Sampson and Schrader 2000). These experimental estimates were provided to JTWC for their use in operations. Evaluations of the resulting intensity estimations are show in Figure 6-2 (MSLP) and Figure 6-3 (Vmax). Errors for both MSLP and Vmax are about 20% larger than those observed in the Atlantic and Eastern Pacific and may suggest that the best track data has more uncertainty in this basin – a result of the heavy reliance on the Dvorak technique and the use of one pressure wind relationship (Akins and Holliday ) to assess tropical cyclone intensity. The wind radii will be evaluated in the next year or so using quikscat scatterometry, when available. Work will continue to refine this algorithm and refine its application to all tropical cyclone basins.

(STIPS). (John A. Knaff,CIRA/Colorado State University, Mark Demaria NOAA/NESDIS, and Charles R. Sampson, Naval Research Laboratory)

6.4 5-DAY STATISTICAL TYPHOON INTENSITY FORECAST (STIFOR) DERIVED FROM CLIMATOLOGY AND PERSISTENCE (John A. Knaff,CIRA/Colorado State University, Mark DeMaria NOAA/NESDIS, and C. R. (Buck) Sampson, Naval Research Laboratory)

6.5 NRL MODIFICATIONS TO JTWC CONSENSUS TOOLS (C. R. (Buck) Sampson, Naval Research Laboratory)

6.6 ON-SCENE ANALYSIS OF TROPICAL CYCLONES USING NUMERICAL WEATHER PREDICTION DATA (CDR Mike Fiorino, USNR, fiorino@tenkimap.com, METOC Department Head NR NRL Science & Technology 220, Naval Air Reserve Center supporting NRL and JTWC)

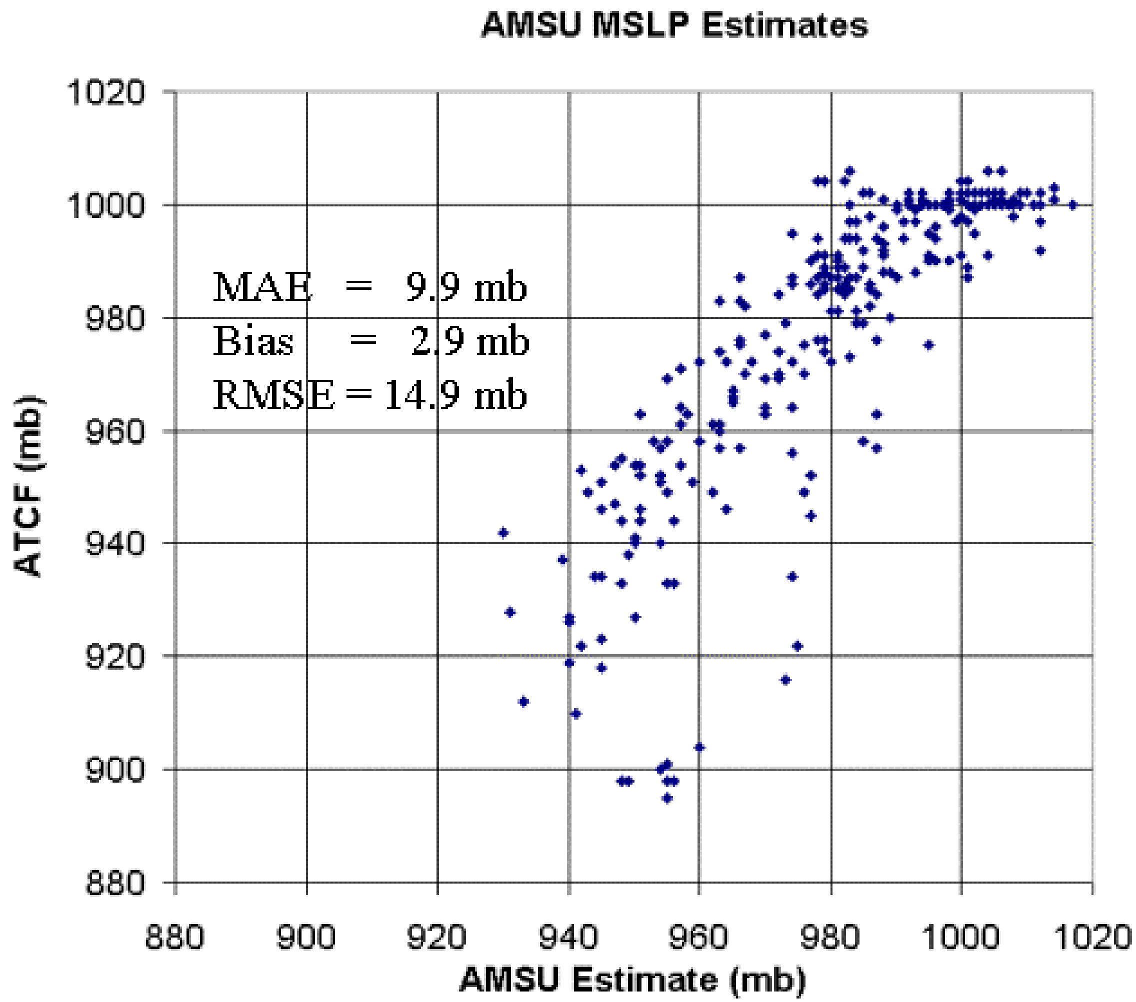


Fig 6-2. Scatter plot of AMSU-based MSLP estimation verses the MSLP values in the ATCF best track. Note that at the writing of this summary the best track dataset was still considered preliminary.

**6.7 SATELLITE APPLICATIONS AT THE JOINT TYPHOON WARNING CENTER (Lt Col Greg Engel, NPMOC/JTWC)**

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## 6.4 5-DAY STATISTICAL TYPHOON INTENSITY FORECAST (STIFOR) DERIVED FROM CLIMATOLOGY AND PERSISTENCE (John A. Knaff,CIRA/Colorado State University, Mark DeMaria NOAA/NESDIS, and C. R. (Buck) Sampson, Naval Research Laboratory)

Currently, many of the guidance models used by forecasters at the JTWC provide forecasts of track and intensity out to and beyond five days. A common approach to assessing the merit and skill of TC forecasts is to compare them with what is referred to as a "control" forecast derived from some combination of climatology and persistence. The combination of climatology and persistence to make control forecasts is referred to as the CLIPER- approach. Currently, there is a set control forecast models designed for making intensity forecasts out to three days in the western North Pacific including the Statistical Typhoon Intensity Forecast (STIFOR) (Chu, 1994) analog methods using climatology for all (CLIM), recurving (RECR) and straight moving storms (STRT), and extrapolation (XTRP). In the ATCF the STIFOR forecasts are included with the CLIPER track forecast (CLIP). Of these methods the STIFOR, which uses the CLIPER approach, has proven the best control forecast method. In order to evaluate and verify 5-day intensity forecasts, an updated version of STIFOR that make forecasts through 120 h was needed. Expanding on these past efforts a five-day STIFOR model was developed (ST5D) and implemented into the ATCF in July of 2001. Details of model development can be found in Knaff et al (2003). In 2001 an independent comparison was made between the 5-day version of STIFOR and the 3-day STIFOR (Chu 1994). Table 6-12 lists the mean absolute errors and biases associated with STIFOR (3-day) and the newly developed 5-day STIFOR (5- day). The mean absolute errors associated with the 5-day STIFOR are significantly smaller for all forecast time periods and much smaller beyond 36-hours, suggesting that the statistical formulation of the new 5-day STIFOR is superior. Based upon preliminary 2002 best track data, a similar result is found as shown in Table 6-13.

| Western North Pacific 2001 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Statistic | | | | | | | | | | |
| | 12-hour | | 24-hour | | 36-hour | | 48-hour | | 72-hour | |
| | 3-day | 5-day | 3-day | 5-day | 3-day | 5-day | 3-day | 5-day | 3-day | 5-day |
| Errors | 7.6 | 7.0 | 12.8 | 11.2 | 17.5 | 14.6 | 21.3 | 17.6 | 26.8 | 21.5 |
| Biases | -1.8 | -1.9 | -3.0 | -2.4 | -4.6 | -4.3 | -7.2 | -6.1 | -13.0 | -8.4 |
| Number | 688 | | 645 | | 597 | | 545 | | 442 | |

Table 6-12: Mean absolute errors of intensity forecasts made by the 3-day STIFOR model (3-day) and the 5-day STIFOR model (5- day) in the western North Pacific for 2001. This verification includes all storms and depressions.

| Western North Pacific 2002 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Statistic | | | | | | | | | | |
| | 12-hour | | 24-hour | | 36-hour | | 48-hour | | 72-hour | |
| | 3-day | 5-day | 3-day | 5-day | 3-day | 5-day | 3-day | 5-day | 3-day | 5-day |
| Errors | 6.9 | 6.4 | 11.6 | 10.2 | 16.0 | 13.8 | 19.4 | 15.9 | 24.8 | 20.4 |
| Biases | -1.2 | -0.7 | -1.5 | -1.8 | -2.6 | -3.6 | -5.2 | -5.3 | -12.0 | -9.2 |
| Number | 718 | | 677 | | 623 | | 569 | | 462 | |

Table 6-13: Mean absolute errors of intensity forecasts made by the 3-day STIFOR model (3-day) and the 5-day STIFOR model (5-day) in the western North Pacific for 2002. This verification includes all storms and depressions.

One of the main purposes for updating these simple models was to provide a verification tool for intensity forecasts through five days. Table 6-14 shows mean absolute forecast errors and biases for the five-day STIFOR model and persistence at times beyond 72 hours derived using independent data, using the preliminary best track data for 2002. All forecasts were run operationally starting 21 July 2001 for the western North Pacific. Five-day STIFOR produces forecasts that are significantly better than persistence alone, reducing errors by a factor of 2 even at these long leads These results are similar to those in the Atlantic and eastern North Pacific and this error saturation likely indicates the limit of predictability for this methodology.

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In July 2002, the STIPS and decay STIPS were made operational at JTWC. Results of this forecast method are mixed. While the decay version of STIPS produced forecasts with smaller mean absolute errors at 12, 36 and 48 hours than ST5D (Table 6-10), these differences were not statistically significant. However, when errors are stratified by initial intensity most of the errors are associated with storms with initial intensities greater than 84 knots (Table 6-11). This deficiency may be caused by the relatively short climatology STIPS was developed upon (July 20, 1997 - Dec. 31, 2001). In examining individual storms, some of the poor performance may be due to the use of forecast values of 200-mb divergence, the rather course resolution of skin temperature (a proxy for SST), the time averaging of forecast variables, and the large special regions used to calculate vertical wind shear. These are the factors that seemed to degrade the forecasts of several very intense tropical cyclones resulting in large under estimates of intensity.

| Homogeneous MAE Western North Pacific 2002 | | | | | |
|---|---|---|---|---|---|
| (Initial Vmax < 84 kt) | | | | | |
| Model | 12-hour | 24-hour | 36-hour | 48-hour | 72-hour |
| ST5D | 6.4 | 10.5 | 15.0 | 18.6 | 24.3 |
| STID | 5.8 | 9.4 | 12.3 | 15.4 | 23.2 |
| STIP | 6.0 | 10.1 | 13.5 | 16.5 | 24.1 |
| Number | 281 | 257 | 224 | 187 | 121 |

| Homogeneous MAE Western North Pacific 2002 | | | | | |
|---|---|---|---|---|---|
| (Initial Vmax > 84 kt) | | | | | |
| Model | 12-hour | 24-hour | 36-hour | 48-hour | 72-hour |
| ST5D | 7.3 | 10.8 | 14.6 | 15.8 | 17.7 |
| STID | 7.8 | 13.1 | 15.8 | 17.4 | 19.0 |
| STIP | 7.8 | 12.9 | 16.1 | 18.4 | 20.8 |
| Number | 146 | 145 | 141 | 133 | 113 |

Table 6-10: Homogeneous mean absolute intensity forecast errors (MAE) from 5-day STIFOR (ST5D), decay-STIPS (STID), and STIPS (STIP). Verification is upon the preliminary best track data and includes all intensity forecasts made by these models in the western North Pacific including those from tropical cyclone cp02 (ELE) and cp03 (HUKO).

| Homogeneous MAE Western North Pacific 2002 |
|---|
| |

| Model | 12-hour | 24-hour | 36-hour | 48-hour | 72-hour |
|---|---|---|---|---|---|
| ST5D | 6.7 | 10.6 | 14.8 | 17.4 | 21.1 |
| STID | 6.5 | 10.8 | 13.6 | 16.2 | 21.1 |
| STIP | 6.6 | 11.1 | 14.5 | 17.3 | 22.5 |
| Number | 427 | 402 | 365 | 320 | 234 |

Table 6-11: Homogeneous mean absolute intensity forecast errors (MAE) stratified by initial intensity from 5-day STIFOR (ST5D), decay-STIPS (STID), and STIPS (STIP). Verification is upon the preliminary best track data and includes all intensity forecasts made by these models in the western North Pacific including those from tropical cyclones 02C (ELE) and 03C (HUKO).

To address the climatological issue, the statistical coefficients will be recalculated using the 2002 cases, which included six super typhoons. While doing so, the use of 200-mb divergence as a predictor will be also be re- examined and this predictor may be eliminated. Other improvements will likely require additional funding. These improvements could include:

1) The use of SST and subsurface temperatures from the Navy's OTIS analysis.

2) The reformulation of the model to use smaller spatial areas for the calculation of shear as well as techniques to remove the storm vortex from this calculation.

3) The redevelopment of the model to predict the 12 or 24 hour changes in intensity. This would remove the dependency upon time averaging.

4) The development of a consensus approach using several tracks and model analyses.

5) The inclusion of the forecasts from ST5D as a predictor (this could also use 12 or 24 incremental changes). This would also help with the issue of a better climatology.

Some of these issues will be discussed at the upcoming Interdepartmental Hurricane Conference.

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Chu, J-H., 1994: A regression model for the western North Pacific tropical cyclone intensity forecasts. NRL Memo. Rep. 7541-94-7215,Naval Research Laboratory, 33 pp. [Available from Naval Research Laboratory, 7 Grace Hopper Avenue, Monterey, CA 93943-5502]

| Western North Pacific 21 July -31 Dec. 2001 | | | | |
|---|---|---|---|---|
| | 96-hour | | 120-hour | |
| Statistic | ST5D | Persistence | ST5D | Persistence |
| Errors | 23.6 | 40.4 | 23.7 | 42.2 |
| Biases | -10.6 | -20.6 | -10.0 | -25.5 |
| Number | 321 | | 243 | |
| Western North Pacific 2002 | | | | |
| Errors | 22.7 | 42.3 | 27.0 | 48.4 |
| Biases | -10.8 | -14.9 | -14.7 | -16.8 |
| Number | 397 | | 307 | |

Table 6-14: Mean absolute error of intensity forecasts made by the STIFOR model (ST5D) and persistence (PER) in the western North Pacific for 2001 and 2002. Verification included all storms and depressions. Note 2002 uses preliminary best track information.

With two years of independent verification of this method showing a statistically significant improvement in forecast ability compared to the 3-day STIFOR (Chu, 1994), this method has become the new baseline for typhoon intensity forecast guidance in the western North Pacific. As a direct result, this method has effectively raised the bar of intensity forecasting skill in the western North Pacific by approximately 20% at 72-hours. Furthermore, this method has directly impacted operational intensity forecasting at JTWC offering the TDO a better first assessment of future intensity change (Steven Vilpors, Personal Communication).

References:

Chu, J-H., 1994: A regression model for the western North Pacific tropical cyclone intensity forecasts. NRL Memo. Rep. 7541-94-7215, Naval Research Laboratory, 33 pp. [Available from Naval Research Laboratory, 7 Grace Hopper Avenue, Monterey, CA 93943-5502]

Knaff, J.A., M. DeMaria, C. S. Sampson, J. M. Gross, 2003: Statistical, five-day tropical cyclone intensity forecasts derived from climatology and persistence. Wea. Forecasting, in press

## 6.5 NRL MODIFICATIONS TO JTWC CONSENSUS TOOLS (C. R. (Buck) Sampson, Naval Research Laboratory)

In early 2001, NRL modified the National Hurricane Center interpolator code for use by the JTWC. This interpolator code has been in use since the mid-90's at NHC and is used to gracefully move and interpolate the NWP model forecasts to the current warning time. Interpolated aids all end in the letter "I". For example, the interpolated NGPS forecast is NGPI. These interpolated tracks are computed for model runtime+6hrs and model runtime+12 hrs so that they are available for the current warning.

Also in early 2001, a seven NWP model consensus was developed (CONT) which included NGPI, GFDI, EGRI, JGSI, JTYI, COWI and AFWI. Post-storm results demonstrated that, on average, a seven model consensus outperforms the five model consensus introduced by SAFA in 2000 (NCON) or the three (GLAV) and two model (RGAV) consensuses introduced on ATCF in 1998. Post-storm analysis also demonstrated that the addition of the recently available interpolated AVN model forecast tracks (JAVI) produced by the JTWC vortex tracker add value to CONT. Thus, an eight model consensus was also introduced in late 2001 (CONU). Minor changes and additions to the interpolator and consensus will be introduced yearly.

## 6.6 ON-SCENE ANALYSIS OF TROPICAL CYCLONES USING NUMERICAL WEATHER PREDICTION DATA (CDR Mike Fiorino, USNR, fiorino@tenkimap.com, METOC Department Head NR NRL Science & Technology 220, Naval Air Reserve Center supporting NRL and JTWC)

As part of a continuing research project on the application of NWP data to operational TC forecasting, a comprehensive TC diagnostic package, originally developed for the next reanalysis project of the European Centre for Medium-range Weather Forecasts (ECMWF), has been transitioned to JTWC. This system (WxMAP-based, see http://www.fnmoc.navy.mil/PUBLIC/WXMAP/.) manages real-time global NWP model field data from a variety of sources and performs a hierarchy of on-scene analysis tasks including: 1) TC tracking; 2) specialized field and TC track displays; and 3) TC wind structure.

Figure 6-4 displays An example of a TC-specific analysis and display where we show the forecast track of a TC out of the South China Sea (indicated with blue/green and blue/red dots) within the 72-h forecast of mid-upper tropospheric moisture and wind. The TC is undergoing extratropical transition on the dry side of the jet stream. The moisture display is also used to track TUTT cells and to diagnose quality of the initial conditions through comparison with water vapor imagery.

A recently added TC structure analysis package calculates TC-centric surface wind profiles for displaying changes in the outer TC wind field and to bias correct global model intensity forecasts. Figure 6-5 shows the symmetric wind profile for the same TC as in Figure 6-4 in the NOGAPS model. Also displayed is the TC wind model profile, based on JTWC estimates of the radius of 34 and 50 kt winds and maximum wind speed, used to construct the NOGAPS synthetic wind observations analyzed during the NOGAPS data assimilation cycle. The analyzed profile (dashed black line) should be similar to the wind model (heavy black line) except for aliasing of the very fine scales (~10 nm) in the TC to the larger scales resolved by the model (~ 100 nm). This aliasing results in a reduced maximum wind speed and an outward shifting of the radius of maximum wind. Statistics of the profiles by quadrant will be the basis of an objective wind radii forecast scheme.

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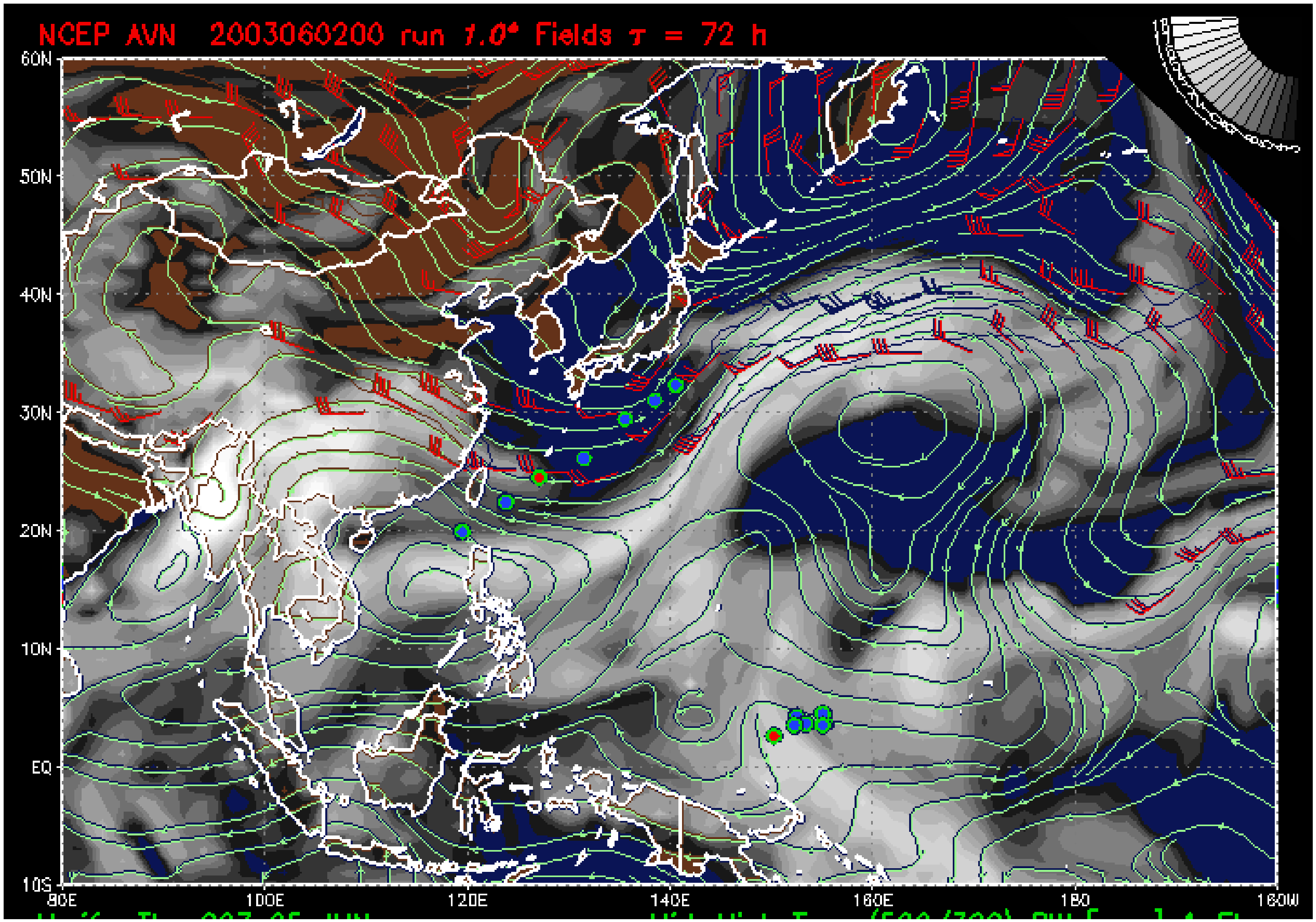


Fig 6-4. An example of a TC-specific analysis and display where we show the forecast track of a TC out of the South China Sea (indicated with blue/green and blue/red dots) within the 72-h forecast of mid-upper tropospheric moisture and wind.

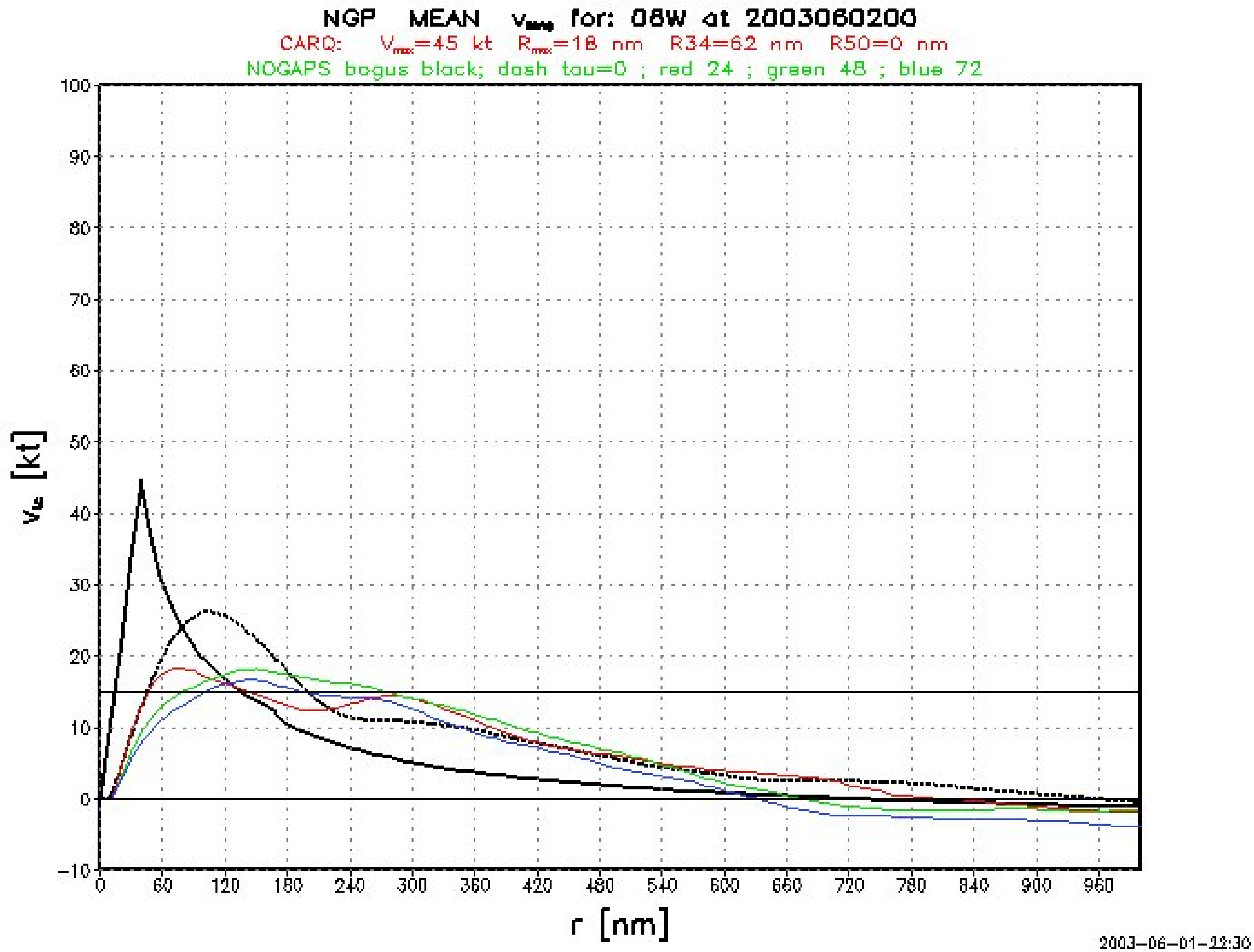

Fig 6-5. Example of a symmetric wind profile for the same TC as in Fig 6-4 in the NOGAPS model. The analyzed profile (dashed black line) should be similar to the wind model (heavy black line) except for aliasing of the very fine scales (~10 nm) in the TC to the larger scales resolved by the model (~ 100 nm).

## 6.7 SATELLITE APPLICATIONS AT THE JOINT TYPHOON WARNING CENTER (Lt Col Greg Engel, NPMOC/JTWC)

### 6.7.1 Introduction

The Joint Typhoon Warning Center (JTWC), Pearl Harbor Hawaii, is responsible for providing tropical cyclone forecasts to the United States Department of Defense and Department of State for the Pacific and Indian Oceans. Prior to 1987, JTWC used reconnaissance aircraft and meteorological satellite data to fulfill this mission. After 1 October 1987, due to budgetary considerations, aircraft reconnaissance flights in the western North Pacific ceased and the JTWC has since relied primarily on satellites for tropical cyclone reconnaissance.

Data from geostationary satellites owned by the United States and other countries as well as data from United States polar and equatorial orbiting satellites are used to assess synoptic features as well as ascertain cyclone position, intensity, and size. This past year has seen an increased use of microwave imagery by JTWC in an effort to improve the temporal and spatial continuity of the analysis of the tropical cyclone prior to issuing a warning on the storm and during the warning process. The increased emphasis on the use of microwave imagery and scatterometer data combined with limited time available due to the tropical cyclone warning process and difficulty in interpreting the data has at times contributed to information overload for the satellite analyst. A systematic approach needs to be developed that allows the satellite analyst to apply a Dvorak type of technique to microwave imagery, and scatterometer data that will enhance initial analysis of storm structure, intensity and position given the time constraints of the forecast process.

### 6.7.2 Tropical cyclone Analysis Process Overview

#### a) Satellite Display and Analysis Capabilities

JTWC has four forecast teams each of which has a dedicated satellite analyst who works closely with a typhoon forecaster. The satellite analyst maintains a continuous watch of the tropical Pacific and Indian Oceans using two key pieces of equipment.

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The Defense Meteorological Satellite Program's (DMSP) Mark IV-B is an Air Force satellite data acquisition and display system built by Lockheed Martin. This equipment provides the satellite analysts timely access to imagery via direct-feed capability from dedicated ground stations on Guam, Kadena, Japan, Hickam, Hawaii, Elmendorf, Alaska, and Lajes, Portugal. The Mark IV-B provides JTWC the capability to view geostationary and polar orbiting imagery and is the only system JTWC has that is capable of displaying Fen Yung 2 (FY-2) and moon light visible imagery.

The second system is the Navy FMQ-17 or Naval Satellite Display System- Enhanced (NSDS-E), built by the Sea Space Corporation. The NSDS-E provides access to Tropical Rainfall Measuring Mission (TRMM) Microwave Imager and DMSP Special Sensor Microwave/Imager (SSM/I) data. Both systems also provide the JTWC satellite analyst with other data from the GMS, GOES, MET-5/7, NOAA, and DMSP satellites.

The Internet is also used to receive microwave imagery and products (scatterometer and AMSU microwave data). Near-real-time access to imagery through a web site developed by the Naval Research Laboratory has allowed the satellite analyst to better exploit microwave imagery in the detection and analysis of tropical cyclones (Hawkins et al. 2000).

b) Synoptic or large area analysis

Geostationary satellite water vapor (WV) imagery is used in time-lapsed loops to ascertain the past and current state of the atmosphere. Water vapor imagery provides an analysis of synoptic features such as long-waves, tropical upper-tropospheric troughs, and regions of divergence/convergence that can both help or hinder tropical cyclone development.

The satellite analyst uses this and other satellite data along with surface observations, upper air observations, satellite derived winds (scatterometer and upper air), radar observations, aircraft observations and model forecast output from DoD, NWS and foreign meteorological agencies to maintain a continuous meteorological watch over the Pacific and Indian Oceans. Imagery from the Cooperative Institute for Meteorological Satellite Studies (CIMSS) at the University of Wisconsin overlays winds on top of imagery enhancing our ability to analyze the atmosphere around a storm. Subsequently, the satellite analyst and typhoon forecaster increase scrutiny on the area(s) where tropical cyclone development is most likely and monitors the satellite data for the development of a circulation and persistent convection.

Once an area is identified as a tropical cyclone development region (suspect area), the satellite analyst contacts the Fleet Numerical Meteorology and Oceanography Center, and the Navy Research Laboratory, Monterey and establishes invest areas or satellite windows over the area of interest.

c) Tropical cyclone Location and Intensity Estimation

Once a suspect area has been identified and there is enough development to determine position and intensity, the satellite analyst is required to provide location and intensity estimates or a fix of the storm. The analyst provides a fix of position at least every 3 hours and intensity at least every 6 hours. A fix is primarily produced through the application of the Dvorak Technique which utilizes visible and infrared (IR) imagery. Fixes are also made using scatterometer, TRMM, Multispectral, and Special Sensor Microwave Imager (SSM/I) data.

Visual (VIS) and IR imagery are the basis for nearly 75% of the position and intensity fixes produced by JTWC. IR imagery is the data most used for determining tropical cyclone location and intensity because of its 24-hour a day, seven days a week availability. IR imagery can also be enhanced to identify features in the various atmospheric levels. VIS imagery provides the highest resolution and has been the best satellite data available for detection of surface features that may not be seen in the IR or WV imagery. Multi-spectral imagery that highlights both upper- and low-level features is also used to determine tropical cyclone position and intensity.

Fixes produced by the JTWC satellite analyst using VIS, IR, microwave, and scatterometer data are added to the fix database along with fixes from other meteorological agencies. This collection of fixes along with observational data is used by the typhoon forecaster to evaluate trends in the tropical cyclone track and intensity, in the development of a “working best track” and for input of a tropical cyclone bogus into numerical models.

Over the past year, the fusing of all available imagery with observational and model data has allowed the satellite analyst to provide the typhoon forecaster with greater storm continuity prior to issuing a warning on the storm. The time between when a cyclone or developing cyclone is first detected by the JTWC satellite analyst to the first tropical cyclone warning has increased from 21.7 hours in 2001 to 32.1 hours in 2002.

6.7.3 Satellite Tropical Cyclone Analysis Using Polar Orbiting Platforms

VIS and IR data are the primary tools for determining tropical cyclone position and intensity using the Dvorak Technique (Dvorak, 1975) because of the availability of the imagery. This past year has seen an increased emphasis on the use of microwave imagery and scatterometer data (Table 6-15) as we strive to obtain additional accuracy and detail that is not available in using the traditional Dvorak Technique.

| | Geo Stationary Imagery | Microwave Imagery | Scatterometer Data |
|---|---|---|---|
| 1999 (71) | 2972 | 373 | 11 |
| 2000 (65) | 3219 | 391 | 186 |
| 2001 (59) | 2666 | 372 | 130 |
| 2002 (56) | 2696 | 729 | 116 |

Table 6-15: Number of fixes by imagery/data type. Number of fixes for the year 2002 are through October. Numbers in parenthesis are number of storms.

a) Scatterometer

Scatterometer data provides the satellite analysts with a view of the low level circulation and seems to be a very good tool for determining outer wind structure during the weak tropical cyclone stage. Studies have shown that scatterometer data is unreliable above 50 kts however, the data is also used for well developed tropical cyclones to determine the radius of 35 kt winds (Edson et al. 2002). The relatively broad swath width and orbital characteristics provides the JTWC with at least one pass over any given tropical cyclone during a 24 hour period. Rain flagged winds appear to provide some value when they are consistent and cover a quadrant of the storm. Experience has shown that when this happens, the rain-flagged winds represent the low end of wind speeds in the area.

JTWC retrieves scatterometer data from three different sources (NOAA, FNMOC, and NRL). All three display different coverage, resolution, and in some instances, different (apparent) wind speed / center positions for the same tropical cyclone. Furthermore, none of the sites are able to deliver the products in timely manner (less than 2-3 hours after the pass). This lack of timely data and differences in data provided has on occasion prevented the analyst from using scatterometer data for assessing intensity or storm structure and in making fixes that impact the next tropical cyclone forecast. Once the scatterometer data is available, a fix is analyzed and incorporated into the tropical cyclone analysis and forecast process. While scatterometer data has not been used as frequently to provide a fix of position during 2002, the typhoon duty officers have used to data to assess storm structure.

Use of the scatterometer data over the past three years has shown problems with depicting false centers in the scatterometer wind field. At times, these differences have been nearly 120 nm from the centers as depicted in TRMM, SSM/I or a good VIS fix. False center events have even been noted in tropical cyclones of typhoon intensity with an eye present in VIS. Using the scatterometer ambiguity product (raw data) from the NOAA site to resolve the false center problem has shown some promise however, the technique is difficult to train upon and there appears to be a large degree of subjectivity in the process. The satellite analyst is also constrained by time.

b) SSM/I - TRMM

85 GHz and 37 GHz DMSP SSM/I and NOAA TRMM data are used in conjunction with the VIS and IR satellite data. The near equatorial orbit of these polar orbiting satellites allow for up to three passes per day over a given tropical cyclone. When high level cloud cover is present, the data has been shown to be useful in detecting a low level cyclonic circulation when none were evident in the VIS or IR data. SSM/I and TRMM data has been especially useful at the Tropical Storm stage (35kt-64kt), when the low level circulation center is well defined, but an eye has not yet become apparent in enhanced IR or VIS imagery. While no rigorous validation has been done, it appears that an eye becomes evident in the microwave data when a Dvorak T number of 4.0 was assigned to the cyclone based upon VIS or IR data. Microwave data is also used to determine the tropical cyclone 35kt wind radius though scatterometer is tool of choice for this application. JTWC has used techniques developed by Cox et al. (1999) to categorize microwave images into intensity bins based on the degree of wrap by a developing eye and correlate that to a an intensity estimate (Figure 6-6). Comparative analysis of this technique with the traditional Dvorak technique has shown good agreement however there have been times when a fix derived using good quality VIS imagery was not validated by the microwave imagery. JTWC is working with the Navy Research Lab and Roger Edson to develop better techniques to incorporate microwave imagery and scatterometer data into the tropical cyclone analysis process.

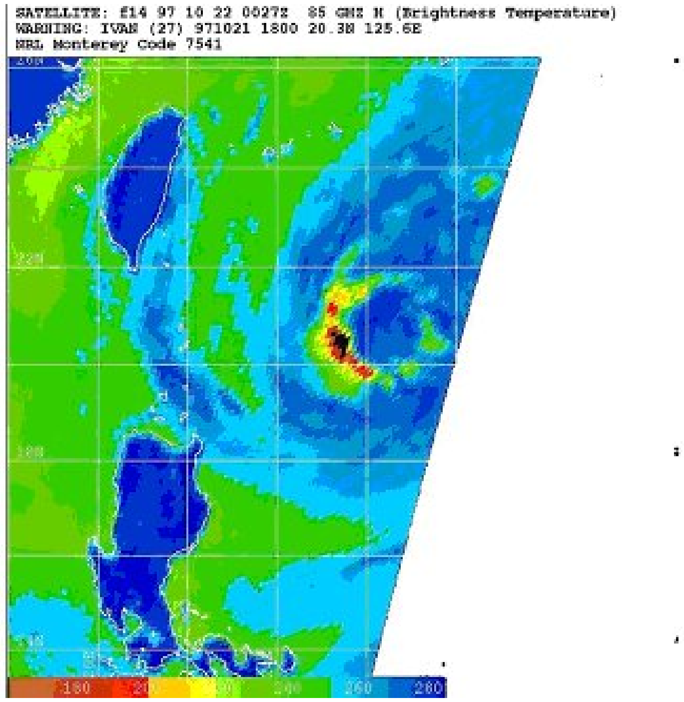


Fig 6-6. Example showing 85 GHz SSM/I imagery depicting a broken ring pattern correlating to 50 to 85 kts maximum wind.

c) Advanced Microwave Sounding Unit (AMSU)

Two new microwave-sounding units on NOAA-15 and NOAA-16 polar orbiting satellites have the ability to see trough the upper-level cirrus and provide data of the environment around a tropical cyclone and within the tropical cyclone. Techniques are being developed and evaluated by CIMSS (Velden et al. 1998). and by the Cooperative Institute for Research in the Atmosphere (CIRA) at Colorado State University to assess wind fields and an improved specification of a tropical cyclone vortex. This capability has helped the JTWC to identify eyes within tropical cyclones not to be detected in VIS and IR imagery and to evaluate TC intensity. Despite some signs showing the utility of AMSU data, it has been used sparingly at JTWC.

d) Objective Dvorak Technique (ODT):

The ODT is being evaluated at the JTWC for intense (> 64 kts) tropical cyclones. The technique developed by the University of Wisconsin (Velden et al. 1998) in cooperation with the Navy Research Lab uses SSM/I and TRMM images to evaluate cloud patterns and temperatures to compute an ODT intensity or T#. Use of the technique at the JTWC indicates that ODT final T# estimates were typically within 0.5 T# of JTWC Best Track estimates (Figure 6-7).

Very cold cloud temperatures led to high bias in Final T# relative to JTWC Best Track estimates (cloud temperatures < upper -70°C) while Rapid intensification flag correctly identified events but led to large Final T# high bias when coupled with very cold cloud top temperatures.

Given the increased emphasis on the use of microwave imagery, scatterometer data, and the incorporation of model data and observational data in the metwatch process, the satellite analysts have been dealing with the problem of information overload. This is compounded by the limited time schedule associated with the tropical cyclone forecast process, the subjective nature of the tropical cyclone analysis process, and delays in data receipt. This points towards the need for a system that fuses additional imagery and data types, that exploits automation, and provides for a systematic approach to conduct tropical cyclone reconnaissance.

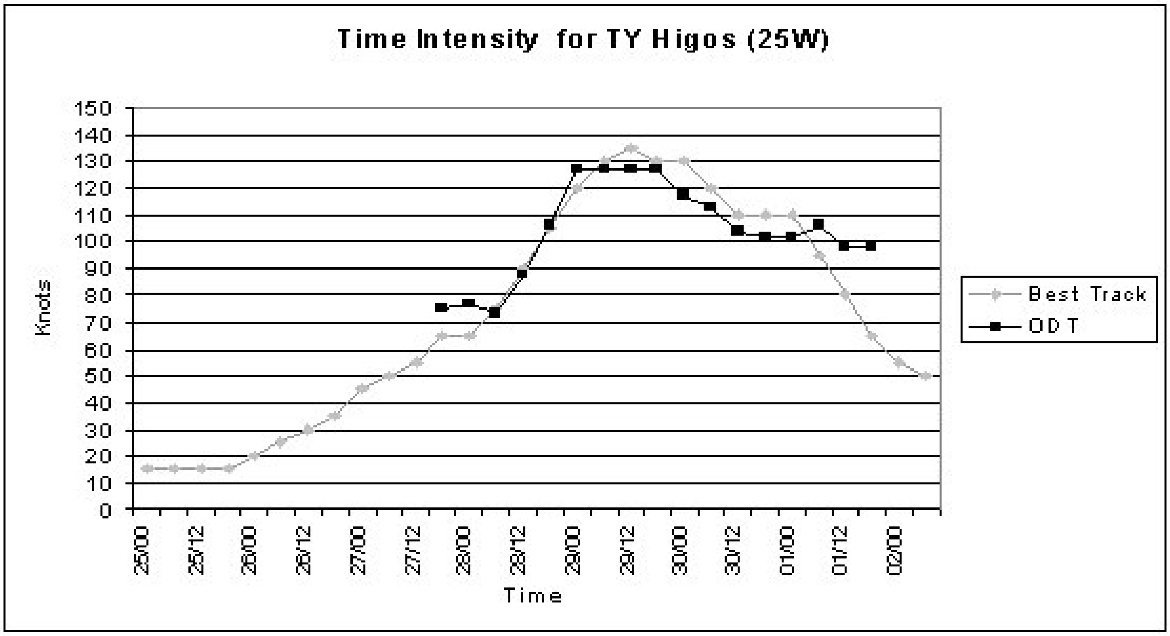


Fig 6-7: Comparison of ODT verses Best Track for TY 25W.

6.7.4 Cooperative Efforts

Many organizations have worked closely with the JTWC in recent years to aid in the satellite data application development effort. All of these entities have provided excellent assistance, guidance and counsel to the JTWC Satellite Operations. The National Center for Environmental Prediction, Satellite Analysis Branch (SAB) has been instrumental in the development of scatterometer wind speed and direction algorithms as well as display techniques. The University of Wisconsin CIMSS has had a long professional association with the JTWC and continues to be one of the major developers of satellite data applications for the tropical cyclone mission. The Naval Research Laboratory, Monterey, CA, has been in the forefront of satellite data display techniques especially with the use of multiple sensors or data sets overlaid over a tropical cyclone and the effort to develop tropical cyclone analysis and forecast techniques using scatterometer data. The Fleet Numerical Meteorology and Oceanography Center, has also had a long relationship with the JTWC and in the satellite realm, has been a mainstay data provider for over 15 years. Collaborative efforts with the use of AMSU data for tropical cyclone forecasting is also developing with the NASA National Space Science and Technology Center and the Colorado State University Cooperative Institute for Research in the Atmosphere.

6.7.5 Future Capabilities

JTWC is currently working to include the capability to ingest MODIS data. MODIS's large 2,330km swath width and resolution of between .25km and 1km will provide exceptional tropical cyclone analysis capabilities however, the data is encoded in NASA Hierarchical Data File (HDF) format, which 17 OWS and JTWC cannot currently utilize. A total of four MODIS instruments are planned for launch prior to 2006. Further coordination with NASA, AFWA, FNMOC, and NOAA is required to gain access to near real-time MODIS data. Satellite data analysis systems like the Mark IVB must be modified to interpret/display HDF file format to exploit MODIS capabilities, or develop software to translate HDF files into Mark IVB-readable files.

6.7.6 Conclusions

Microwave imagery has been of a great benefit in increasing our ability to fix on storms earlier and obtain a better understanding of storm position and structure. The imagery has contributed to greater lead times from first analysis of position and intensity to warning. Microwave and scatterometer data has at times allowed the satellite analyst to adjust position and intensity estimates made using VIS and IR imagery and have allowed the typhoon forecaster to adjust their tropical cyclone analysis and forecast process. Much work still needs to be done to fully exploit the operational benefits of this data.

The most significant issue with utilizing TRMM, SSMI, AMSU, and scatterometer data to analyze tropical cyclones for intensity and position is the lack of a unified technique that that has been scientifically validated against ground truth. JTWC satellite analysts also must deal with the challenges of personnel turnover associated with military duty that increase the training burden on a new satellite analyst. A Dvorak type technique that utilizes microwave imagery and scatterometer data in systematic approach to tropical cyclone analyses of position, intensity and structure is a critical need. This would aid in improved analysis and forecasts of tropical cyclones, help alleviate some of the information overload, enable the analysis of a tropical cyclone in the time constraints of the forecast process, and provided a structured program training new satellite analysts.

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