Annual Report on Activities of the RSMC Tokyo – Typhoon Center 2001

Japan Meteorological Agency

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Introduction

The RSMC Tokyo - Typhoon Center (hereinafter referred to as "the Center") is the Regional Specialized Meteorological Centre (RSMC) with activity specialization in analysis, tracking and forecasting of western North Pacific tropical cyclones within the framework of the World Weather Watch (WWW) Programme of the World Meteorological Organization (WMO). The Center was established at the Headquarters of the Japan Meteorological Agency (JMA) in July 1989, following the designation by the WMO Executive Council at its 40th session held in Geneva in June 1988.

The Center conducts the following operations on a routine basis:

(1) Preparation of information on the formation, movement and development of tropical cyclones and associated meteorological phenomena;
(2) Preparation of information on synoptic scale atmospheric situations that affect the behavior of tropical cyclones; and
(3) Dissemination of the above information to National Meteorological Centers (NMCs), in particular to the Members of the ESCAP/WMO Typhoon Committee, in appropriate formats for operational processing.

In addition to the routine services mentioned above, the Center distributes a series of reports entitled “Annual Report on Activities of the RSMC Tokyo - Typhoon Center” to serve as operational references for the NMCs concerned. This report aims at summarizing the activities of the Center and reviewing tropical cyclones of the year.

In this 2001 issue, the outline of routine operations at the Center and its operational products are presented in Chapter 1. Chapter 2 reports the major activities of the Center in 2001. Chapter 3 describes atmospheric and oceanic conditions in the tropics and gives the highlights of tropical cyclone activities in 2001. In Chapter 4, verification statistics of operational forecasts and predictions of the two numerical models of the Center are presented. The best track data for the tropical cyclones in 2001 are shown in table and chart forms in Appendices. All the texts, tables, charts and appendixes are included in the CD-ROM.

The CD-ROM contains 3-hourly cloud images of all the tropical cyclones in 2001 of TS intensity or higher in the area of responsibility of the Center, and software to view them. The software has various functions for analyzing satellite imagery such as animation of images, which facilitates efficient post-analysis of tropical cyclones and their environments. A setup program and a users' manual for the software are also included in the CD-ROM. Appendix 7 shows an outline of the CD-ROM and how to use the software.

Chapter 1

Operations at the RSMC Tokyo - Typhoon Center in 2001

The area of responsibility of the Center covers the western North Pacific and the South China Sea (0° - 60°N, 100°E - 180°) including the marginal seas and adjacent land areas (see Figure 1.1). The Center makes analyses and forecasts of tropical cyclones when they are in or expected to move into the area and provides the National Meteorological Services (NMSs) concerned with the RSMC products through the GTS, the AFTN and the JMA radio facsimile broadcast (JMH).

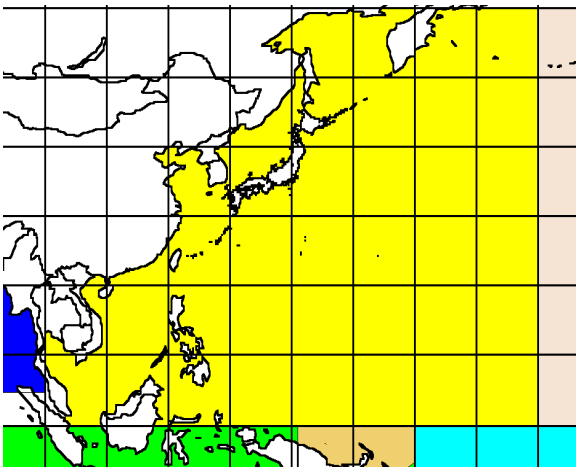


Figure 1.1
Area of responsibility (yellow) of the RSMC Tokyo – Typhoon Center

1.1 Analysis

Surface analyses are performed four times a day, at 00, 06, 12 and 18 UTC. The tropical cyclone analysis begins with the determination of the center position of a tropical cyclone. Cloud images from the Geostationary Meteorological Satellite (GMS) are the principal source for the determination of the center position, especially of tropical cyclones migrating over the data-sparse ocean area. The direction and speed of the movement of a tropical cyclone are determined primarily from the six-hourly displacement vectors of the center position.

The central pressure of a tropical cyclone is determined mainly from the CI-number, which is derived from the satellite imagery using Dvorak's method. The CI-number also gives the maximum sustained wind speed in the vicinity of the center. Radii of circles for the gale-force wind and the storm-force wind are determined from surface observations and low-level cloud motion winds (LCW) which are derived from cloud motion vectors of GMS images at fifteen-minute intervals in the vicinity of the tropical cyclone.

1.2 Forecast

Predictions of the two numerical prediction models of JMA, Typhoon Model (TYM) and Global Spectral Model (GSM), are the primary bases for the forecast of tropical cyclone tracks. The Persistence-Climatology method (PC method) that uses statistical techniques on the basis of linear extrapolation and climatological properties of tropical cyclone movements

is also adopted for tropical cyclones particularly in lower latitudes. The central pressure and the maximum sustained wind speed are forecast based on the results of Dvorak's method, the PC method and the numerical prediction.

The range into which the center of a tropical cyclone is expected to move with 70% probability at each validation time is shown as the probability circle. The radius of the circle is statistically determined according to the speed of tropical cyclone movement.

1.3 Provision of RSMC Products

The Center prepares and disseminates the following RSMC bulletins and charts via the GTS, the AFTN or the JMH when:

- a tropical cyclone of tropical storm (TS) intensity or higher exists in the area of responsibility of the Center;
- a tropical cyclone is expected to reach TS intensity or higher in the area within 24 hours; or
- a tropical cyclone of TS intensity or higher is expected to move into the area within 24 hours.

The RSMC products are continually issued as long as the tropical cyclone keeps TS intensity or higher within the area of responsibility. Appendix 5 denotes the code forms of the bulletins transmitted through the GTS.

RSMC Tropical Cyclone Advisory (WTPQ20-25 RJTD: via GTS)

The RSMC Tropical Cyclone Advisory reports the following elements in the analysis, 24-hour, 48-hour and 72-hour forecasts of a tropical cyclone, respectively:

Analysis	Center position of a tropical cyclone Accuracy of determination of the center position Direction and speed of the movement Central pressure Maximum sustained wind speed (10-minute averaged) Radii of over 50- and 30-knot wind areas
24-and 48-hour forecasts	Center position and radius of the probability circle* Direction and speed of the movement Central pressure Maximum sustained wind speed (10-minute averaged)
72-hour forecast	Center position and radius of the probability circle* Direction and speed of the movement

* A circular range into which the tropical cyclone is expected to move with the probability of 70% at each validation time.

RSMC Guidance for Forecast (FXPQ20-25 RJTD: via GTS)

The RSMC Guidance for Forecast reports the results of numerical predictions of GSM and TYM: GSM is run twice a day with initial analyses at 00 and 12 UTC and TYM four times a day with initial analyses at 00, 06, 12 and 18 UTC. The Guidance presents GSM's six-hourly predictions of a tropical cyclone up to 90 hours for 00 and 12 UTC and TYM's six-hourly predictions up to 84 hours for 00, 06, 12 and 18 UTC. It includes:

NWP prediction (T=06 to 84 or 90)	
	Center position of a tropical cyclone
	Central pressure*
	Maximum sustained wind speed*

* Predictions of these parameters are given as deviations from those at the initial time.

SAREP (TCNA20/21 RJTD: via GTS)

The SAREP reports a tropical cyclone analysis using GMS imagery including intensity information (CI-number) based on Dvorak's method. It is issued a half to one hour after observations at 00, 03, 06, 09, 12, 15, 18 and 21 UTC and contains:

GMS imagery analysis	Center position of a tropical cyclone
	Accuracy of determination of the center position
	Mean diameter of the cloud system
	CI-number**
	Apparent change in intensity in the last 24 hours**
	Direction and speed of the movement

** These parameters are reported at 00, 06, 12, 18 UTC while not at other times.

RSMC Prognostic Reasoning (WTPQ30-35 RJTD: via GTS)

The RSMC Prognostic Reasoning provides a brief reasoning for a tropical cyclone forecast. It is issued at 00 and 06 UTC following the issuance of the RSMC Tropical Cyclone Advisory. In the bulletin, general comments on the forecasting method, synoptic situation of the subtropical ridge, movement and intensity of the tropical cyclone, and some relevant remarks are given in plain language.

RSMC Tropical Cyclone Best Track (AXPQ20 RJTD: via GTS)

The RSMC Tropical Cyclone Best Track gives post-analyzed data of tropical cyclones. It contains the center position, central pressure and maximum sustained wind. The Best Track for a tropical cyclone is finalized usually one and a half months after the termination of issuance of above RSMC bulletins for the tropical cyclone.

Tropical Cyclone Advisory for SIGMET (FKPQ30-35 RJTD: via AFTN)

The Center, as one of the Tropical Cyclone Advisory Centres under the framework of the International Civil Aviation Organization (ICAO), provides the Tropical Cyclone Advisory for SIGMET for Meteorological Watch Offices (MWOs) concerned to support the preparation of SIGMET information on a tropical cyclone. It includes the following elements in the analysis, 12-hour, 24-hour forecasts of a tropical cyclone:

Analysis and 12- and 24-hour forecasts
- Center position of a tropical cyclone (analysis)
- Center position of the tropical cyclone (forecast)
- Direction and speed of the movement
- Central pressure
- Maximum sustained wind speed (ten-minute averaged)

Prognostic Charts of 850-hPa and 200-hPa Streamline
(FUXT852/202, FUXT854/204: via JMH)

Analysis and 24- and 48-hour prognostic charts of 850-hPa and 200-hPa streamlines are broadcast via the JMA's HF radio facsimile (JMH). These prognoses are produced with GSM at 00 and 12 UTC over the area spanning from 20°S to 60°N in latitude and from 80°E to 160°W in longitude.

1.4 RSMC Data Serving System

JMA has been operating the RSMC Data Serving System that allows NMCs concerned to retrieve NWP products such as predicted fields in grid-point-value (GPV) form and observational data through the Internet or the Integrated Service Digital Network (ISDN) since 1995. The products and data provided through the system are listed in Appendix 6.

Tropical Cyclone Web Site:

Tropical cyclone advisories are available on a real time basis through the Internet at: http://ddb.kishou.go.jp/typhoon/cyclone/cyclone.html.

Chapter 2

Major Activities of the RSMC Tokyo - Typhoon Center in 2001

2.1 Dissemination of RSMC Products

In 2001, the RSMC Tokyo - Typhoon Center provided operational products for tropical cyclone forecasting to NMCs via the GTS, the AFTN and the JMA radio facsimile broadcast (JMH). Monthly and annual total numbers of issuance of the products are listed in Table 2.1.

Table 2.1 Monthly and annual total number of products issued by the RSMC Tokyo – Typhoon Center in 2001

Product	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TCNA20	16	0	0	0	14	20	88	95	161	75	23	54	546
TCNA21	17	0	0	0	16	21	95	104	167	80	34	57	591
WTPQ20-25	17	0	0	0	16	22	101	112	176	83	35	60	622
WTPQ30-35	7	0	0	0	9	11	48	50	88	39	17	27	296
FXPQ20-25	16	0	0	0	24	33	140	159	246	122	49	85	874
FKPQ30-35	16	0	0	0	16	21	94	108	170	81	34	57	597
AXPQ20	7	3	0	0	0	1	1	6	3	3	5	4	33
AUXT85/20	62	56	62	60	62	60	62	62	60	62	60	62	730
FUXT852/854	62	56	62	60	62	60	62	62	60	62	60	62	730
FUXT202/204	62	56	62	60	62	60	62	62	60	62	60	62	730

Notes: - via the GTS or the AFTN -

SAREP	TCNA20/21 RJTD
RSMC Tropical Cyclone Advisory	WTPQ20-25 RJTD
RSMC Prognostic Reasoning	WTPQ30-35 RJTD
RSMC Guidance for Forecast	FXPQ20-25 RJTD
Tropical Cyclone Advisory for SIGMET	FKPQ30-35 RJTD
RSMC Tropical Cyclone Best Track	AXPQ20 RJTD

- via the JMH Meteorological Radio Facsimile -

Analysis of 850 and 200 hPa Streamline	AUXT85/AUXT20
Prognosis of 850 hPa Streamline	FUXT852/FUXT854
Prognosis of 200 hPa Streamline	FUXT202/FUXT204

2.2 Publication

The Center published:

1) “Technical Review (No. 4)” that contains three papers on typhoon predictions in March 2001; and

2) “Annual Report on Activities of the RSMC Tokyo-Typhoon Center in 2000” in July 2001.

2.3 Monitoring of Observational Data Availability

The Center carried out regular monitoring of the information exchange for enhanced observations of tropical cyclones in accordance with the standard procedures stipulated in Section 6.2, Chapter 6 of "The Typhoon Committee Operational Manual (TOM) - Meteorological Component." The monitoring for this season was conducted for the following two periods:

1. from 00UTC 2 July to 18UTC 6 July (for STS Utor (0104))
2. from 00UTC 7 November to 18UTC 11 November (for TY Lingling (0123))

The results were distributed to all the Typhoon Committee Members in February 2002, and are available on the Distributed Database of JMA at:
ftp://ddb.kishou.go.jp/pub/monitoring/rsmc.

Chapter 3

Atmospheric and Oceanographic Conditions in the Tropics and Tropical Cyclones in 2001

3.1 Summary of Atmospheric and Oceanographic Conditions in the Tropics

Sea surface temperatures (SSTs) were more than 0.5°C below normal in the central equatorial Pacific during January through March. In the western equatorial Pacific, positive SST anomalies exceeding +0.5°C were found around 140°E almost throughout the year 2001. From April there was a gradual eastward shift of the area of the positive SST anomalies, and during June-August the positive anomalies were observed in most of the regions west of 130°W. The SST anomaly for a monitoring region (NINO.WEST; 0°-14°N, 130°E-150°E) was above normal throughout the year, while the SST anomaly for another monitoring region (NINO.3; 4°N-4°S, 150°W-90°W) was within 0.3°C in the absolute value until August, and remained –0.5°C during September through December. Charts of monthly mean SST anomalies for the western North Pacific are included in the CD-ROM.

Convective activities in the tropics continued to be above normal from the central Indian Ocean to the western Pacific, and below normal over the central Pacific until around April. However, this contrastive pattern disappeared in the latter half of the year.

The center of large-scale divergence at 200 hPa shifted westward from its normal position during January through March, and then returned to its normal position from April to November and shifted eastward in December. In the lower troposphere, zonal winds over the western Pacific, which were anomalous easterlies in January, turned almost normal in the latter half of the year.

The subtropical jet near Japan was shifted northward from the end of June to July, and weaker than normal in August. The sub-tropical high over south of Japan expanded northward from the second half of June to the first half of August. In consequence many tropical cyclones took northwestward tracks along the southwestern periphery of the high during this period. Monthly mean streamlines at 850 hPa for July and tropical cyclone tracks in July are presented in Figure 3.1 and Appendix 3, respectively.

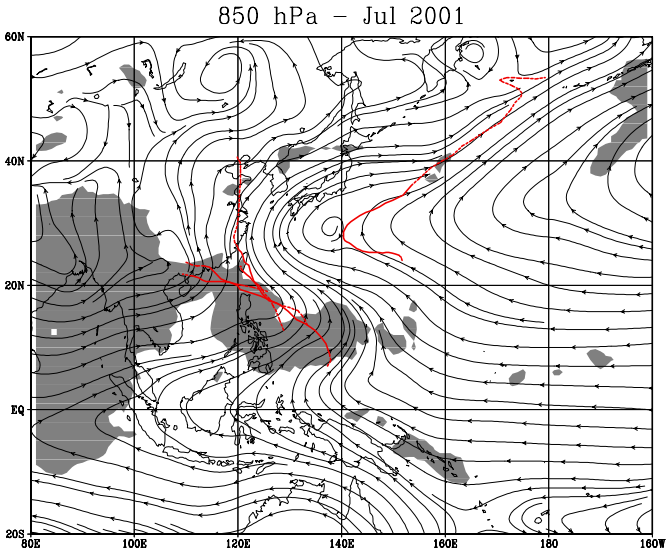


Figure 3.1 Monthly mean streamlines at 850 hPa and high-cloud amount greater than 30% (shaded) in July 2001.

Charts of monthly mean streamlines at 850 hPa and 200 hPa, and high-cloud amounts for the months from April to December are included in the CD-ROM.

3.2 Tropical Cyclones in 2001

In 2001, 26 tropical cyclones of tropical storm (TS) intensity or higher were tracked in the western North Pacific and the South China Sea. The total number is normal compared to the thirty-year average of 26.7 for 1971-2000. Sixteen cyclones out of them (62% of the total) reached typhoon (TY) intensity. The percentage of 62% is a little larger than normal (54%; 24-year average for 1977-2000). Four out of the remainder attained severe tropical storm (STS) intensity and the others remained at TS intensity (see Table 3.1).

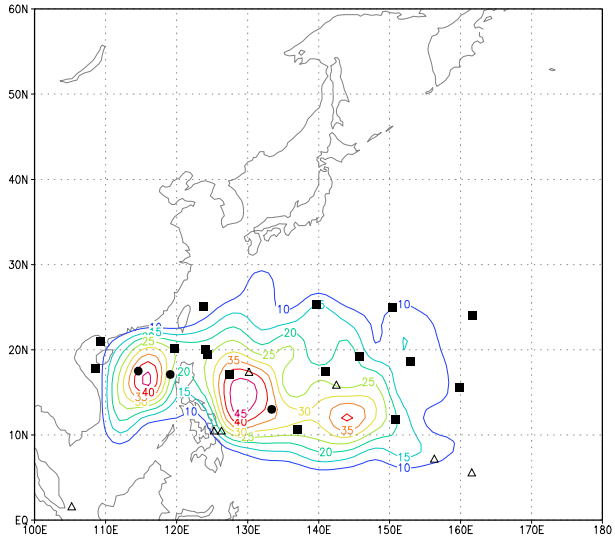


Figure 3.2 Genesis points of 26 TCs in 2001 (dots) and number of accumulated TC geneses per 4°x4° grid box for 1951-2000 (contours).

The tropical cyclone season of this year began in the middle of May about one month and a half later than normal with the development of STS Cimaron (0101). Since then tropical cyclone activity in the basin had been suppressed and no tropical cyclone of TS intensity or higher was generated for more than one month.

In late June cyclogenesis became active and seven tropical cyclones were generated in total from the end of June to the end of July. As the extension of a sub-tropical high was greater than normal to the west and to the north throughout this period, six cyclones except TY Kong-rey (0106) took northwestward tracks without recurving and made landfall on the continent or Taiwan. TY Chebi (0102), TS Trami (0105) and TY Toraji (0108) which hit or passed close to Taiwan caused serious damage to the region.

The number of tropical cyclone formation was normal from August to September; six and five cyclones formed in August and September, respectively. After the middle of August the sub-tropical high weakened, and many cyclones moved northward east of Japan along the western periphery of the high. Among them TY Pabuk (0111) and TY Danas (0115) hit Japan and brought heavy damage to the country. Meanwhile two typhoons, TY Nari (0116) and TY Lekima (0119) hit Taiwan in September, affecting the region seriously. TY Nari (0116) also brought record-breaking rainfall to the Okinawa Islands and caused heavy damage such as flooding there.

In October two typhoons tracked south of Japan in succession and another typhoon moved northward east of the Mariana Islands in the end of the month. In November TY Lingling (0123), the only tropical cyclone for the month developed in the South China Sea, made landfall on southern Vietnam and severely damaged the country.

Three tropical cyclones were generated in December. It was the first time in the last eight years that three or more tropical cyclones were generated in December. Vamei (0126), the last storm of the year 2001, reached TS intensity at unusually low latitude 1.5 °N east of Singapore. There is no tropical cyclone on the best track data for 1951-2000 that formed so close to the equator.

Other features of this tropical cyclone season were as follows:

- Tropical cyclones in 2001 tended to track in higher latitudes. Distribution of their genesis points was about normal. (see Figure 3.2);

- Average of duration of TS intensity or higher, minimum central pressure and maximum sustained wind were all about normal (see Table 3.1).

RSMC best track data for the tropical cyclones in 2001 and maps of their tracks are shown in Appendices 1 and 3, respectively. Appendix 4 indicates the monthly and annual frequency of tropical cyclones that attained TS intensity or higher in the western North Pacific and the South China Sea for 1951- 2001.

Table 3.1 List of the tropical cyclones which attained TS intensity or higher in 2001

Tropical Cyclone			Duration (UTC)					Minimum Pressure & Max. Wind (UTC)	(N)	(E)	(hPa)	(kt)
STS	CIMARON	(0101)	110000	May	-	141200	May	130000	20.9	121.7	985	50
TY	CHEBI	(0102)	200600	Jun	-	240000	Jun	221800	21.0	119.9	965	65
STS	DURIAN	(0103)	300600	Jun	-	021800	Jul	011800	20.8	110.8	970	60
STS	UTOR	(0104)	020000	Jul	-	061200	Jul	040600	18.9	122.0	960	60
TS	TRAMI	(0105)	100000	Jul	-	111200	Jul	101200	20.8	122.8	994	40
TY	KONG-REY	(0106)	220000	Jul	-	290000	Jul	260600	29.7	141.1	955	70
STS	YUTU	(0107)	231800	Jul	-	260000	Jul	250000	20.6	113.9	975	55
TY	TORAJI	(0108)	270000	Jul	-	301800	Jul	280600	19.1	124.3	960	75
TY	MAN-YI	(0109)	020600	Aug	-	091800	Aug	041800	23.6	143.7	955	80
TS	USAGI	(0110)	100600	Aug	-	110000	Aug	100600	17.8	108.5	992	35
TY	PABUK	(0111)	141200	Aug	-	221800	Aug	170000	21.6	138.2	960	70
TY	WUTIP	(0112)	270600	Aug	-	030000	Sep	291200	24.0	146.5	930	90
TS	SEPAT	(0113)	271800	Aug	-	301800	Aug	280600	25.1	161.2	990	45
TS	FITOW	(0114)	301800	Aug	-	310600	Aug	300000	19.7	109.8	990	35
TY	DANAS	(0115)	040000	Sep	-	120600	Sep	080600	28.4	142.6	945	85
TY	NARI	(0116)	060000	Sep	-	170600	Sep	110600	26.3	127.1	960	75
			191800	Sep	-	200600	Sep					
TY	VIPA	(0117)	180000	Sep	-	211200	Sep	201800	36.1	145.8	975	65
TY	FRANCISCO	(0118)	200000	Sep	-	251800	Sep	231800	27.2	147.6	945	85
TY	LEKIMA	(0119)	221200	Sep	-	271800	Sep	240600	19.8	121.5	965	70
TY	KROSA	(0120)	040600	Oct	-	090600	Oct	061200	23.4	135.3	950	80
TY	HAIYAN	(0121)	121200	Oct	-	181200	Oct	152100	24.2	124.7	960	70
TY	PODUL	(0122)	200000	Oct	-	280000	Oct	251200	20.0	154.1	925	100
TY	LINGLING	(0123)	061800	Nov	-	120000	Nov	110000	13.5	112.5	940	85
TS	KAJIKI	(0124)	050000	Dec	-	060600	Dec	070600	12.4	116.5	996	35
			061800	Dec	-	080600	Dec					
TY	FAXAI	(0125)	161800	Dec	-	260000	Dec	221800	13.9	151.5	915	105
TS	VAMEI	(0126)	270000	Dec	-	271800	Dec	270600	1.5	104.4	1006	45

Chapter 4

Verification of Forecasts in 2001

4.1 Operational Forecast

Operational forecasts of the tropical cyclones of TS intensity or higher in 2001 were verified with the best track data. Verified elements are 24-hour and 48-hour forecasts of the center position, central pressure and maximum sustained wind, and 72-hour forecasts of the center position. Position and intensity errors of operational forecasts for each tropical cyclone in 2001 are indicated in Appendix 2.

4.1.1 Center Position

Figure 4.1 shows annual mean errors of 24-hour (1982 - 2001), 48-hour (1988 - 2001) and 72-hour (1997 - 2001) forecasts of center positions. Annual mean position errors in 2001 were 155 km for 24-hour forecast, 274 km for 48-hour forecast and 411 km for 72-hour forecast. The figure of 155 km for 24-hour forecast was nearly equal to that of 2000. The 48-hour forecast was slightly better than 282 km of 2000, although the 72-hour forecast was slightly worse than 404 km of 2000.

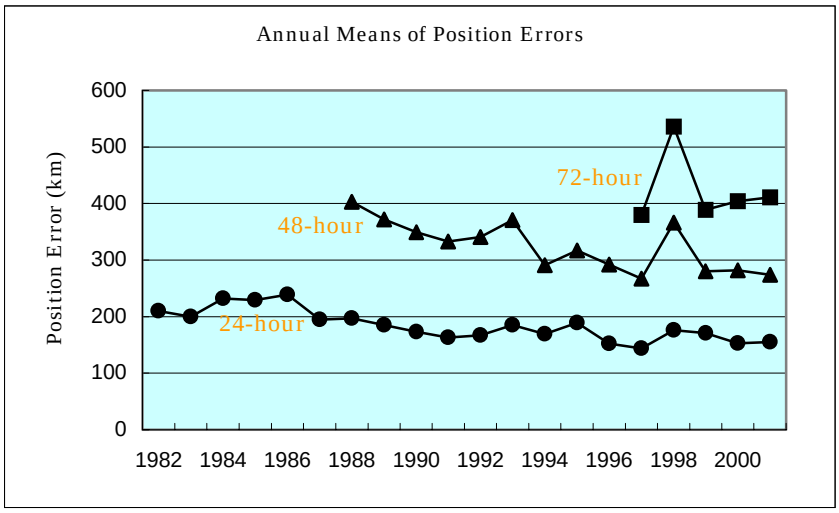


Figure 4.1 Annual means of position errors of 24-, 48- and 72-hour operational track forecasts.

Position errors of 24-, 48- and 72-hour track forecasts for each tropical cyclone in this season are summarized in Table 4.1. The forecast scores of TY Toraji and TY Lingling, which took steady northward or westward courses, were particularly well, and TY Nari, which drifted over the waters between Taiwan and Okinawa for long time, contributed to the scores to no small extent. On the other hand, the forecasts of TY Kong-rey, Francisco etc., which recurved southeast of Japan, had rather large distance errors because of their rapid movement changes.

Position errors were also compared to those by the persistency (PER) method. The ratios of EO (position errors of operational forecasts) to EP (position errors of PER-method forecasts) in percentage are described in Table 4.1. EO/EP smaller (greater) than 100% means that operational forecasts are better (worse) than PER-method forecasts. Annual mean EO/EPs for the 24-, 48- and 72-hour forecasts in 2001 were 70% (64% in 2000), 50% (50%) and 50% (43%), respectively. The improvement ratio of 48-hour forecasts was equal to that for the previous year, while the ratios of 24- and 72-hour forecasts were a little bit smaller than those for 2000.

Table 4.1 Mean position errors of 24-, 48- and 72-hour operational forecasts for each tropical cyclone in 2001

Tropical Cyclone		24-hour Forecast				48-hour Forecast				72-hour Forecast			
		Position Error & Number of Forecast				Position Error & Number of Forecast				Position Error & Number of Forecast			
		Mean (km)	S.D. (km)	Num.	EO/EP (%)	Mean (km)	S.D. (km)	Num.	EO/EP (%)	Mean (km)	S.D. (km)	Num	EO/EP (%)
STS CIMARON	(0101)	142	44	10	59	161	54	6	21	245	29	2	-
TY CHEBI	(0102)	207	115	11	67	449	167	7	76	591	90	3	39
STS DURIAN	(0103)	244	139	6	224	306	12	2	-	-	-	0	-
STS UTOR	(0104)	197	110	14	71	348	149	10	51	478	161	6	72
TS TRAMI	(0105)	165	19	2	-	-	-	0	-	-	-	0	-
TY KONG-REY	(0106)	191	91	24	103	382	206	20	74	584	283	16	61
STS YUTU	(0107)	216	89	5	82	482	0	1	-	-	-	0	-
TY TORAJI	(0108)	82	38	11	62	177	43	7	55	298	39	3	42
TY MAN-YI	(0109)	156	55	25	76	235	90	21	39	279	138	17	27
TS USAGI	(0110)	-	-	0	-	-	-	0	-	-	-	0	-
TY PABUK	(0111)	141	131	29	65	291	273	25	56	477	462	21	54
TY WUTIP	(0112)	172	114	23	132	270	134	18	82	313	99	14	79
TS SEPAT	(0113)	208	54	8	74	336	135	3	30	-	-	0	-
TS FITOW	(0114)	-	-	0	-	-	-	0	-	-	-	0	-
TY DANAS	(0115)	173	84	29	66	276	132	25	45	407	93	21	47
TY NARI	(0116)	106	68	41	61	160	86	37	39	283	125	32	46
TY VIPA	(0117)	129	51	10	41	260	80	6	28	293	128	2	-
TY FRANCISCO	(0118)	202	97	19	73	361	170	15	52	467	224	11	33
TY LEKIMA	(0119)	121	57	17	83	187	65	13	64	185	91	9	37
TY KROSA	(0120)	212	79	16	89	377	188	12	53	887	291	8	63
TY HAIYAN	(0121)	148	78	20	44	363	196	16	46	666	408	11	71
TY PODUL	(0122)	117	59	28	47	217	113	24	39	276	147	20	33
TY LINGLING	(0123)	89	55	17	76	165	81	13	63	320	109	9	79
TS KAJIKI	(0124)	143	131	5	68	212	34	5	86	-	-	0	-
TY FAXAI	(0125)	174	89	33	66	332	162	29	56	492	251	25	57
TS VAMEI	(0126)	-	-	0	-	-	-	0	-	-	-	0	-
Annual Mean (Total)		155	93	403	70	274	171	315	50	411	278	230	50

Figure 4.2 presents the histogram of 24-, 48- and 72-hour forecast position errors. The ratio of 24-hour forecast errors smaller than 150 km was 57% (59% in 2000), the ratio of 48-hour forecast errors smaller than 300 km was 67% (69%) and the ratio of 72-hour forecast errors smaller than 450 km was 68% (70%).

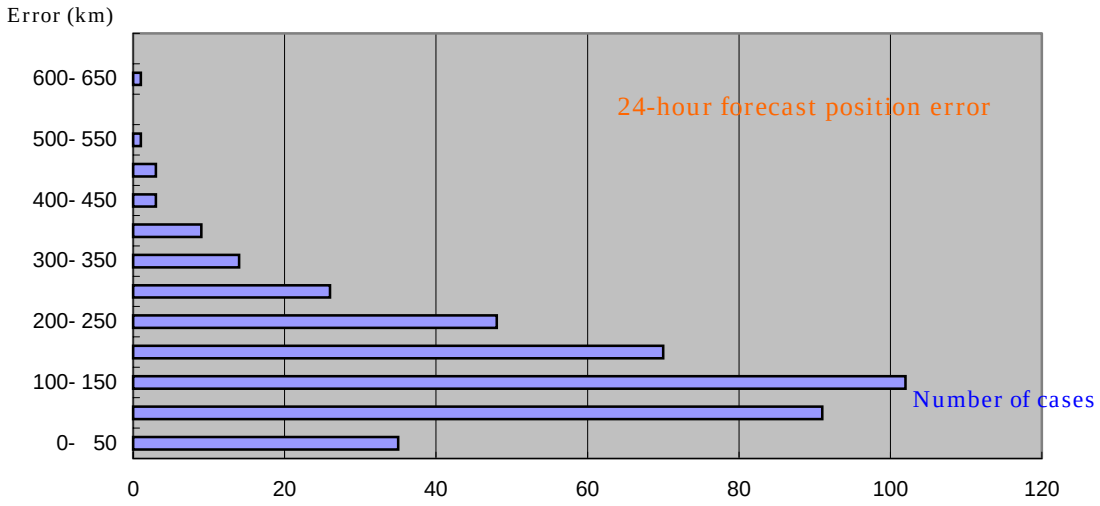


Figure 4.2 Histogram of 24-hour forecast position errors in 2001 (those for 48- and 72 hour forecasts are shown in the CD-ROM).

Table 4.2 presents mean hitting ratios and radii of 70% probability circles of operational forecasts for each tropical cyclone in 2001. The annual mean radius of 70% probability circles issued with 24-hour position forecasts was 183 km, and their hitting ratio was 70% (in 282 out of 403 cases, a tropical cyclone actually located within the issued probability circle). As for 48-hour forecasts, those are 325 km and 73% (in 230 out of 315 cases), respectively, and for 72-hour forecasts, 474 km and 71% (in 163 out of 230 cases), respectively. These hitting ratios for 2001 were almost the same as those for 2000.

Table 4.2 Mean hitting ratios (%) and radii (km) of 70% probability circles issued for 24-, 48- and 72-hour operational forecasts for each tropical cyclone in 2001

Tropical Cyclone			24-hour Forecast			48-hour Forecast			72-hour Forecast		
			Ratio (%)	Num.	Radius (km)	Ratio (%)	Num.	Radius (km)	Ratio (%)	Num.	Radius (km)
STS	CIMARON	(0101)	90	10	193	100	6	321	100	2	463
TY	CHEBI	(0102)	64	11	185	14	7	315	0	3	463
STS	DURIAN	(0103)	50	6	198	50	2	343	-	0	-
STS	UTOR	(0104)	57	14	201	50	10	332	17	6	463
TS	TRAMI	(0105)	50	2	167	-	0	-	-	0	-
TY	KONG-REY	(0106)	54	24	189	50	20	315	25	16	463
STS	YUTU	(0107)	40	5	189	0	1	315	-	0	-
TY	TORAJI	(0108)	100	11	185	100	7	315	100	3	463
TY	MAN-YI	(0109)	80	25	195	86	21	325	94	17	472
TS	USAGI	(0110)	-	0	-	-	0	-	-	0	-
TY	PABUK	(0111)	79	29	189	72	25	334	71	21	481
TY	WUTIP	(0112)	65	23	186	83	18	336	100	14	473
TS	SEPAT	(0113)	25	8	190	33	3	383	-	0	-
TS	FITOW	(0114)	-	0	-	-	0	-	-	0	-
TY	DANAS	(0115)	55	29	190	72	25	320	71	21	468
TY	NARI	(0116)	83	41	159	97	37	307	97	32	470
TY	VIPA	(0117)	90	10	195	100	6	389	100	2	463
TY	FRANCISCO	(0118)	53	19	191	53	15	329	45	11	463
TY	LEKIMA	(0119)	82	17	167	100	13	334	100	9	537
TY	KROSA	(0120)	38	16	182	50	12	326	0	8	491
TY	HAIYAN	(0121)	70	20	180	50	16	321	45	11	463
TY	PODUL	(0122)	86	28	180	83	24	336	95	20	474
TY	LINGLING	(0123)	94	17	184	100	13	316	89	9	471
TS	KAJIKI	(0124)	80	5	185	100	5	326	-	0	-
TY	FAXAI	(0125)	61	33	178	48	29	321	60	25	475
TS	VAMEI	(0126)	-	0	-	-	0	-	-	0	-
Annual Mean (Total)			70	403	183	73	315	325	71	230	474

4.1.2 Central Pressure and Maximum Wind Speed

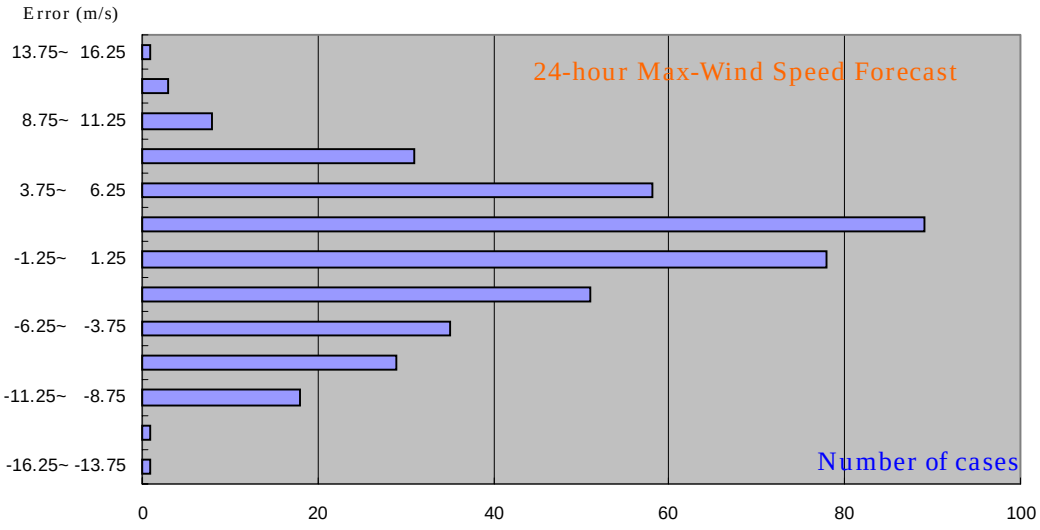
In June 2001, JMA started 48-hour tropical cyclone intensity forecasts. Table 4.3 gives root mean square errors (RMSEs) of 24- and 48-hour intensity forecasts for each tropical cyclone in 2001. Annual mean RMSEs of the central pressure and the maximum wind speed for 24-hour forecasts were 10.9 hPa (13.0 hPa in 2000) and 5.2 m/s (5.9 m/s in 2000), respectively, while those for 48-hour forecasts were 15.6 hPa and 6.9 m/s, respectively. The intensity forecasts of TY Faxai, which made rapid development in December, was very difficult, particularly for 48-hour ones. The overall performance of intensity forecasts in 2001 was better than that in 2000.

Figure 4.3 presents the histogram of maximum wind speed errors for 24- and 48-hour

forecasts. The ratio of absolute errors smaller than 3.75 m/s was 54% (54% in 2000) and 70% of total 48-hour forecasts had errors smaller than 6.25 m/s. The overall performance of 48-hour intensity forecasts seems good, however, relatively large errors were seen in rapid developing/decaying cases such as TY Faxai (see Appendix 2 for individual cases).

Table 4.3 Mean intensity errors of 24- and 48-hour operational forecasts for each tropical cyclone in 2001.

Tropical Cyclone			24-hour Forecast					48-hour Forecast				
			Central Pressure		Max. Wind			Central Pressure		Max. Wind		
			Mean (hPa)	RMSE (hPa)	Mean (m/s)	RMSE (m/s)	Num.	Mean (hPa)	RMSE (hPa)	Mean (m/s)	RMSE (m/s)	Num.
STS	CIMARON	(0101)	-9.3	10.2	6.2	6.3	10	0.5	3.9	1.3	2.3	6
TY	CHEBI	(0102)	-1.4	6.4	0.9	2.9	11	0.4	15.3	0.4	6.1	7
STS	DURIAN	(0103)	9.0	11.1	-3.9	4.6	6	11.0	12.1	-6.4	6.6	2
STS	UTOR	(0104)	3.4	5.5	4.4	5.3	14	10.2	11.7	1.3	2.4	10
TS	TRAMI	(0105)	-13.0	13.0	7.7	7.7	2	-	-	-	-	0
TY	KONG-REY	(0106)	-4.0	9.4	2.1	3.4	24	-2.0	13.6	2.1	4.3	20
STS	YUTU	(0107)	11.8	13.2	-5.7	6.4	5	15.0	15.0	-7.7	7.7	1
TY	TORAJI	(0108)	0.1	11.6	0.5	6.8	11	-4.1	15.5	3.3	9.4	7
TY	MAN-YI	(0109)	0.0	6.9	-0.8	3.3	25	1.8	9.7	-1.3	5.9	21
TS	USAGI	(0110)	-	-	-	-	0	-	-	-	-	0
TY	PABUK	(0111)	-4.1	6.3	2.3	3.6	29	-5.9	8.6	3.1	4.1	25
TY	WUTIP	(0112)	4.2	15.2	-0.9	5.8	23	3.3	21.3	0.0	7.8	18
TS	SEPAT	(0113)	-1.5	2.8	1.3	2.2	8	-2.0	2.0	2.6	2.6	3
TS	FITOW	(0114)	-	-	-	-	0	-	-	-	-	0
TY	DANAS	(0115)	0.2	9.7	0.1	4.7	29	-0.5	9.4	0.9	4.6	25
TY	NARI	(0116)	0.0	9.9	-0.2	6.3	41	2.6	9.9	-1.2	6.2	37
TY	VIPA	(0117)	5.9	9.9	-3.9	5.3	10	7.3	8.5	-4.7	5.0	6
TY	FRANCISCO	(0118)	1.1	12.8	-0.1	5.9	19	3.3	13.2	-0.7	5.6	15
TY	LEKIMA	(0119)	-4.5	11.1	2.4	5.4	17	-10.0	18.5	5.3	9.6	13
TY	KROSA	(0120)	-0.3	9.4	0.8	4.6	16	-0.8	15.3	1.1	6.2	12
TY	HAIYAN	(0121)	2.6	5.8	-0.1	3.9	20	3.8	10.0	-0.2	5.6	16
TY	PODUL	(0122)	1.8	13.9	-1.4	5.6	28	7.9	20.9	-3.8	8.7	24
TY	LINGLING	(0123)	2.6	11.8	-0.6	5.4	17	7.2	13.4	-2.0	5.3	13
TS	KAJIKI	(0124)	-8.6	9.9	5.7	6.4	5	-9.8	11.6	6.7	7.7	5
TY	FAXAI	(0125)	3.0	16.5	-0.6	6.5	33	6.4	29.0	-2.1	11.6	29
TS	VAMEI	(0126)	-	-	-	-	0	-	-	-	-	0
Annual Mean (Total)			0.3	10.9	0.4	5.2	403	1.7	15.6	0.0	6.9	315



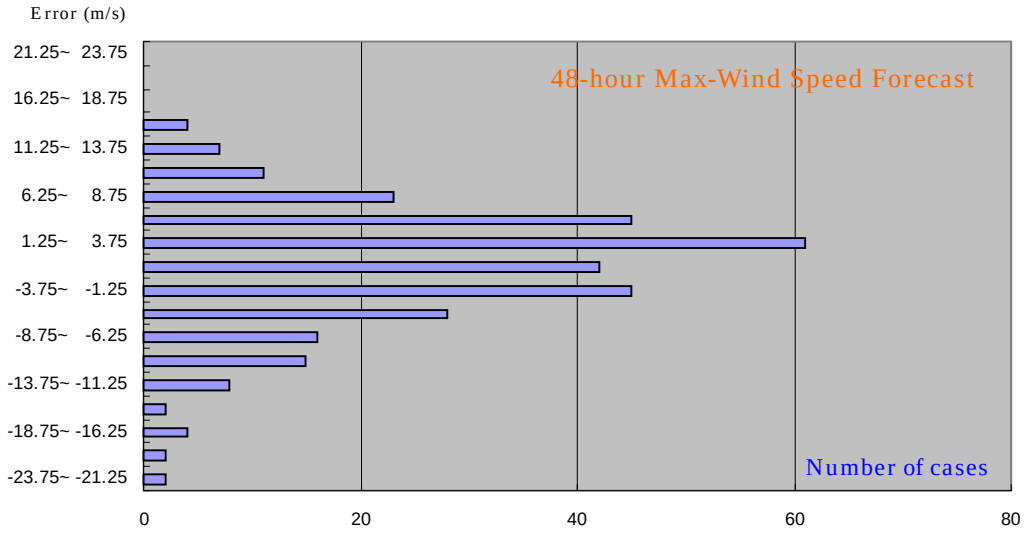


Figure 4.3 Histogram of maximum wind speed errors for 24- and 48- hour forecasts in 2001 (those of central pressure errors for 24- and 48-hour forecasts are included in the CD-ROM)

4.2 TYM and GSM Predictions

JMA replaced its mainframe computer and Numerical Analysis and Prediction System (NAPS) in March 2001. In combination with the replacement, the horizontal/vertical resolutions of Typhoon Model (TYM) were increased from 40 km/ 15 levels to 24 km/ 25 levels and the operational frequency of TYM was increased from twice (00UTC and 12UTC) a day to four times (00UTC, 06UTC, 12UTC and 18UTC) a day. The vertical resolution of Global Spectral Model (GSM) was enhanced from 30 levels to 40 levels mainly in the stratosphere.

TYM and GSM provide primary information for forecasters for the RSMC Tokyo – Typhoon Center to make operational track and intensity forecasts. Track predictions by TYM and GSM up to 84 and 90 hours, respectively, were verified with the best track data and predictions by the persistency (PER) method*. Thirty-hour, 54-hour and 78-hour intensity predictions by TYM and GSM were also verified with these data.

Note: The PER-method assumes that a tropical cyclone holds the same movement throughout the forecast period and forecasts are based upon the linear extrapolation of the latest 6-hour track of a tropical cyclone. Prediction errors by the PER-method are used to evaluate the relative performance of model predictions.

4.2.1 TYM Prediction

1) Center Position

Annual mean position errors of TYM predictions from 1996 are indicated in Figure 4.4. In 2001, prediction by TYM increased to 482, which is more than double as compared to 224 in 2000 because of the increase of the operational frequency described above. Annual mean position errors for 30-hour*, 54-hour* and 78-hour* predictions in 2001 were 185 km

(173 km in 2000), 315 km(313 km) and 468 km (502 km), respectively. The performance of the TYM track prediction in 2001 was slightly worse for the forecast period for 30-hours, almost the same for 54-hours and rather well for 78-hours compared to the previous year. Mean position errors of 18-, 30-, 42-, 54-, 66- and 78-hour predictions for each tropical cyclone are also shown in Table 4.4.

Note: Thirty-, 54- and 78-hour predictions by TYM and GSM are the primary information for forecasters in preparing 24-, 48- and 72-hour operational forecasts, respectively.

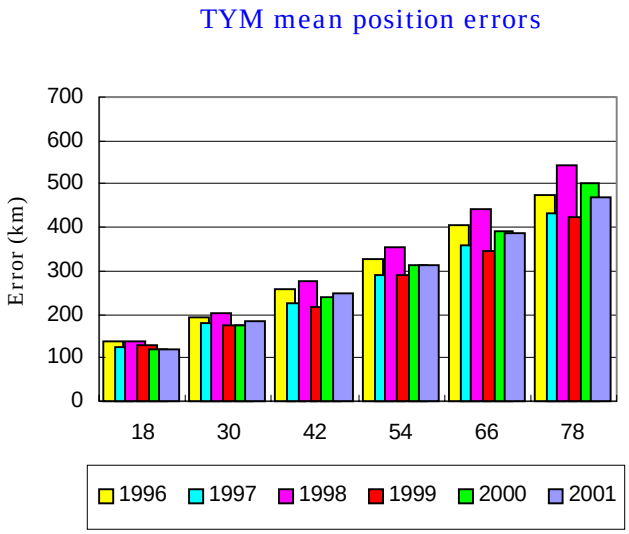


Figure 4.4 TYM annual mean position errors from 1996.

Table 4.4 Mean position errors (km) of TYM for each tropical cyclone in 2001. Number of samples is given in parentheses.

Tropical Cyclone		T=18		T=30		T=42		T=54		T=66		T=78	
STS	0101 CIMARON	94.2	(13)	146.8	(11)	231.6	(9)	297.5	(7)	262.1	(5)	319.3	(3)
TY	0102 CHEBI	148.6	(14)	259.4	(12)	364.8	(10)	448.1	(8)	445.8	(6)	473.0	(4)
STS	0103 DURIAN	157.8	(9)	259.6	(7)	389.4	(5)	438.5	(3)	618.5	(1)	-	(-)
STS	0104 UTOR	184.3	(17)	269.3	(15)	273.3	(13)	307.9	(11)	274.5	(9)	248.5	(7)
TS	0105 TRAMI	218.6	(5)	313.2	(3)	587.1	(1)	-	(-)	-	(-)	-	(-)
TY	0106 KONG-REY	144.5	(27)	206.8	(25)	296.0	(23)	424.5	(21)	514.1	(19)	597.9	(17)
STS	0107 YUTU	155.0	(8)	244.8	(6)	355.0	(3)	469.2	(1)	-	(-)	-	(-)
TY	0108 TORAJI	115.1	(14)	174.3	(12)	280.1	(10)	357.5	(8)	402.0	(6)	488.6	(4)
TY	0109 MAN-YI	110.2	(26)	170.9	(24)	221.7	(22)	268.5	(20)	326.3	(18)	364.1	(16)
TS	0110 USAGI	-	(-)	-	(-)	-	(-)	-	(-)	-	(-)	-	(-)
TY	0111 PABUK	158.4	(32)	273.0	(30)	383.7	(28)	526.6	(26)	699.6	(24)	826.9	(22)
TY	0112 WUTIP	123.2	(25)	202.3	(23)	279.2	(21)	386.4	(19)	407.8	(17)	410.7	(15)
TS	0113 SEPAT	123.3	(13)	209.9	(11)	270.8	(8)	333.8	(5)	647.5	(2)	1044.9	(1)
TS	0114 FITOW	-	(-)	-	(-)	-	(-)	-	(-)	-	(-)	-	(-)
TY	0115 DANAS	133.8	(30)	215.2	(28)	300.0	(26)	344.1	(24)	413.8	(22)	520.6	(20)
TY	0116 NARI	80.8	(52)	117.8	(50)	152.0	(48)	211.0	(46)	286.4	(44)	401.9	(42)
TY	0117 VIPA	101.2	(12)	140.5	(10)	180.1	(8)	322.0	(6)	540.0	(4)	706.3	(2)
TY	0118 FRANCISCO	126.9	(22)	232.4	(20)	326.9	(18)	396.5	(16)	478.4	(14)	586.4	(12)
TY	0119 LEKIMA	101.8	(26)	160.4	(24)	212.5	(22)	245.3	(20)	269.0	(18)	291.4	(16)
TY	0120 KROSA	145.9	(18)	207.3	(16)	239.3	(14)	276.7	(12)	346.4	(10)	550.0	(8)
TY	0121 HAIYAN	111.5	(23)	168.0	(21)	239.4	(19)	317.0	(17)	446.5	(15)	464.9	(13)
TY	0122 PODUL	78.3	(31)	97.9	(29)	134.9	(27)	171.6	(25)	218.6	(23)	293.1	(21)
TY	0123 LINGLING	89.9	(19)	116.9	(17)	121.2	(15)	174.8	(13)	255.2	(11)	385.6	(9)
TS	0124 KAJIKI	125.3	(11)	215.1	(9)	269.1	(7)	266.0	(5)	298.6	(3)	227.9	(1)
TY	0125 FAXAI	120.9	(35)	173.1	(33)	245.2	(31)	320.8	(29)	402.7	(27)	479.3	(25)
TS	0126 VAMEI	-	(-)	-	(-)	-	(-)	-	(-)	-	(-)	-	(-)
	Annual Mean	120.6	(482)	185.0	(436)	247.6	(388)	315.0	(342)	387.0	(298)	467.5	(258)

Table 4.5 gives TYM's relative performance compared to the PER-method. In this comparison, life stages of tropical cyclones were classified into three categories, "Before", "During" and "After" recurvature. Each stage is defined with the direction of movement of each tropical cyclone at each prediction time concerned. The Table indicates that TYM outperformed the PER-method throughout the whole forecast period beyond 18 hours from the initial time and improvement rates were roughly 25% for 18-hour, 35% for 30-hour, 40% for 42-hour and 45~50% for 54-hour to 78-hour predictions. These improvement rates in 2001 were smaller than those in 2000 by about 5%. Looking at the results of respective stages, improvement rates were relatively higher in "After" stage in which position errors were larger compared with other two stages.

Figure 4.5 (in the CD-ROM) presents histograms of the position errors of 30-, 54- and 78-hour predictions of TYM. The ratio of 30-hour prediction errors smaller than 150 km was 40% (47% in 2000), the ratio of 54-hour prediction errors smaller than 300 km was 58% (61%) and the ratio of 78-hour prediction errors smaller than 450 km was 56% (57%).

Table 4.5 Mean position errors (km) of TYM and PER predictions for the tropical cyclones in 2001 in each stage of motion. Number of samples is given in parentheses.

TIME	MODEL	Before (180° ~ 320°)	During (320° ~ 10°)	After (10° ~ 180°)	All (0° ~ 360°)
(moving direction)					
T=18	TYM	125.8 (203)	111.1 (112)	120.7 (167)	120.6 (482)
	PER	143.4 (203)	140.6 (112)	181.2 (167)	155.9 (482)
	IMPROV	12.3 %	21.0 %	33.4 %	22.6 %
T=30	TYM	190.2 (175)	174.3 (101)	186.0 (160)	185.0 (436)
	PER	254.8 (175)	240.6 (101)	340.5 (160)	283.0 (436)
	IMPROV	25.4 %	27.6 %	45.4 %	34.6 %
T=42	TYM	242.1 (144)	239.1 (91)	258.0 (153)	247.6 (388)
	PER	368.2 (144)	372.1 (91)	521.7 (153)	429.6 (388)
	IMPROV	34.3 %	35.7 %	50.6 %	42.4 %
T=54	TYM	288.6 (121)	303.0 (77)	343.7 (144)	315.0 (342)
	PER	446.8 (121)	540.6 (77)	726.9 (144)	585.8 (342)
	IMPROV	35.4 %	43.9 %	52.7 %	46.2 %
T=66	TYM	330.0 (102)	438.6 (64)	406.0 (132)	387.0 (298)
	PER	538.5 (102)	664.2 (64)	926.0 (132)	737.2 (298)
	IMPROV	38.7 %	34.0 %	56.2 %	47.5 %
T=78	TYM	391.1 (88)	482.0 (52)	518.1 (118)	467.5 (258)
	PER	654.7 (88)	688.8 (52)	1086.8 (118)	859.2 (258)
	IMPROV	40.3 %	30.0 %	52.3 %	45.6 %

2) Central Pressure and Maximum Wind Speed

Mean errors of 30- and 54-hour central pressure predictions by TYM were +1.3 hPa (+5.2 hPa in 2000) and +0.7 hPa (+5.2 hPa), respectively in 2001. TYM's positive bias in the central pressure prediction was greatly reduced due to the major version-up of the model in March 2001. Their root mean square errors (RMSEs) were also reduced to 13.5 hPa for 30-hour predictions from 15.6 hPa in 2000, and to 15.1 hPa for 54-hour predictions from 17.5 hPa in 2000. Meanwhile the bias for 30-hour maximum wind speed predictions was –0.8 m/s (-1.4 m/s in 2000) with a RMSE of 6.7 m/s (7.1 m/s), and the bias for 54-hour ones was –1.2 m/s (-1.6 m/s) with a RMSE of 7.1 m/s (7.4 m/s).

Figure 4.6 shows histograms of the errors of 30-hour central pressure and maximum wind speed predictions. About 47% (52% in 2000) of the central pressure predictions had errors with absolute values less than 7.5 hPa, while 43% (44%) of the maximum wind speed predictions with absolute values less than 3.75 m/s. As for 54-hour predictions, these ratios were 68% (62%) with absolute values less than 12.5 hPa and 64% (60%) with absolute values less than 6.25 m/s, respectively (Figures are shown in the CD-ROM)).

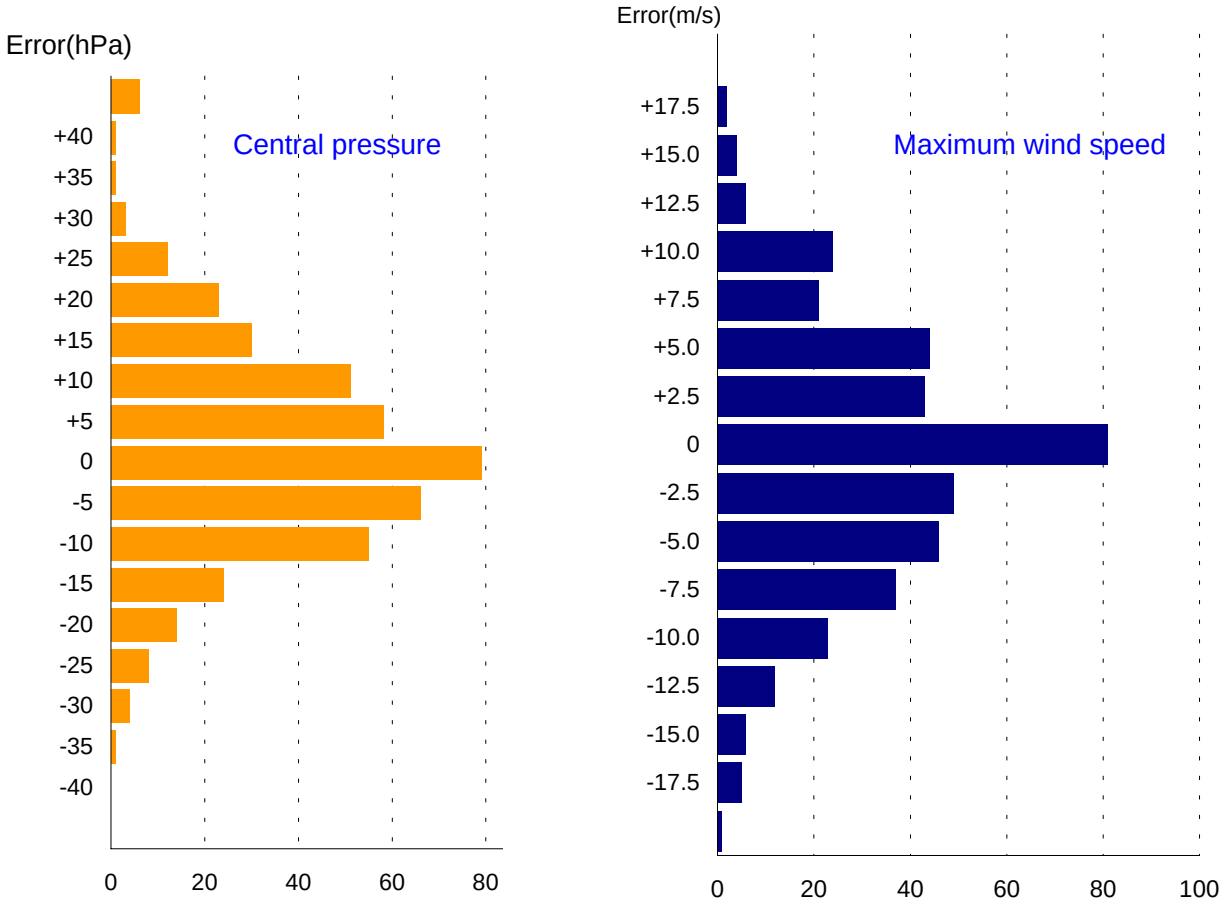


Figure 4.6 Error distribution of TYM 30-hour intensity predictions (left; for central pressure, right; for maximum wind speed , those for 54- and 78-hourpredictions are included in the CD-ROM).

4.2.2 GSM Prediction

1) Center Position

GSM annual mean position errors from 1996 are presented in Figure 4.7. In 2001, a total of 245 predictions were made by GSM and the errors for 30-hour, 54-hour and 78-hour predictions were 172 km (165 km in 2000), 283 km (276 km) and 425 km (402 km), respectively. The overall performance of GSM was slightly worse than that in 2000. The position errors of GSM, however, were smaller than those of TYM throughout the forecast period. Mean position errors of the 18-, 30-, 42-, 54-, 66- and 78-hour predictions for each tropical cyclone are given in Table 4.6.

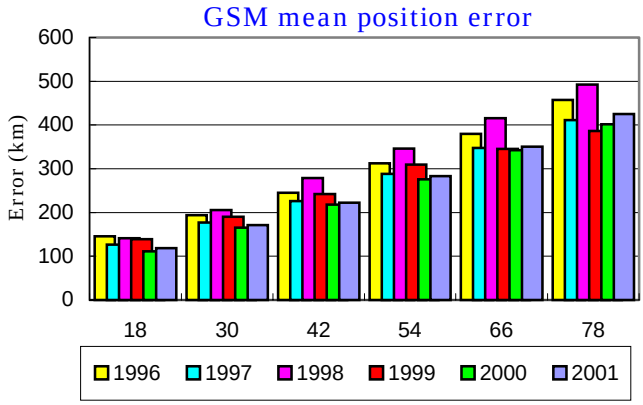


Figure 4.7 GSM annual mean position errors from 1996.

Table 4.6 Mean position errors (km) of GSM for each tropical cyclone in 2001

Tropical Cyclone		T=18		T=30		T=42		T=54		T=66		T=78	
STS	0101 CIMARON	106.9	(7)	160.0	(6)	201.1	(5)	253.3	(4)	324.1	(3)	551.5	(2)
TY	0102 CHEBI	149.3	(7)	222.7	(6)	304.4	(5)	423.8	(4)	482.6	(3)	571.2	(2)
STS	0103 DURIAN	82.0	(4)	120.9	(2)	196.0	(1)	-	(-)	-	(-)	-	(-)
STS	0104 UTOR	162.4	(9)	206.6	(8)	238.2	(7)	309.7	(6)	394.9	(5)	430.4	(4)
TS	0105 TRAMI	247.2	(2)	381.4	(1)	-	(-)	-	(-)	-	(-)	-	(-)
TY	0106 KONG-REY	177.4	(14)	268.0	(13)	388.8	(12)	545.2	(11)	659.2	(10)	781.0	(8)
STS	0107 YUTU	147.9	(4)	237.5	(3)	-	(-)	-	(-)	-	(-)	-	(-)
TY	0108 TORAJI	115.9	(7)	185.5	(6)	265.8	(5)	315.1	(4)	353.4	(3)	340.9	(2)
TY	0109 MAN-YI	122.3	(13)	162.5	(12)	185.5	(11)	199.2	(10)	232.1	(9)	271.4	(8)
TS	0110 USAGI	-	(-)	-	(-)	-	(-)	-	(-)	-	(-)	-	(-)
TY	0111 PABUK	86.4	(17)	151.2	(16)	226.3	(15)	313.1	(14)	417.1	(13)	524.5	(12)
TY	0112 WUTIP	101.8	(13)	147.0	(12)	206.0	(11)	286.1	(10)	223.3	(8)	294.8	(8)
TS	0113 SEPAT	163.3	(7)	217.9	(6)	258.2	(5)	210.1	(3)	228.8	(2)	450.1	(1)
TS	0114 FITOW	-	(-)	-	(-)	-	(-)	-	(-)	-	(-)	-	(-)
TY	0115 DANAS	125.8	(15)	181.4	(14)	224.4	(13)	265.4	(12)	323.2	(11)	405.5	(10)
TY	0116 NARI	66.4	(26)	87.8	(25)	113.7	(24)	149.2	(23)	222.3	(22)	285.4	(18)
TY	0117 VIPA	111.6	(5)	200.7	(4)	281.0	(3)	332.0	(2)	760.8	(1)	-	(-)
TY	0118 FRANCISCO	171.8	(11)	262.6	(10)	338.9	(9)	385.9	(8)	427.3	(7)	476.1	(6)
TY	0119 LEKIMA	97.0	(13)	136.0	(12)	159.8	(11)	145.8	(10)	161.7	(9)	156.1	(8)
TY	0120 KROSA	199.6	(9)	290.7	(8)	356.3	(7)	449.5	(6)	581.9	(5)	855.1	(4)
TY	0121 HAIYAN	123.5	(12)	183.7	(11)	254.8	(10)	376.3	(9)	523.2	(8)	577.5	(7)
TY	0122 PODUL	79.8	(16)	121.6	(15)	163.2	(14)	206.6	(13)	285.0	(12)	373.8	(11)
TY	0123 LINGLING	83.3	(10)	98.8	(9)	145.6	(8)	182.1	(7)	247.9	(6)	335.3	(5)
TS	0124 KAJIKI	98.6	(6)	144.4	(5)	225.4	(4)	281.0	(3)	308.8	(2)	331.5	(1)
TY	0125 FAXAI	128.6	(18)	176.1	(17)	224.1	(16)	324.5	(15)	393.7	(14)	476.3	(13)
TS	0126 VAMEI	-	(-)	-	(-)	-	(-)	-	(-)	-	(-)	-	(-)
	Annual Mean	118.8	(245)	171.5	(221)	222.7	(196)	283.2	(174)	350.2	(153)	425.0	(130)

Table 4.7 gives GSM's relative performance compared to the PER-method. Improvement rates were roughly 25 % (35% in 2000) for 18-hour, 40% (45%) for 30-hour, and 50% (55~60%) for 54-hour to 78-hour predictions. These improvement rates in 2001 were smaller than those in 2000 by 5~10%. The percentage is relatively high in “After” stage and low in “Before” stage.

Table 4.7 Mean position errors (km) of GSM and PER predictions for the tropical cyclones in 2001 in each stage of motion.

TIME	MODEL	Before (180° ~ 320°)		During (320° ~ 10°)		After (10° ~ 180°)		All (0° ~ 360°)	
(moving direction)									
T=18	GSM	120.2	(101)	111.3	(60)	122.5	(84)	118.8	(245)
	PER	142.8	(101)	134.8	(60)	183.3	(84)	154.8	(245)
	IMPROV	15.8 %		17.5 %		33.2 %		23.2 %	
T=30	GSM	172.4	(87)	150.6	(53)	184.0	(81)	171.5	(221)
	PER	250.9	(87)	240.0	(53)	336.1	(81)	279.5	(221)
	IMPROV	31.3 %		37.2 %		45.2 %		38.7 %	
T=42	GSM	217.5	(71)	197.8	(50)	244.3	(75)	222.7	(196)
	PER	346.0	(71)	377.3	(50)	526.5	(75)	423.1	(196)
	IMPROV	37.2 %		47.6 %		53.6 %		47.4 %	
T=54	GSM	256.6	(60)	242.9	(43)	330.0	(71)	283.2	(174)
	PER	434.9	(60)	513.7	(43)	726.7	(71)	573.4	(174)
	IMPROV	41.0 %		52.7 %		54.6 %		50.6 %	
T=66	GSM	308.0	(52)	331.3	(37)	395.5	(64)	350.2	(153)
	PER	536.6	(52)	677.1	(37)	908.4	(64)	726.1	(153)
	IMPROV	42.6 %		51.1 %		56.5 %		51.8 %	
T=78	GSM	351.1	(41)	412.3	(31)	483.9	(58)	425.0	(130)
	PER	636.6	(41)	672.1	(31)	1103.8	(58)	853.5	(130)
	IMPROV	44.9 %		38.6 %		56.2 %		50.2 %	

Figure 4.8 (in the CD-ROM) presents histograms of the position errors of 30-, 54- and 78-hour predictions of GSM. The ratio of 30-hour prediction errors smaller than 150 km was 49% (58% in 2000), the ratio of 54-hour prediction errors smaller than 300 km was 67% (70%) and the ratio of 78-hour prediction errors smaller than 450 km was 68% (72%).

2) Central Pressure and Maximum Wind Speed

Figure 4.9 shows histograms of central pressure errors and the maximum wind speed errors of 30-hour predictions of GSM. The histograms show that in almost all cases GSM underestimated the intensity of tropical cyclones in its 30-hour predictions and has a considerable positive bias in the central pressure prediction.

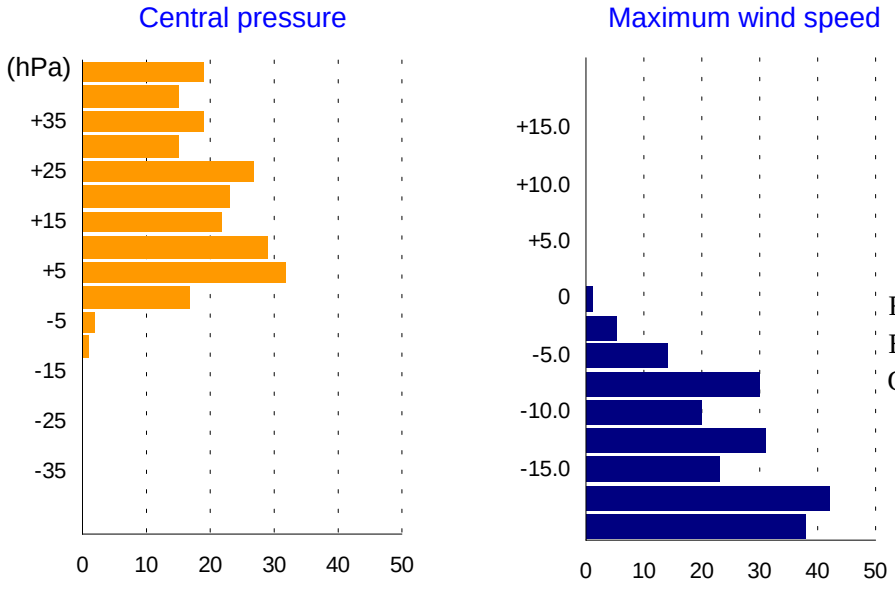
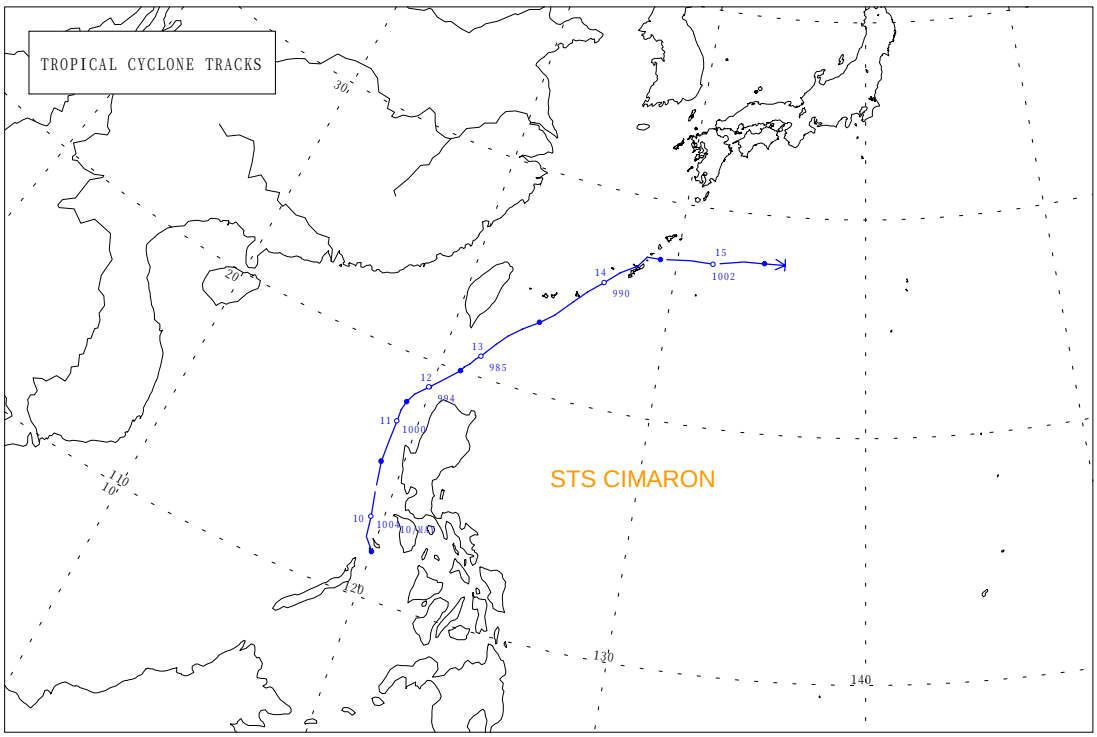


Figure 4.9
Error distribution of 30-hour GSM intensity predictions

STS SIMARON (0101)

A tropical depression formed between Mindoro Island and Palawan Island, the Philippines at 12UTC 9 May 2001. Moving northward, the depression developed into a tropical storm west of Luzon Island at 00UTC 11 May and was named Cimaron. It turned to the northeast and further intensified into a severe tropical storm south of Taiwan at 00UTC 13 May. Slightly weakening to TS intensity, Cimaron kept its northeastward track south of Japan until 09UTC 14 May. It then moved eastward and transformed into an extratropical cyclone near northeast of Okinawa shortly.

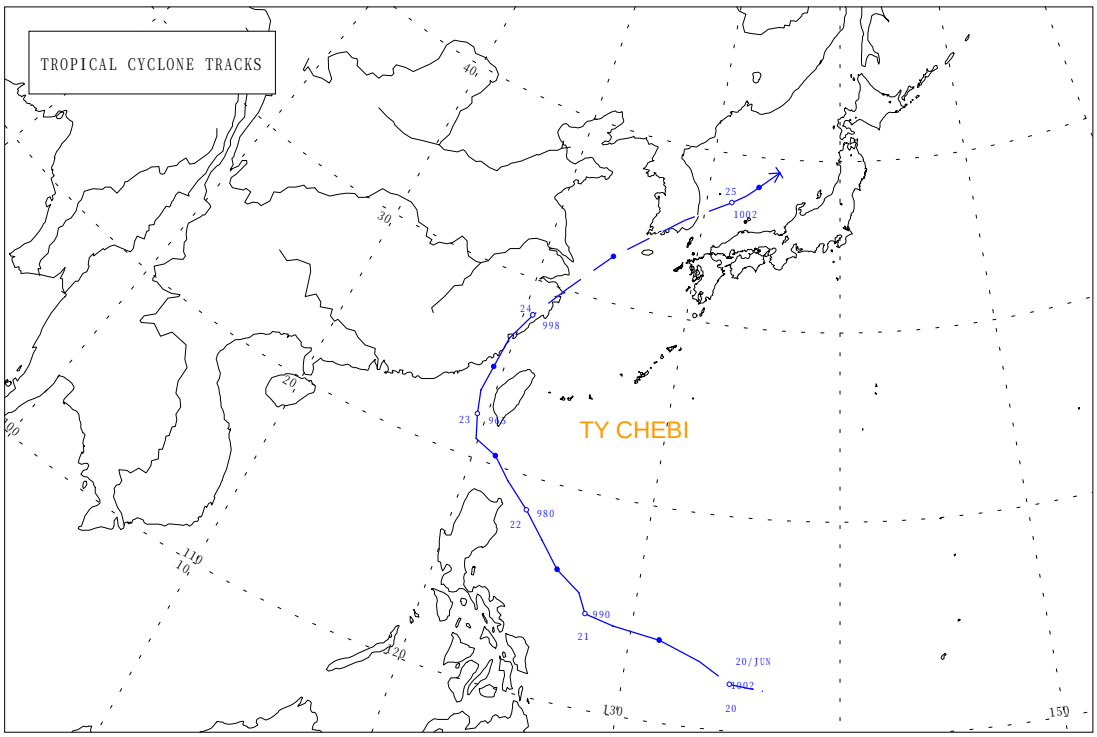
Date/Time (UTC)		Center Position Lat (N)	Lon (E)	Central pressure (hPa)	Max Wind (kt)	Grade
STS CIMARON (0101)						
May	09/12	11.8	120.0	1004	-	TD
	09/18	12.3	119.6	1004	-	TD
	10/00	13.1	119.5	1004	-	TD
	10/06	14.1	119.3	1004	-	TD
	10/12	15.3	119.1	1002	-	TD
	10/18	16.2	119.1	1002	-	TD
	11/00	17.1	119.1	1000	35	TS
	11/06	17.6	119.1	998	35	TS
	11/12	18.0	119.2	998	35	TS
	11/18	18.4	119.4	996	40	TS
	12/00	18.9	119.9	994	40	TS
	12/06	19.5	120.5	994	40	TS
	12/12	20.0	121.0	994	40	TS
	12/15	20.2	121.1	992	45	TS
	12/18	20.4	121.3	990	45	TS
	12/21	20.7	121.5	990	45	TS
	13/00	20.9	121.7	985	50	STS
May	13/03	21.6	122.2	985	50	STS
	13/06	22.1	122.6	990	45	TS
	13/09	22.6	123.2	990	45	TS
	13/12	23.1	123.9	990	45	TS
	13/15	23.6	124.5	990	45	TS
	13/18	24.4	125.2	990	45	TS
	13/21	25.0	125.8	990	45	TS
	14/00	25.6	126.5	990	45	TS
	14/03	26.2	127.2	992	45	TS
	14/06	26.7	128.0	996	40	TS
	14/09	27.2	128.4	998	35	TS
	14/12	27.2	129.1	1000	-	L
	14/18	27.4	130.7	1000	-	L
	15/00	27.4	131.9	1002	-	L
	15/06	27.7	133.5	1002	-	L
	15/12	27.7	134.6	1004	-	L
	15/18					Dissip



TY CHEBI (0102)

After more than one-month rest of tropical cyclone activity from the middle of May, a tropical depression formed northwest of Yap Island at 18UTC 19 June. Moving west-northwestward, it became a tropical storm at 06UTC 20 June. Chebi turned to the northwest east of the Philippines at 00UTC 21 June and then attained STS intensity. It further intensified into a typhoon south of Taiwan at 18UTC 22 June and moved northward passing through the Taiwan Straits. Having landed on the southeast of China, Chebi rapidly weakened into a tropical storm at 18UTC 23 June and into a tropical depression soon. The depression moved northeastward and transformed into an extratropical cyclone over the East China Sea at 12UTC on that day.

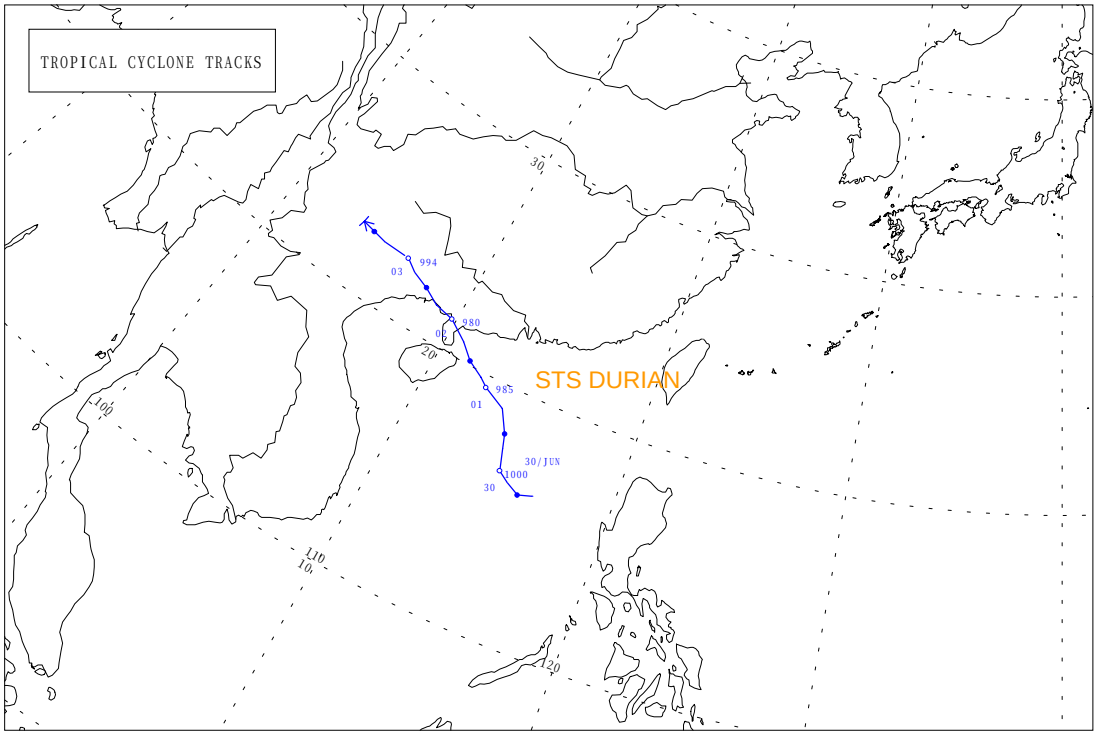
Date/Time		Center Position		Central pressure	Max Wind	Grade	Date/Time		Center Position		Central pressure	Max Wind	Grade
	(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)			(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)	
TY CHEBI (0102)													
Jun	19/18	11.9	136.4	1004	-	TD	Jun	23/00	22.2	119.5	965	65	TY
	20/00	12.1	134.9	1002	-	TD		23/06	23.4	119.2	965	65	TY
	20/06	13.0	133.4	996	35	TS		23/12	24.8	119.4	985	50	STS
	20/12	13.7	131.4	996	35	TS		23/18	26.5	119.7	994	40	TS
	20/18	14.0	129.1	992	40	TS		24/00	28.1	120.6	998	-	TD
	21/00	14.3	127.7	990	45	TS		24/06	30.1	122.1	1000	-	TD
	21/06	15.2	127.2	990	45	TS		24/12	32.6	124.4	1000	-	L
	21/12	16.0	125.9	985	50	STS		24/18	35.6	128.7	1002	-	L
	21/18	17.2	124.8	980	50	STS		25/00	37.1	131.9	1002	-	L
	22/00	18.4	123.6	980	55	STS		25/06	37.6	132.9	1002	-	L
	22/06	19.5	122.2	970	60	STS		25/12	38.2	133.8	1004	-	L
	22/12	20.5	121.2	970	60	STS		25/18	38.7	134.5	1002	-	L
	22/18	21.0	119.9	965	65	TY		26/00					Dissip



STS DURIAN (0103)

Durian formed as a tropical depression west of Luzon Island at 06UTC 29 June. It moved westward, then north-northwestward and became a tropical storm at 06UTC 30 June. Turning to the west-northwest, the storm further developed into a severe tropical storm at 18UTC 30 June. Durian then made landfall on the Leizhou Penisula, China on the early morning of 2 July. After the landfall it weakened to a tropical storm at 06UTC 2 July and to a tropical depression around Nanning, China at 18UTC on that day. The depression dissipated around the border between China and Viet Nam on 3 July.

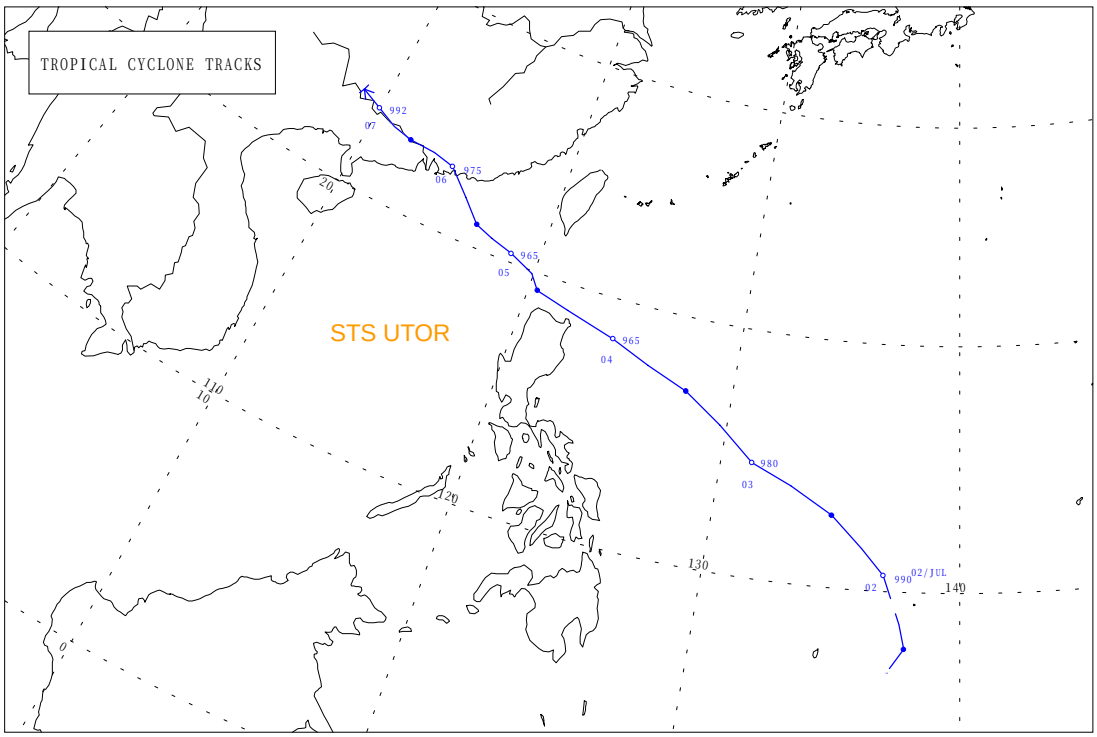
Date/Time		Center Position		Central pressure	Max Wind	Grade	Date/Time		Center Position		Central pressure	Max Wind	Grade
	(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)			(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)	
STS DURIAN (0103)													
Jun	29/06	16.2	116.6	1004	-	TD	Jul	01/18	20.8	110.8	970	60	STS
	29/12	16.0	116.0	1000	-	TD		02/00	21.4	109.8	980	50	STS
	29/18	16.3	115.4	1000	-	TD		02/06	21.6	108.8	980	45	TS
	30/00	16.6	114.9	1000	-	TD		02/12	22.0	108.0	990	40	TS
	30/06	17.5	114.6	996	35	TS		02/18	22.3	107.1	992	-	TD
	30/12	18.1	114.4	990	45	TS		03/00	22.7	106.5	994	-	TD
	30/18	19.0	113.8	985	50	STS		03/06	22.7	105.1	994	-	TD
Jul	01/00	19.5	112.7	985	50	STS		03/12	22.8	104.4	996	-	TD
	01/06	19.8	112.3	985	50	STS		03/18					Dissip
	01/12	20.2	111.5	980	55	STS							



STS UTOR (0104)

A tropical depression, which formed east of the Palau Islands at 06UTC 1 July, moved northward and developed into a tropical storm northwest of Yap Island at 00UTC 2 July. Turning to the northwest, it gradually intensified and became a severe tropical storm far east of Luzon Island at 06UTC 3 July. The storm kept STS intensity in the South China Sea until it approached the southern coast of mainland China on 5 July. Utor then made landfall near east of Hong Kong around 22UTC on that day and was downgraded to TS intensity soon. Moving to the west, it further weakened to a tropical depression over land in southern China at 12UTC 06 July and dissipated on the next day.

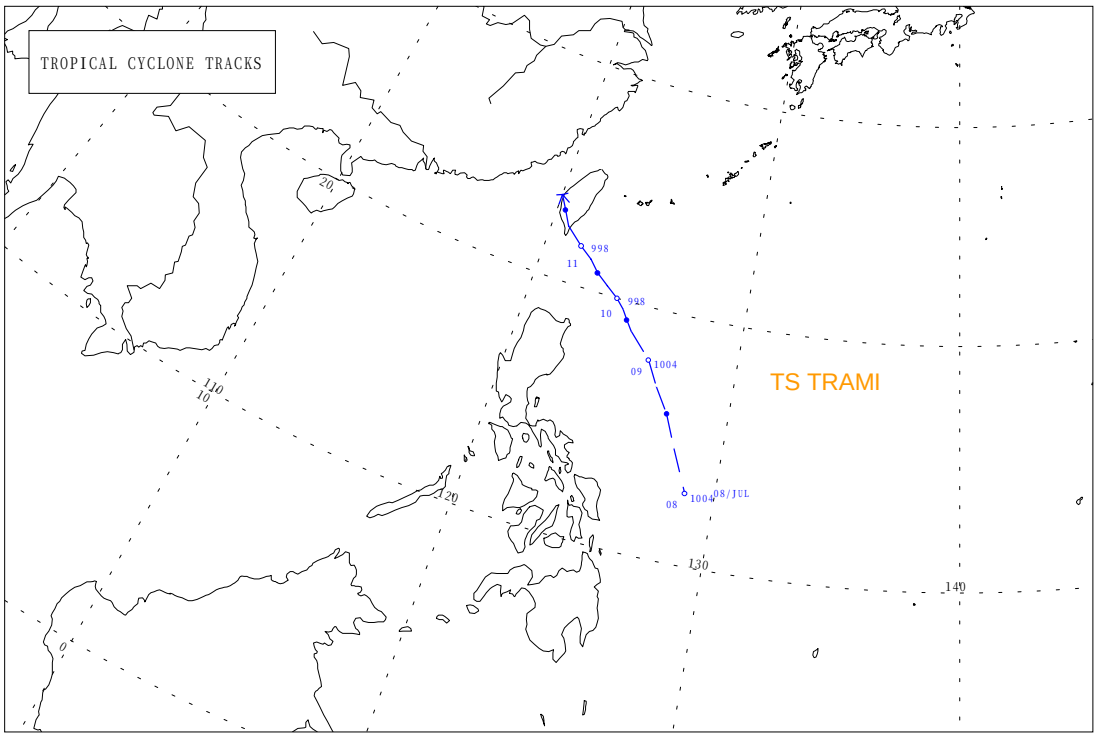
Date/Time		Center Position		Central pressure	Max Wind	Grade	Date/Time		Center Position		Central pressure	Max Wind	Grade
	(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)			(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)	
STS UTOR (0104)													
Jul	01/06	7.0	137.3	998	-	TD	Jul	04/12	19.3	120.4	965	60	STS
	01/12	7.9	137.9	996	-	TD		04/18	19.9	119.9	965	60	STS
	01/18	8.8	137.7	992	-	TD		05/00	20.4	118.7	965	60	STS
	02/00	10.6	137.0	990	35	TS		05/06	20.7	117.6	965	60	STS
	02/06	11.6	136.1	990	35	TS		05/12	21.0	116.7	965	55	STS
	02/12	12.8	134.8	990	40	TS		05/18	21.9	115.7	970	50	STS
	02/18	13.8	133.0	985	45	TS		06/00	22.9	114.5	975	45	TS
	03/00	14.5	131.3	980	45	TS		06/06	23.1	113.4	983	35	TS
	03/06	15.8	129.7	970	55	STS		06/12	23.1	112.1	986	-	TD
	03/12	16.9	128.0	970	55	STS		06/18	23.3	111.1	990	-	TD
	03/18	17.6	126.1	965	60	STS		07/00	23.7	110.0	992	-	TD
	04/00	18.3	124.3	965	60	STS		07/06					Dissip
	04/06	18.9	122.0	960	60	STS							



TS TRAMI (0105)

Trami was a short lived storm, which formed as a tropical depression east of Samar Island, the Philippines at 00UTC 8 July, and took a northwestward track throughout its whole life. On the northwestward track, it developed into a tropical storm northeast of Luzon Island at 00UTC 10 July. Trami continued to move northwestward and made landfall on southern Taiwan at 06UTC 11 July. Soon after the landfall it was downgraded to a tropical depression over the island and dissipated near over the western part of Taiwan on that day.

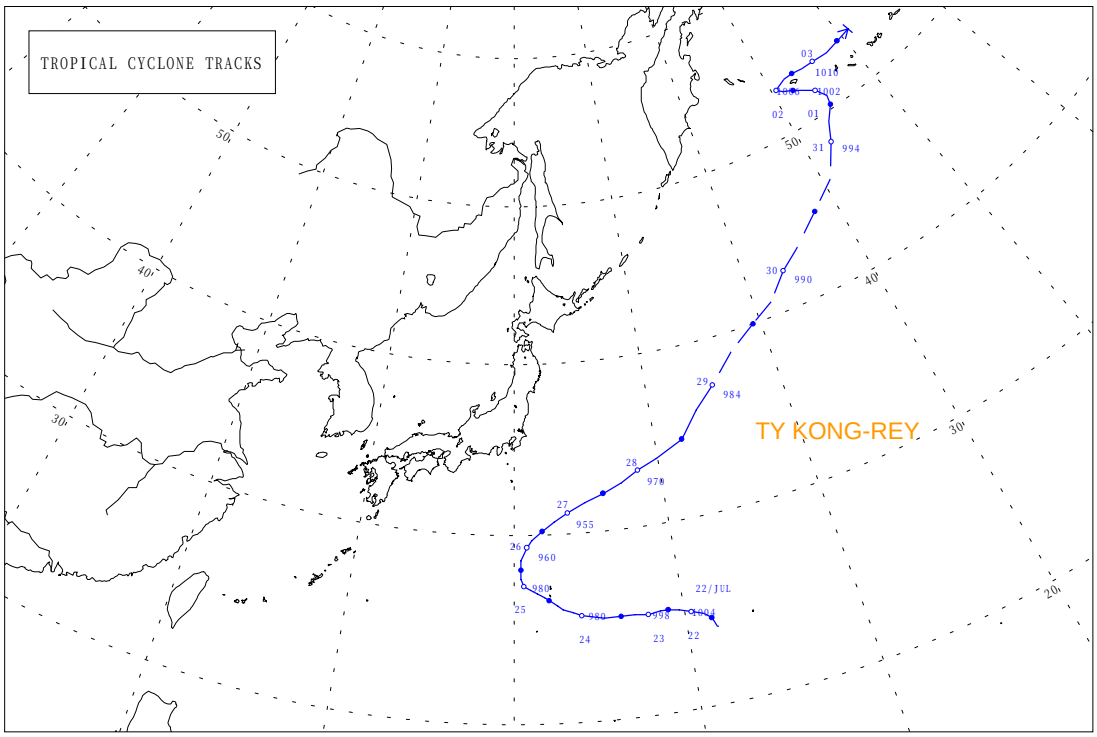
Date/Time		Center Position		Central pressure	Max Wind	Grade	Date/Time		Center Position		Central pressure	Max Wind	Grade
	(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)			(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)	
TS TRAMI (0105)													
Jul	08/00	12.8	128.8	1004	-	TD	Jul	10/00	20.0	124.0	998	35	TS
	08/06	14.5	128.0	1004	-	TD		10/06	20.4	123.4	996	35	TS
	08/12	15.8	127.4	1004	-	TD		10/12	20.8	122.8	994	40	TS
	08/18	16.8	126.7	1004	-	TD		10/18	21.3	122.3	996	35	TS
	09/00	17.8	126.1	1004	-	TD		11/00	21.7	121.7	998	35	TS
	09/06	18.8	125.0	1002	-	TD		11/06	22.4	120.8	998	35	TS
	09/12	19.2	124.7	1002	-	TD		11/12	23.0	120.4	1000	-	TD
	09/18	19.6	124.4	1000	-	TD		11/18					Dissip



TY KONG-REY (0106)

Kong-rey was the first typhoon of this season which developed over the waters east of Japan. A tropical depression, which formed west of Minamitori-shima at 06UTC 21 July, attained TS intensity on its westward track at 00UTC 22 July. It developed gradually and was upgraded to a severe tropical storm east of Iwo-jima at 18UTC 23 July. Turning to the north-northeast, it further developed into a typhoon northwest of Chichi-jima at 18UTC 25 July and reached its peak of maximum sustained winds of 70 knots north of the Island at 06UTC on the following day. On a east-northeastward track Kong-rey started weakening and was downgraded to STS intensity east of Japan at 06UTC 28 July. Accelerating to the northeast, the storm became an extratropical cyclone far east of Japan at 00UTC 29 July.

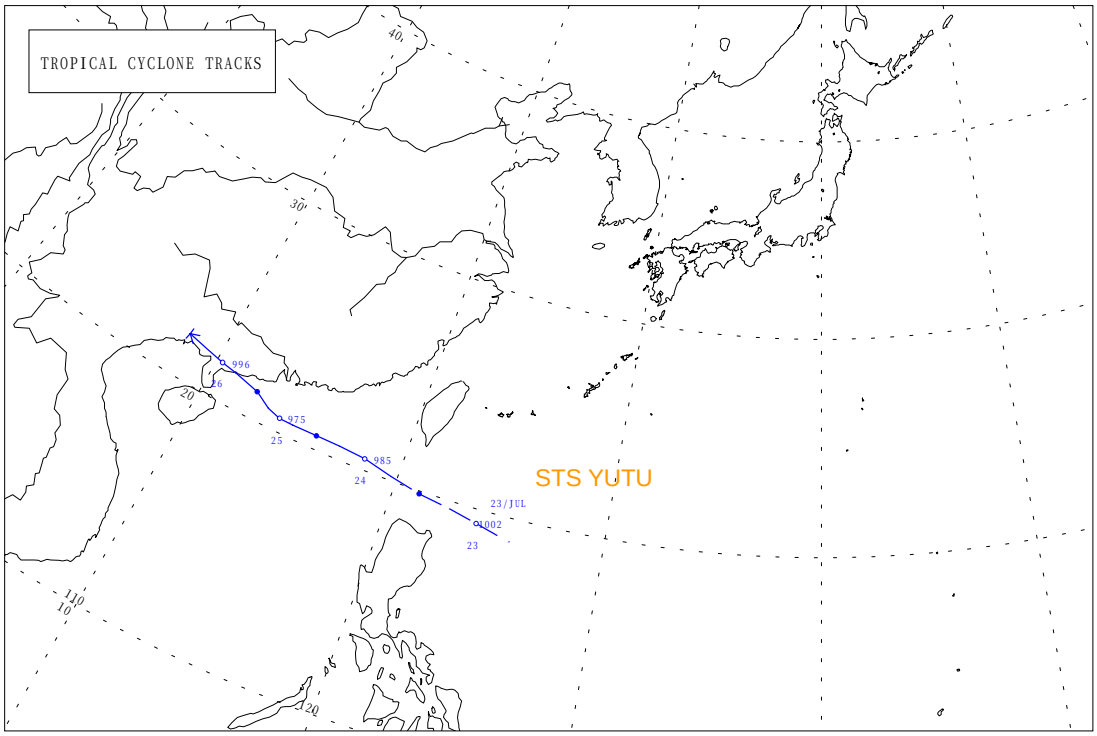
Date/Time (UTC)		Center Position Lat (N)	Lon (E)	Central pressure (hPa)	Max Wind (kt)	Grade
TY KONG-REY (0106)						
Jul	21/06	24.0	151.7	1008	-	TD
	21/12	24.5	151.5	1008	-	TD
	21/18	24.8	151.1	1006	-	TD
	22/00	25.0	150.4	1004	35	TS
	22/06	25.2	149.7	1002	40	TS
	22/12	25.3	149.1	1002	40	TS
	22/18	25.3	148.6	1000	40	TS
	23/00	25.2	147.9	998	40	TS
	23/06	25.3	147.1	996	45	TS
	23/12	25.3	146.3	992	45	TS
	23/18	25.3	145.3	985	50	STS
	24/00	25.5	144.0	980	55	STS
	24/03	25.7	143.5	980	55	STS
	24/06	25.9	142.9	980	55	STS
	24/09	26.1	142.6	980	55	STS
	24/12	26.4	142.1	980	55	STS
	24/15	26.6	141.8	980	55	STS
	24/18	26.8	141.4	980	55	STS
	24/21	27.0	141.0	980	55	STS
	25/00	27.2	140.6	980	55	STS
	25/06	27.6	140.4	975	55	STS
	25/12	28.1	140.4	970	60	STS
	25/18	28.6	140.4	965	65	TY
	26/00	29.3	140.8	960	70	TY
	26/06	29.7	141.1	955	70	TY
	26/12	30.2	141.8	955	70	TY
	26/18	30.7	142.6	955	70	TY
	27/00	31.2	143.5	955	70	TY
	27/06	31.7	144.7	955	70	TY
	27/12	32.1	146.0	960	70	TY
	27/18	32.6	147.3	965	65	TY
	28/00	33.2	148.5	970	65	TY
	28/06	33.7	149.9	975	60	STS
	28/12	34.5	151.9	980	60	STS
	28/18	36.0	153.4	980	60	STS
	29/00	37.2	155.0	984	-	L
	29/06	38.8	157.1	988	-	L
	29/12	40.0	159.4	988	-	L
	29/18	40.9	161.4	988	-	L
	30/00	42.4	163.3	990	-	L
	30/06	43.3	165.1	990	-	L
	30/12	44.9	168.0	992	-	L
	30/18	46.2	170.7	992	-	L
	31/00	48.2	172.6	994	-	L
	31/06	49.4	173.5	996	-	L
	31/12	50.3	174.6	998	-	L
	31/18	50.9	174.8	1000	-	L
Aug	01/00	51.6	174.1	1002	-	L
	01/06	52.1	172.9	1002	-	L
	01/12	52.4	172.1	1004	-	L
	01/18	52.7	171.1	1004	-	L
	02/00	53.0	170.5	1006	-	L
	02/06	53.4	171.9	1008	-	L
	02/12	53.4	173.0	1008	-	L
	02/18	53.3	174.3	1008	-	L
	03/00	53.3	175.7	1010	-	L
	03/06	53.2	177.5	1014	-	L
	03/12	53.4	179.3	1016	-	L
	03/18					Dissip


TROPICAL CYCLONE TRACKS
TY KONG-REY
50
40
30
20
03
1010
1002
02
01
31
994
30
990
29
984
28
978
27
955
26
960
980
25
24
980
998
23
1004
22
22/JUL

STS YUTU (0107)

A tropical depression formed northeast of Luzon Island at 18UTC 22 July. Moving west-northwestward, it developed into a tropical storm northwest of the island at 18UTC 23 July and was upgraded to a severe tropical storm southeast of Hong Kong at 06UTC 24 July. After it reached peak intensity south off Hong Kong at 00UTC 25 July, Yutu weakened to a tropical storm southwest of Hong Kong at 18UTC 25 July and made landfall on the coast of southern China around this time. Moving westward, it was downgraded to a tropical depression in southern China at 00UTC 26 July and dissipated on that day.

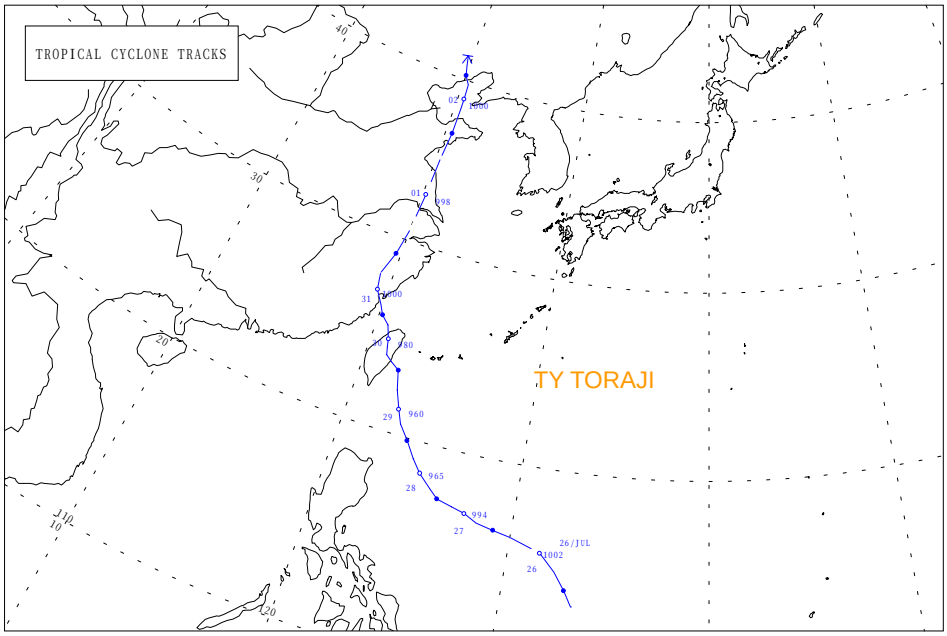
Date/Time		Center Position		Central pressure	Max Wind	Grade	Date/Time		Center Position		Central pressure	Max Wind	Grade
	(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)			(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)	
STS YUTU (0107)													
Jul	22/18	19.0	125.7	1004	-	TD	Jul	24/18	20.6	114.6	980	50	STS
	23/00	19.4	124.1	1002	-	TD		25/00	20.6	113.9	975	55	STS
	23/06	19.7	122.7	1002	-	TD		25/06	20.8	113.2	975	55	STS
	23/12	19.9	121.2	1000	-	TD		25/12	21.2	112.4	980	50	STS
	23/18	20.2	119.7	994	35	TS		25/18	21.5	111.1	985	45	TS
	24/00	20.5	118.3	985	45	TS		26/00	21.6	110.3	996	-	TD
	24/06	20.6	117.0	980	50	STS		26/06	21.8	109.3	998	-	TD
	24/12	20.6	115.8	980	50	STS		26/12					Dissip



TY TORAJI (0108)

Toraji formed as a tropical depression far east of the Philippines at 06UTC 25 July. Moving northwestward and then west-northwestward, it attained TS intensity east of Luzon Island at 00UTC 27 July and STS intensity at 12UTC on that day. It became a typhoon and made a slight turn to the northwest at 18UTC 27 July and then reached peak intensity of maximum sustained winds of 75 knots northeast of Luzon Island at 06UTC 28 July. Along the northwestward track Toraji started weakening just prior to the landfall on Taiwan around 16UTC 29 July. It then entered the Taiwan Strait and was downgraded to a tropical depression close to the coast of southeastern China at 18UTC 30 July. Having landed on southeastern China around 21UTC on that day, the depression moved northward and became an extratropical cyclone over land east of Beijing at 06UTC 1 August.

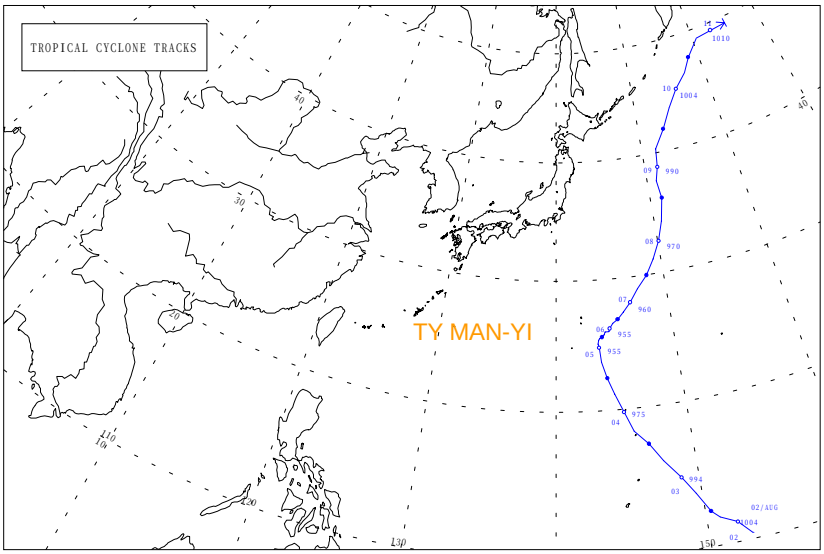
Date/Time		Center Position		Central pressure	Max Wind	Grade	Date/Time		Center Position		Central pressure	Max Wind	Grade
	(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)			(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)	
TY TORAJI (0108)													
Jul	25/06	13.6	133.4	1002	-	TD	Jul	29/18	23.8	121.2	975	60	STS
	25/12	14.3	133.0	1002	-	TD		29/21	24.2	121.1	980	50	STS
	25/18	15.1	132.4	1002	-	TD		30/00	24.6	121.0	980	50	STS
	26/00	15.9	131.6	1002	-	TD		30/06	25.3	120.7	985	45	TS
	26/06	16.4	130.0	1002	-	TD		30/12	25.7	120.2	994	35	TS
	26/12	16.6	129.1	1002	-	TD		30/18	26.2	119.9	996	-	TD
	26/18	16.8	128.2	1000	-	TD		31/00	26.9	119.4	1000	-	TD
	27/00	17.1	127.5	994	35	TS		31/06	27.8	119.2	1000	-	TD
	27/06	17.3	126.8	990	45	TS		31/12	29.1	119.7	1000	-	TD
	27/12	17.5	126.0	980	55	STS		31/18	30.5	120.0	998	-	TD
	27/18	17.9	125.5	970	65	TY	Aug	01/00	32.8	120.2	998	-	TD
	28/00	18.5	124.8	965	70	TY		01/06	35.0	120.3	996	-	L
	28/06	19.1	124.3	960	75	TY		01/12	36.7	120.5	994	-	L
	28/12	19.9	123.7	960	75	TY		01/18	38.3	120.5	996	-	L
	28/18	20.6	123.1	960	75	TY		02/00	38.9	120.5	1000	-	L
	29/00	21.3	122.8	960	75	TY		02/06	39.8	120.4	1006	-	L
	29/06	22.2	122.4	960	75	TY		02/12	40.3	120.0	1008	-	L
	29/12	23.2	122.1	960	75	TY		02/18	40.9	119.8	1012	-	L
	29/15	23.5	121.6	970	65	TY		03/00						Dissip



TY MAN-YI (0109)

A tropical depression, which formed north of the Truk Islands at 18UTC 1 August, developed into a tropical storm on a northwestward track at 06UTC 2 August and into a severe tropical storm east of the Mariana Islands at 06UTC on the following day. Slightly turning to the north-northwest, it further intensified into a typhoon north of the Mariana Islands on 06UTC 4 August and reached its peak of maximum sustained winds of 80 knots east of Iwo-jima at 18UTC 4 August. Man-yi then decelerated and began to change its track to the northeast on 5 August. On the northeastward track it was downgraded to a severe tropical storm east of Japan at 00UTC 8 August. Accelerating to the north, it further weakened to a tropical storm at 00UTC 9 August and became an extratropical cyclone at 18UTC on that day.

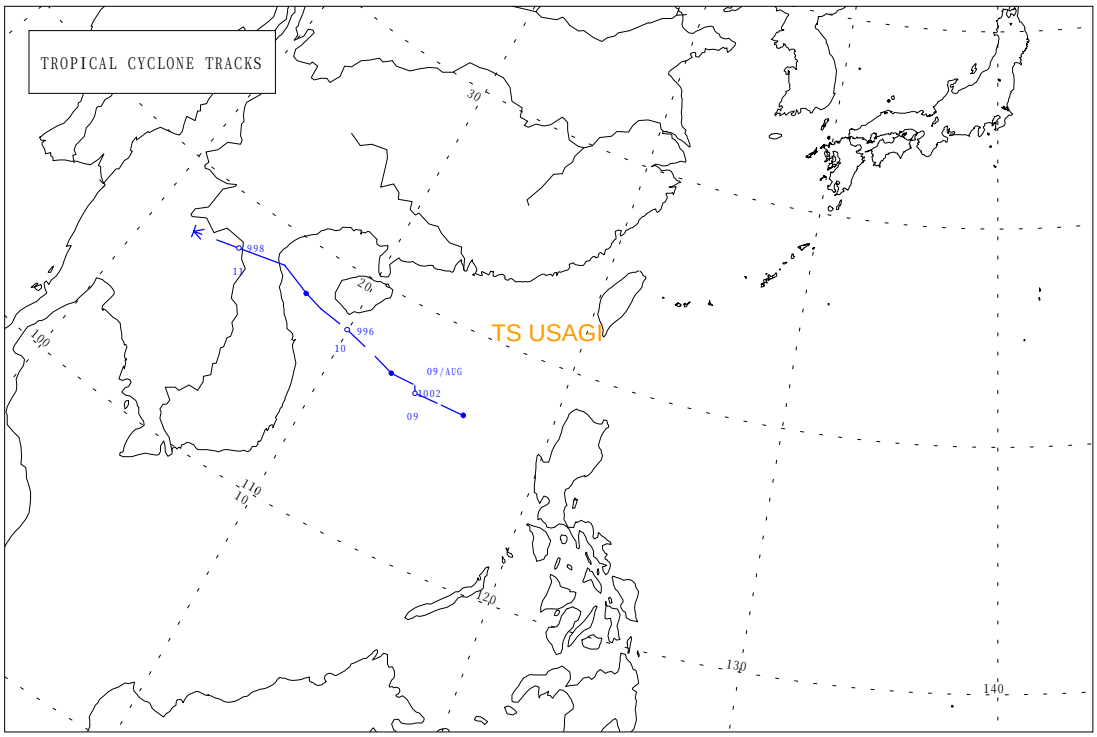
Date/Time		Center Position		Central pressure	Max Wind	Grade	Date/Time		Center Position		Central pressure	Max Wind	Grade
	(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)			(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)	
TY MAN-YI (0109)													
Aug	01/18	10.4	152.8	1004	-	TD	Aug	06/06	26.5	144.9	955	75	TY
	02/00	11.3	152.0	1004	-	TD		06/12	26.8	145.4	955	75	TY
	02/06	11.8	150.9	1000	35	TS		06/18	27.3	145.9	955	75	TY
	02/12	12.3	150.4	996	40	TS		07/00	28.0	146.6	960	70	TY
	02/18	13.6	149.6	996	40	TS		07/06	29.0	147.4	960	70	TY
	03/00	14.8	148.8	994	45	TS		07/12	30.0	148.4	965	65	TY
	03/06	16.1	147.7	990	50	STS		07/18	31.2	149.3	965	65	TY
	03/12	17.4	146.8	985	50	STS		08/00	32.6	150.1	970	60	STS
	03/18	18.4	145.8	980	55	STS		08/06	34.2	150.7	975	55	STS
	04/00	19.8	145.2	975	60	STS		08/12	36.1	151.2	980	55	STS
	04/06	21.2	144.6	965	70	TY		08/18	37.6	151.0	985	50	STS
	04/12	22.4	144.1	960	75	TY		09/00	38.8	151.4	990	45	TS
	04/18	23.6	143.7	955	80	TY		09/06	40.4	151.6	992	45	TS
	05/00	24.7	143.6	955	80	TY		09/12	42.0	153.0	996	40	TS
	05/03	25.0	143.5	955	80	TY		09/18	43.7	154.3	1002	-	L
	05/06	25.3	143.6	955	80	TY		10/00	45.2	155.8	1004	-	L
	05/09	25.4	143.7	955	80	TY		10/06	46.4	157.5	1008	-	L
	05/12	25.5	143.9	955	80	TY		10/12	47.7	158.6	1008	-	L
	05/15	25.7	144.1	955	80	TY		10/18	49.1	160.6	1010	-	L
	05/18	25.9	144.2	955	80	TY		11/00	49.3	162.9	1010	-	L
	05/21	25.9	144.5	955	75	TY		11/06						Dissip
	06/00	26.1	144.6	955	75	TY							



TS USAGI (0110)

Usagi was a very short lived cyclone of which duration of TS intensity or higher was less than one day. The storm formed as a tropical depression over the South China Sea at 12UTC 8 August and moved westward throughout its whole life. It became a tropical storm southwest of Hainan Island at 06UTC 10 August and then made landfall on the north of Viet Num on the early morning of 11 August. Shortly after the landfall it weakened to a tropical depression around the border between LAO P.D.R and Viet Nam at 00UTC 11 August and dissipated on that day.

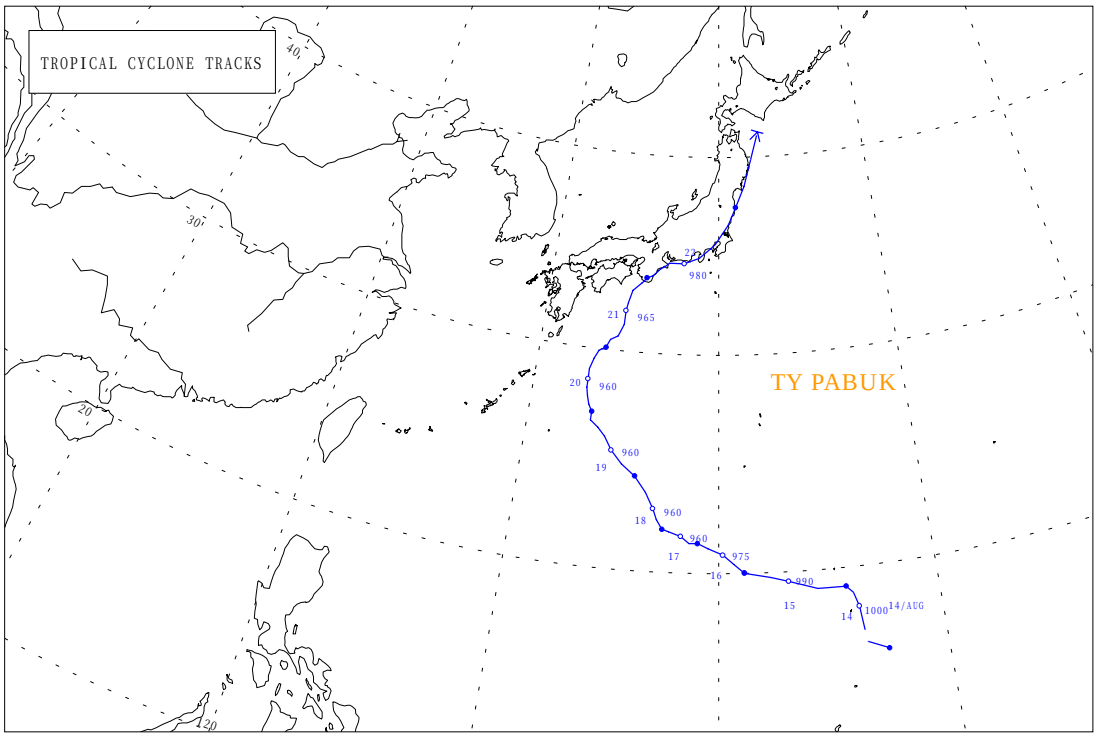
Date/Time		Center Position		Central pressure	Max Wind	Grade	Date/Time		Center Position		Central pressure	Max Wind	Grade
	(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)			(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)	
TS USAGI (0110)													
Aug	08/12	16.6	116.2	1004	-	TD	Aug	10/00	17.6	110.0	996	-	TD
	08/18	16.6	115.1	1004	-	TD		10/06	17.8	108.5	992	35	TS
	09/00	16.6	113.9	1002	-	TD		10/12	18.0	107.6	992	35	TS
	09/06	16.9	113.7	1000	-	TD		10/18	18.5	106.1	994	35	TS
	09/12	16.9	112.6	998	-	TD		11/00	18.0	104.0	998	-	TD
	09/18	17.2	111.6	998	-	TD		11/06					Dissip



TY PABUK (0111)

Pabuk formed as a tropical depression east of the Mariana Islands at 12UTC 13 August. Moving northward, it developed into a tropical storm over the northern part of the Islands at 12UTC 14 August. Turning to the west-northwest, the storm further intensified into a severe tropical storm south of Iwo-jima at 06UTC 15 August and became a typhoon at 18UTC on the following day. Having reached its peak at 00UTC 17 August, it moved northwestward south of Japan from 18 to 19 August, keeping TY intensity. Pabuk then changed its direction to the north-northeast on 20 August and made landfall on the Pacific coast of Japan after 10UTC 21 August. After the landfall the typhoon passed along the Pacific coast of Japan with gradual weakening from the evening of 21 to the early morning of 23 August. It was downgraded to a tropical depression just east of northern Japan at 18UTC 22 August and dissipated shortly.

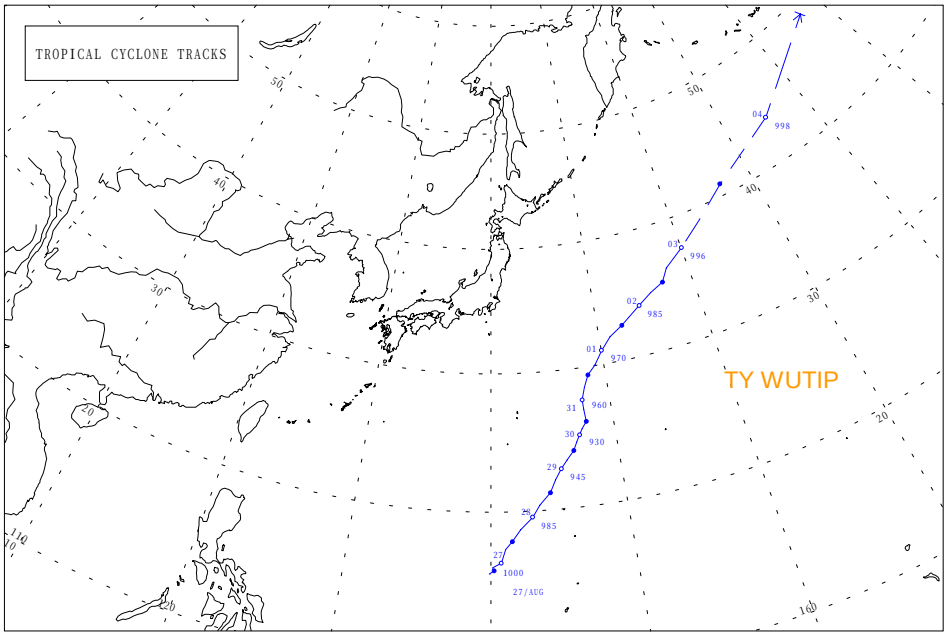
Date/Time		Center Position		Central pressure	Max Wind	Grade	Date/Time		Center Position		Central pressure	Max Wind	Grade
	(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)			(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)	
TY PABUK (0111)													
Aug	13/12	16.4	147.4	1002	-	TD	Aug	19/21	28.1	132.9	960	70	TY
	13/18	16.8	146.5	1000	-	TD		20/00	28.5	132.9	960	70	TY
	14/00	18.3	146.3	1000	-	TD		20/03	29.0	132.9	960	70	TY
	14/06	18.9	146.1	998	-	TD		20/06	29.5	133.1	960	70	TY
	14/12	19.2	145.8	996	35	TS		20/09	29.9	133.3	960	70	TY
	14/18	19.2	144.5	992	40	TS		20/12	30.1	133.7	965	65	TY
	15/00	19.6	143.2	990	45	TS		20/15	30.5	133.9	965	65	TY
	15/06	19.8	142.4	985	50	STS		20/18	30.7	134.3	965	65	TY
	15/12	20.0	141.2	985	50	STS		20/21	31.3	134.6	965	65	TY
	15/18	20.4	140.7	980	55	STS		21/00	32.0	134.6	965	65	TY
	16/00	20.8	140.2	975	60	STS		21/03	32.4	134.7	965	60	STS
	16/06	21.1	139.5	975	60	STS		21/06	33.0	134.9	970	55	STS
	16/12	21.3	139.0	970	60	STS		21/09	33.4	135.4	970	55	STS
	16/18	21.3	138.6	965	65	TY		21/10	33.5	135.5	970	55	STS
	17/00	21.6	138.2	960	70	TY		21/12	33.7	135.7	970	55	STS
	17/06	21.8	137.6	960	70	TY		21/15	33.8	136.0	975	50	STS
	17/12	21.9	137.3	960	70	TY		21/18	34.2	136.5	975	50	STS
	17/18	22.3	137.0	960	70	TY		21/19	34.3	136.7	975	50	STS
	18/00	22.8	136.8	960	70	TY		21/21	34.5	137.0	975	50	STS
	18/06	23.5	136.4	960	70	TY		22/00	34.5	137.9	980	45	TS
	18/12	24.2	135.8	960	70	TY		22/03	34.8	138.8	982	45	TS
	18/18	24.7	135.1	960	70	TY		22/05	35.3	139.5	982	45	TS
	19/00	25.3	134.5	960	70	TY		22/06	35.5	139.8	982	45	TS
	19/03	25.9	134.1	960	70	TY		22/09	36.5	140.6	985	45	TS
	19/06	26.3	133.7	960	70	TY		22/12	37.4	141.1	986	40	TS
	19/09	26.6	133.3	960	70	TY		22/15	38.5	141.7	988	40	TS
	19/12	27.0	133.3	960	70	TY		22/18	39.9	142.2	988	-	TD
	19/15	27.3	133.1	960	70	TY		23/00					Dissip
	19/18	27.7	133.0	960	70	TY							


TROPICAL CYCLONE TRACKS
40
30
20
120
TY PABUK
980
21
965
20
960
19
960
18
960
17
960
16
975
15
990
14
1000
14/AUG

TY WUTIP (0112)

Wutip, which formed as a tropical depression west of the Mariana Islands at 06UTC 26 August, took an almost northeastward track throughout its whole life of about one week. It developed rapidly to attain TS intensity at 06UTC 27 August, STS intensity at 00UTC 28 August and became a typhoon southeast of Iwo-jima at 12UTC 28 August. After it reached peak intensity of maximum sustained winds of 90 knots on 29 August, Wutip turned to the north with weakening east of Chichi-jima at 12UTC 30 August and returned to the northeastward track on the next day. It was downgraded to STS intensity east of Japan at 18UTC 31 August and to TS intensity far east of Japan at 06UTC 2 September. Accelerating to the northeast, the storm transformed into an extratropical cyclone at 00UTC on the following day.

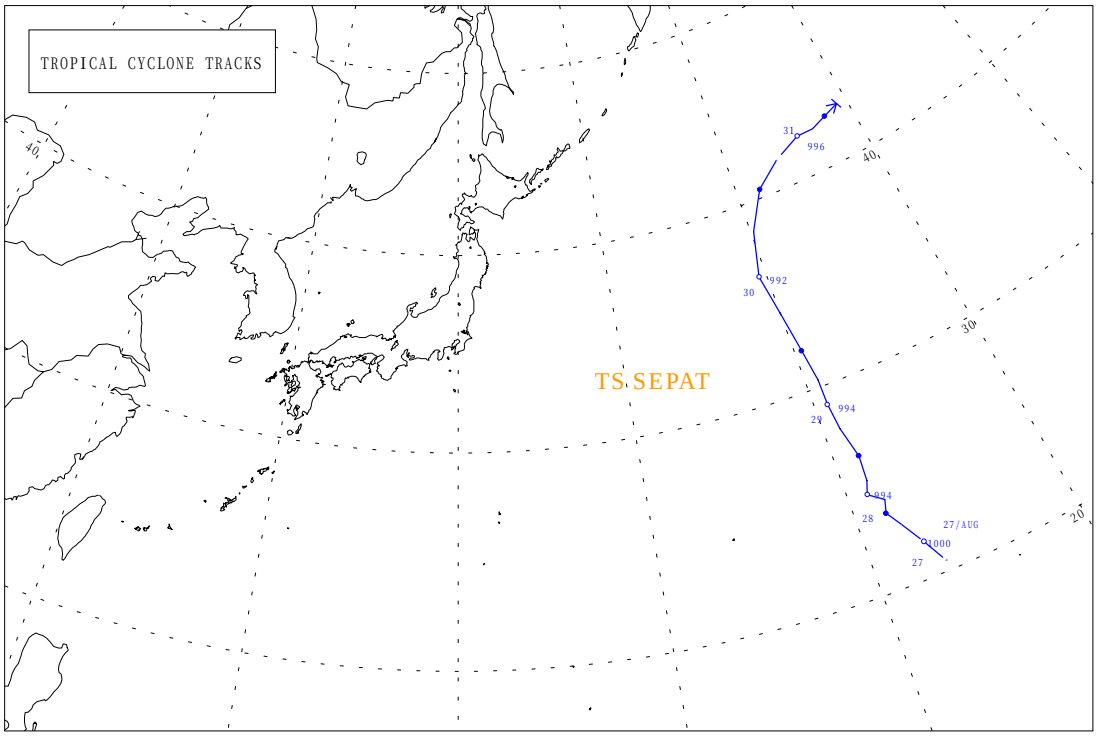
Date/Time		Center Position		Central pressure	Max Wind	Grade	Date/Time		Center Position		Central pressure	Max Wind	Grade
	(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)			(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)	
TY WUTIP (0112)													
Aug	26/06	15.9	139.9	1000	-	TD	Aug	31/00	27.6	147.7	960	70	TY
	26/12	16.1	140.2	1000	-	TD		31/06	28.5	148.0	960	70	TY
	26/18	16.3	140.1	1000	-	TD		31/12	29.4	148.5	965	65	TY
	27/00	16.6	140.7	1000	-	TD		31/18	30.1	149.2	970	60	STS
	27/06	17.5	141.0	996	35	TS	Sep	01/00	31.1	150.0	970	60	STS
	27/12	18.0	141.5	994	40	TS		01/06	32.0	151.0	975	60	STS
	27/18	18.8	142.1	990	45	TS		01/12	32.7	152.3	975	60	STS
	28/00	19.6	143.0	985	55	STS		01/18	33.2	153.1	980	55	STS
	28/06	20.4	143.6	975	60	STS		02/00	33.9	154.3	985	50	STS
	28/12	21.2	144.4	965	70	TY		02/06	34.7	155.7	990	45	TS
	28/18	22.1	144.9	955	75	TY		02/12	35.2	157.1	990	45	TS
	29/00	22.8	145.4	945	80	TY		02/18	36.2	157.9	994	40	TS
	29/06	23.4	145.9	935	85	TY		03/00	37.4	160.0	996	-	L
	29/12	24.0	146.5	930	90	TY		03/06	38.9	162.7	996	-	L
	29/18	24.6	146.8	930	90	TY		03/12	41.0	166.5	998	-	L
	30/00	25.1	147.1	930	90	TY		03/18	42.6	170.9	998	-	L
	30/06	25.5	147.4	935	85	TY		04/00	43.9	175.0	998	-	L
	30/12	26.0	147.8	945	80	TY		04/06	46.5	180.6	996	-	L
	30/18	26.9	147.7	955	75	TY		04/12						Dissip



TS SEPAT (0113)

Soon after the generation of Wutip, Sepat formed as a tropical depression northwest of Wake Island at 18UTC 26 August. It moved north-northwestward and became a tropical storm east of Minamitori-shima at 18UTC 27 August. Accelerating to the north over the waters far east of Japan, it kept TS intensity for a few days. Then turning to the northeast, the storm transformed into an extratropical cyclone at 18UTC 30 August.

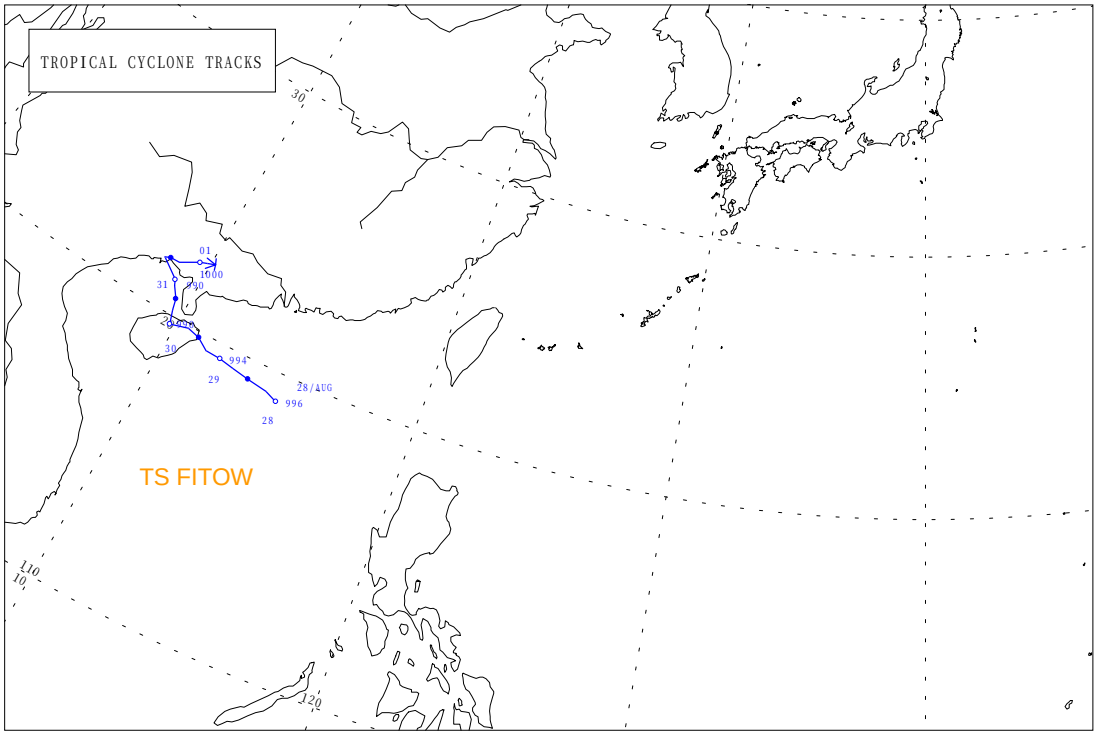
Date/Time		Center Position		Central pressure	Max Wind	Grade	Date/Time		Center Position		Central pressure	Max Wind	Grade
	(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)			(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)	
TS SEPAT (0113)													
Aug	26/18	20.5	163.3	1000	-	TD	Aug	29/12	32.0	160.4	994	40	TS
	27/00	21.6	162.7	1000	-	TD		29/18	34.1	160.0	992	40	TS
	27/06	22.7	162.0	1000	-	TD		30/00	36.2	159.5	992	40	TS
	27/12	23.4	161.5	1000	-	TD		30/06	38.5	160.2	992	40	TS
	27/18	24.0	161.7	996	35	TS		30/12	40.5	161.6	992	40	TS
	28/00	24.5	161.0	994	40	TS		30/18	41.6	163.5	992	-	L
	28/06	25.1	161.2	990	45	TS		31/00	42.3	165.6	996	-	L
	28/12	26.3	161.3	990	45	TS		31/06	42.3	166.8	996	-	L
	28/18	27.8	160.9	992	45	TS		31/12	42.6	168.0	1000	-	L
	29/00	29.1	160.7	994	40	TS		31/18					Dissip
	29/06	30.4	160.7	994	40	TS							



TS FITOW (0114)

Fitow was a very short lived cyclone with only a half day duration of TS intensity or higher. It formed as a tropical depression over the South China Sea at 00UTC 28 August. The depression moved westward for two days and turned to the northwest passing Hainan Island on 30 August. Changing its direction to the northwest, it reached TS intensity over the Gulf of Tongking at 18UTC 30 August and then made landfall on the coast around the border between Viet Nam and China on the afternoon of 31 August. After the landfall it quickly weakened to a tropical depression and dissipated on the following day.

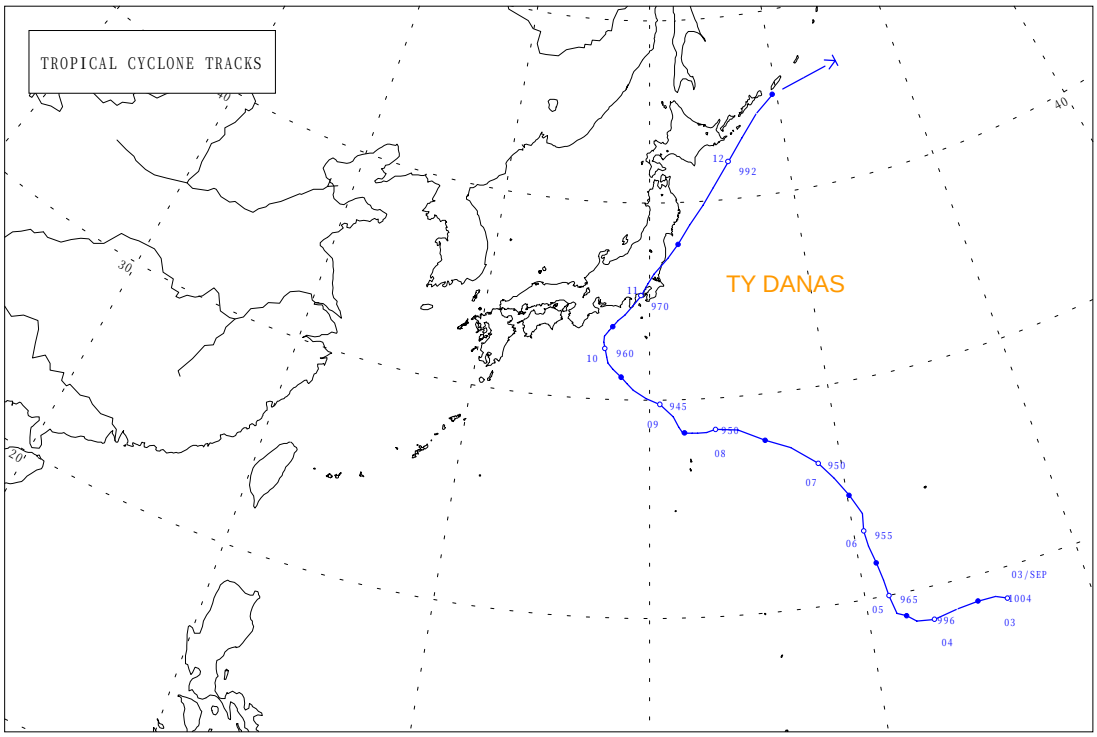
Date/Time		Center Position		Central pressure	Max Wind	Grade	Date/Time		Center Position		Central pressure	Max Wind	Grade
	(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)			(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)	
TS FITOW (0114)													
Aug	28/00	19.0	114.7	996	-	TD	Aug	30/06	20.2	109.6	992	-	TD
	28/06	19.2	114.2	996	-	TD		30/12	20.6	109.5	992	-	TD
	28/12	19.3	113.4	996	-	TD		30/18	21.0	109.2	990	35	TS
	28/18	19.4	112.7	996	-	TD		31/00	21.2	109.1	990	35	TS
	29/00	19.5	112.1	994	-	TD		31/06	21.7	108.3	992	-	TD
	29/06	19.5	111.5	994	-	TD		31/12	21.8	108.5	996	-	TD
	29/12	19.8	111.0	992	-	TD		31/18	21.8	108.9	998	-	TD
	29/18	19.9	110.5	992	-	TD	Sep	01/00	22.2	109.6	1000	-	TD
	30/00	19.7	109.8	990	-	TD		01/06	22.3	109.9	1002	-	TD



TY DANAS (0115)

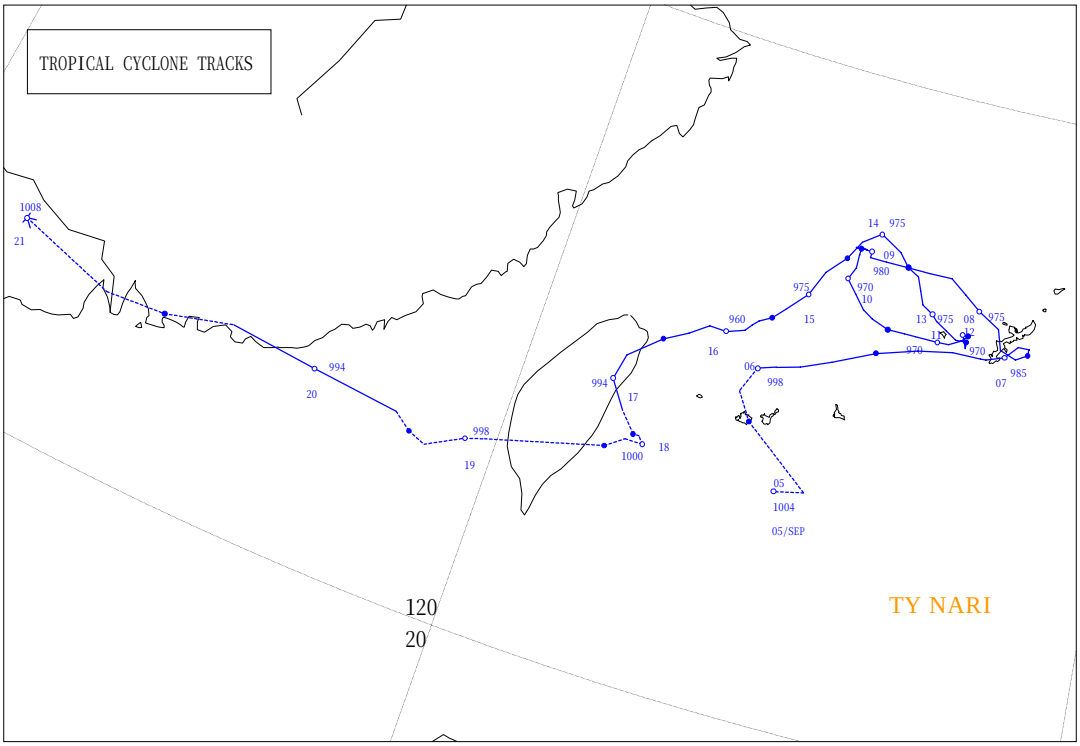
A tropical depression, which formed south of Minamitori-shima at 00UTC 3 September, moved westward and attained TS intensity at 00UTC 4 September. Turning to the north-northwest, it steadily intensified into a severe tropical storm at 12 UTC 4 September and into a typhoon at 00UTC 5 September. It then took a northwestward track and reached its peak of maximum sustained winds of 85 knots north of Chichi-jima at 06UTC 8 September. The typhoon migrated to the waters south of Japan with gradual weakening on 10 September, where it made a change of direction to the northeast and hit the Pacific coast near Tokyo around 00UTC 11 September. After it passed over Tokyo, Danas blew out into the east of Japan on the afternoon of that day and weakened to a tropical storm. It accelerated on the northeastward track and became an extratropical cyclone near the southern Kuril Islands at 06UTC 12 September.

Date/Time		Center Position		Central pressure	Max Wind	Grade	Date/Time		Center Position		Central pressure	Max Wind	Grade
	(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)			(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)	
TY DANAS (0115)													
Sep	03/00	18.7	156.3	1004	-	TD	Sep	09/03	30.1	139.8	945	85	TY
	03/06	18.9	155.8	1002	-	TD		09/06	30.5	139.1	945	85	TY
	03/12	18.9	155.0	1000	-	TD		09/09	30.8	138.7	945	85	TY
	03/18	18.8	154.0	1000	-	TD		09/12	31.1	138.4	950	80	TY
	04/00	18.6	152.9	996	35	TS		09/15	31.5	137.9	950	80	TY
	04/06	18.7	152.1	990	45	TS		09/18	31.8	137.6	955	75	TY
	04/12	19.0	151.7	980	55	STS		09/21	32.1	137.5	955	75	TY
	04/18	19.2	151.3	975	60	STS		10/00	32.5	137.4	960	70	TY
	05/00	20.0	151.1	965	70	TY		10/03	32.8	137.3	960	70	TY
	05/06	20.7	151.0	960	75	TY		10/06	33.1	137.3	960	70	TY
	05/12	21.5	150.8	955	80	TY		10/09	33.4	137.6	960	70	TY
	05/18	22.3	150.6	955	80	TY		10/12	33.6	137.8	960	70	TY
	06/00	23.0	150.5	955	80	TY		10/15	33.9	138.1	960	70	TY
	06/06	23.8	150.6	950	80	TY		10/18	34.2	138.5	965	60	STS
	06/12	24.7	150.1	950	80	TY		10/21	34.7	139.0	970	55	STS
	06/18	25.6	149.5	950	80	TY		11/00	35.2	139.5	970	55	STS
	07/00	26.4	148.8	950	80	TY		11/03	35.8	139.9	974	55	STS
	07/06	27.3	147.5	955	75	TY		11/06	36.3	140.3	976	50	STS
	07/12	27.8	146.2	955	75	TY		11/09	37.1	141.2	985	45	TS
	07/18	28.4	144.8	955	75	TY		11/12	37.8	141.9	985	45	TS
	08/00	28.5	143.6	950	80	TY		11/15	38.8	142.7	990	40	TS
	08/03	28.4	143.1	950	80	TY		11/18	39.8	143.7	990	40	TS
	08/06	28.4	142.6	945	85	TY		11/21	40.7	144.5	990	40	TS
	08/09	28.4	142.3	945	85	TY		12/00	42.0	145.7	992	40	TS
	08/12	28.4	141.9	945	85	TY		12/03	43.2	146.9	992	40	TS
	08/15	28.4	141.8	945	85	TY		12/06	44.4	148.2	994	-	L
	08/18	28.7	141.6	945	85	TY		12/12	45.3	149.7	998	-	L
	08/21	29.2	141.3	945	85	TY		12/18	45.9	152.4	998	-	L
	09/00	29.8	140.6	945	85	TY		13/00						Dissip


TROPICAL CYCLONE TRACKS
TY DANAS
12
992
11
970
10
960
09
945
08
950
07
950
06
955
05
965
04
996
03
1004
03/SEP
40
30
20

TY NARI (0116)

Nari was a long-lived tropical cyclone which drifted over waters between Taiwan and Okinawa for more than ten days. It formed as a tropical depression east of Taiwan at 00UTC 5 September. Moving northwestward and then northward, it developed into a tropical storm over the same waters at 00UTC 6 September. It then turned to the east and was upgraded to a severe tropical storm close to Okinawa at 21UTC 6 September on that day. After it crossed Okinawa Island on the morning of 7 September, Nari began to turn round and passed the Island again on the early morning of 8 September. It then made about one and a half counterclockwise rotation over the waters west of Okinawa from 7 to 14 September. During the turn Nari developed into a typhoon at 00UTC 11 September, weakened to a severe tropical storm at 03UTC 12 September and passed Kume-jima (an island west of Okinawa) on the early morning of 13 September. After the turn it took a southwestward track and made landfall on the northern part of Taiwan around 14UTC 16 September with significant weakening. It left Taiwan east to the sea around 02UTC 17 September and was downgraded to a tropical depression at 06UTC on that day. For the following 30 hours, the tropical depression stayed near east of Taiwan. Then it crossed the southern part of Taiwan and entered the Taiwan Straits at 18UTC 18 September. Moving westward, it redeveloped and attained TS intensity in the northern part of the South China Sea at 18UTC 19 September. Nari made landfall on the southern part of continental China around 02UTC 20 September and was downgraded to a tropical depression soon. The depression roamed along the southern Chinese coasts and dissipated on the next day.



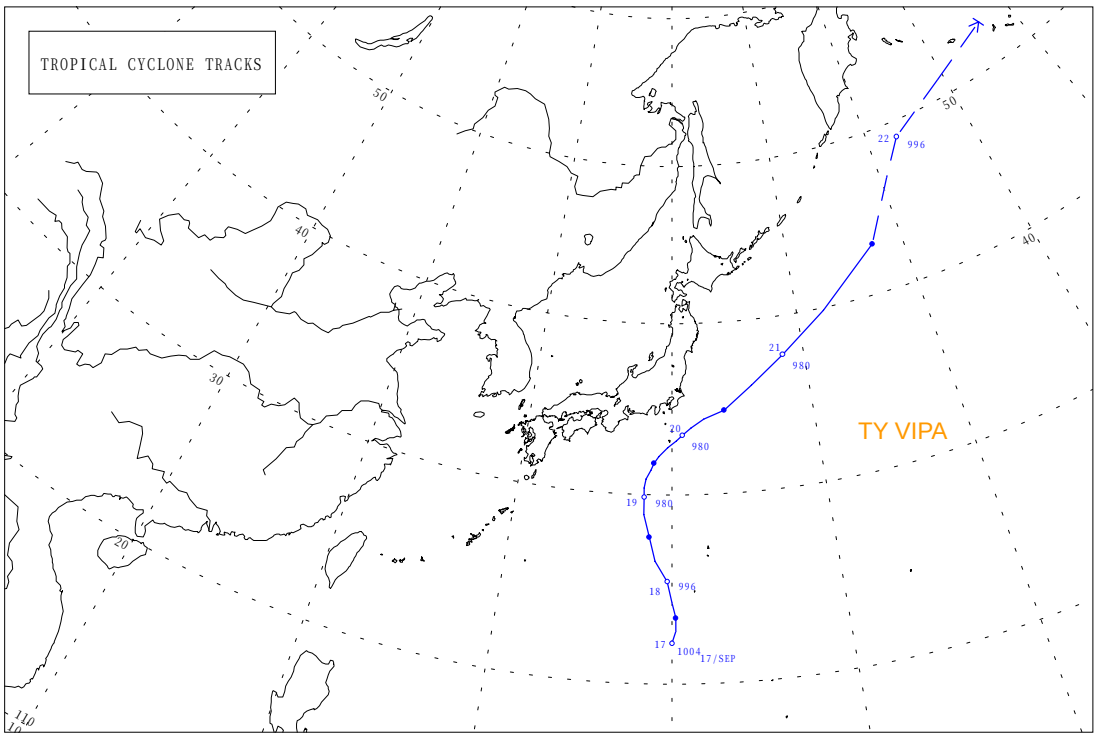
TY NARI (0116)

Date/Time		Center Position		Central pressure	Max Wind	Grade	Date/Time		Center Position		Central pressure	Max Wind	Grade
	(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)			(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)	
Sep	05/00	23.4	124.6	1004	-	TD	Sep	11/15	26.4	127.1	960	75	TY
	05/06	23.5	125.1	1002	-	TD		11/18	26.4	127.1	965	70	TY
	05/12	24.3	123.9	1002	-	TD		11/21	26.4	127.1	970	65	TY
	05/18	24.7	123.6	1000	-	TD		12/00	26.4	127.1	970	65	TY
	06/00	25.1	123.8	998	35	TS		12/03	26.4	127.1	975	60	STS
	06/03	25.2	124.1	996	35	TS		12/06	26.4	127.1	975	60	STS
	06/06	25.3	124.5	994	35	TS		12/09	26.2	127.2	975	60	STS
	06/09	25.5	125.0	994	35	TS		12/12	26.3	127.2	975	60	STS
	06/12	25.8	125.7	994	35	TS		12/15	26.3	127.0	975	60	STS
	06/15	26.0	126.4	992	40	TS		12/18	26.4	126.8	975	60	STS
	06/18	26.1	127.0	992	40	TS		12/21	26.5	126.6	975	60	STS
	06/21	26.1	127.5	985	50	STS		13/00	26.6	126.5	975	60	STS
	06/22	26.1	127.6	985	50	STS		13/03	26.7	126.3	975	60	STS
	07/00	26.2	127.9	985	50	STS		13/06	26.9	126.2	975	60	STS
	07/03	26.4	128.1	985	50	STS		13/09	27.1	126.1	975	60	STS
	07/06	26.4	128.3	985	50	STS		13/12	27.2	125.9	975	60	STS
	07/09	26.4	128.3	980	55	STS		13/18	27.4	125.7	975	60	STS
	07/12	26.3	128.3	980	55	STS		14/00	27.6	125.3	975	60	STS
	07/15	26.2	128.1	975	60	STS		14/06	27.4	125.0	975	60	STS
	07/18	26.3	127.8	975	60	STS		14/12	27.1	124.8	975	60	STS
	07/21	26.6	127.7	975	60	STS		14/18	26.8	124.5	980	55	STS
	08/00	26.8	127.3	975	60	STS		15/00	26.4	124.3	975	60	STS
	08/03	27.0	127.0	975	60	STS		15/06	26.1	124.0	970	65	TY
	08/06	27.2	126.7	975	60	STS		15/12	25.9	123.8	970	65	TY
	08/09	27.2	126.3	975	60	STS		15/15	25.8	123.6	970	65	TY
	08/12	27.2	125.9	975	60	STS		15/18	25.7	123.5	965	70	TY
	08/15	27.2	125.5	975	60	STS		15/21	25.6	123.4	965	70	TY
	08/18	27.2	125.2	975	60	STS		16/00	25.5	123.1	960	75	TY
	08/21	27.3	125.2	975	60	STS		16/03	25.5	122.8	960	75	TY
	09/00	27.3	125.2	980	55	STS		16/06	25.3	122.5	960	75	TY
	09/03	27.3	125.0	980	55	STS		16/12	25.1	122.1	970	65	TY
	09/06	27.3	124.9	980	55	STS		16/18	24.7	121.6	990	40	TS
	09/09	27.3	125.1	975	60	STS		17/00	24.3	121.5	994	35	TS
	09/12	27.3	125.0	970	60	STS		17/06	23.9	121.8	998	-	TD
	09/15	27.2	125.0	970	60	STS		17/12	23.6	122.1	1000	-	TD
	09/18	27.2	125.0	970	60	STS		17/18	23.6	122.2	998	-	TD
	09/21	27.0	125.0	970	60	STS		18/00	23.5	122.3	1000	-	TD
	10/00	26.8	124.9	970	60	STS		18/06	23.5	122.0	998	-	TD
	10/03	26.6	125.1	970	60	STS		18/12	23.3	121.7	998	-	TD
	10/06	26.4	125.3	970	60	STS		18/18	22.8	119.8	998	-	TD
	10/09	26.3	125.5	970	60	STS		19/00	22.7	119.5	998	-	TD
	10/12	26.2	125.8	970	60	STS		19/06	22.4	118.9	996	-	TD
	10/15	26.2	126.1	970	60	STS		19/12	22.5	118.6	998	-	TD
	10/18	26.2	126.3	970	60	STS		19/18	22.7	118.3	992	40	TS
	10/21	26.2	126.5	970	60	STS		20/00	22.8	116.8	994	35	TS
	11/00	26.2	126.7	970	65	TY		20/06	22.9	115.3	1002	-	TD
	11/03	26.2	126.9	965	70	TY		20/12	22.6	114.2	1006	-	TD
	11/06	26.3	127.1	960	75	TY		20/18	22.5	113.2	1006	-	TD
	11/09	26.4	127.2	960	75	TY		21/00	22.9	111.5	1008	-	TD
	11/12	26.4	127.2	960	75	TY		21/06					Dissip

TY VIPA (0117)

While Nari was tracking over Taiwan, a tropical depression formed south of Iwo-jima at 00UTC 17 September. Moving northward, it passed west of the Island and developed into a tropical storm at 00UTC 18 September. It further developed and was upgraded to a severe tropical storm west of Chichi-jima at 12UTC on that day. Vipa then changed its direction to the northeast south of Japan around 12UTC 19 September. Accelerating to the northeast, it reached TY intensity east of Japan at 18UTC 20 September. Having weakened to a severe tropical storm at 00UTC 21 September, it transformed into an extratropical cyclone southeast of the Kuril Islands soon.

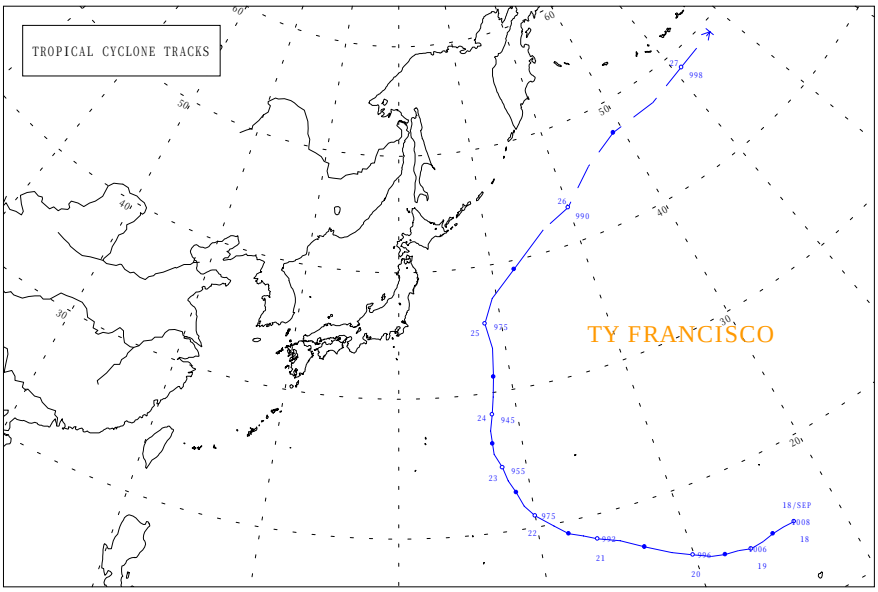
Date/Time		Center Position		Central pressure	Max Wind	Grade	Date/Time		Center Position		Central pressure	Max Wind	Grade
	(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)			(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)	
TY VIPA (0117)													
Sep	17/00	22.1	140.0	1004	-	TD	Sep	19/18	32.7	139.7	980	60	STS
	17/06	22.7	140.2	1004	-	TD		19/21	33.1	140.3	980	60	STS
	17/12	23.4	140.2	1004	-	TD		20/00	33.4	140.7	980	55	STS
	17/18	24.2	140.0	1004	-	TD		20/03	33.8	141.3	980	55	STS
	18/00	25.3	139.7	996	40	TS		20/06	34.3	142.2	980	55	STS
	18/06	26.4	139.0	990	45	TS		20/12	34.8	143.7	980	60	STS
	18/12	27.7	138.6	985	50	STS		20/18	36.1	145.8	975	65	TY
	18/18	28.9	138.2	985	50	STS		21/00	37.7	148.4	980	60	STS
	19/00	29.9	138.2	980	55	STS		21/06	39.9	152.1	985	55	STS
	19/03	30.4	138.2	980	55	STS		21/12	43.1	157.4	992	-	L
	19/06	30.9	138.3	980	55	STS		21/18	46.8	160.6	996	-	L
	19/09	31.4	138.6	980	55	STS		22/00	49.0	162.9	996	-	L
	19/12	31.8	138.8	980	60	STS		22/06	51.2	169.3	996	-	L
	19/15	32.2	139.1	980	60	STS		22/12					Dissip



TY FRANCISCO (0118)

One day after the generation of Vipa, Francisco formed as a tropical depression near the Marshall Islands at 00UTC 18 September. It moved westward, then northwestward and attained TS intensity north of Eniwetok Island at 00UTC 20 September. Turning to the north-northwest, the storm began to develop and became a severe tropical storm east of the Mariana Islands at 18UTC 21 September and was upgraded to a typhoon northeast of the Islands at 06UTC 22 September. Francisco then took a northward track and reached peak intensity of maximum sustained winds of 85 knots east of Chichi-jima at 18UTC 23 September. Accelerating to the north with gradual weakening, it was downgraded to a severe tropical storm east of Japan at 00UTC 25 September and became an extratropical cyclone on that day.

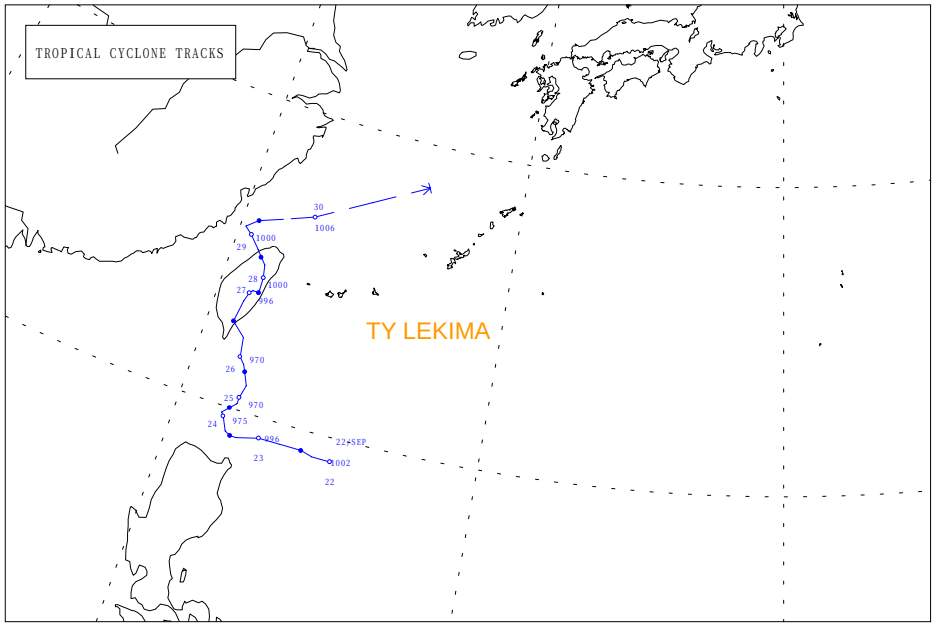
Date/Time		Center Position		Central pressure	Max Wind	Grade	Date/Time		Center Position		Central pressure	Max Wind	Grade
	(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)			(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)	
TY FRANCISCO (0118)													
Sep	18/00	15.0	166.9	1008	-	TD	Sep	22/18	23.5	148.4	960	75	TY
	18/06	15.0	166.1	1006	-	TD		23/00	24.5	148.1	955	75	TY
	18/12	14.9	165.3	1008	-	TD		23/06	25.5	147.6	950	80	TY
	18/18	14.7	164.5	1006	-	TD		23/12	26.3	147.6	950	80	TY
	19/00	14.6	163.6	1006	-	TD		23/18	27.2	147.6	945	85	TY
	19/06	14.8	162.8	1006	-	TD		24/00	28.4	147.9	945	85	TY
	19/12	14.9	161.9	1004	-	TD		24/06	29.7	148.2	955	75	TY
	19/18	15.1	161.0	1002	-	TD		24/12	31.2	148.5	965	70	TY
	20/00	15.6	159.9	996	35	TS		24/18	33.4	148.8	970	65	TY
	20/06	16.2	158.6	996	35	TS		25/00	35.4	148.4	975	60	STS
	20/12	17.1	157.0	996	35	TS		25/06	37.3	149.5	980	55	STS
	20/18	17.9	155.5	992	40	TS		25/12	39.3	152.3	985	50	STS
	21/00	18.4	154.0	992	40	TS		25/18	41.9	156.5	988	-	L
	21/06	18.8	153.1	992	40	TS		26/00	43.0	160.0	990	-	L
	21/12	19.2	152.1	990	45	TS		26/06	45.6	164.1	992	-	L
	21/18	19.9	151.2	985	50	STS		26/12	47.3	168.8	996	-	L
	22/00	20.8	150.0	975	60	STS		26/18	47.7	175.2	998	-	L
	22/06	21.6	149.3	970	65	TY		27/00	48.6	181.0	998	-	Out
	22/12	22.6	148.9	965	70	TY							



TY LEKIMA (0119)

Lekima, which formed as a tropical depression northeast of Luzon Island at 00UTC 22 September, moved westward and reached TS intensity at 12UTC on that day. Turning to the north, it rapidly developed into a severe tropical storm north of Luzon Island at 18UTC 23 September and into a typhoon over the same waters at 06UTC 24 September. Lekima continued to move northward with weakening to STS intensity and made landfall on southeastern Taiwan around 11UTC 26 September. Soon after the landfall it was downgraded to a tropical storm over the island and to a tropical depression at 18UTC 27 September. The depression left Taiwan to the northern part of the Taiwan Straits around 18UTC 28 September. It then turned to the northeast around 18UTC 29 September and dissipated in the East China Sea on the next day.

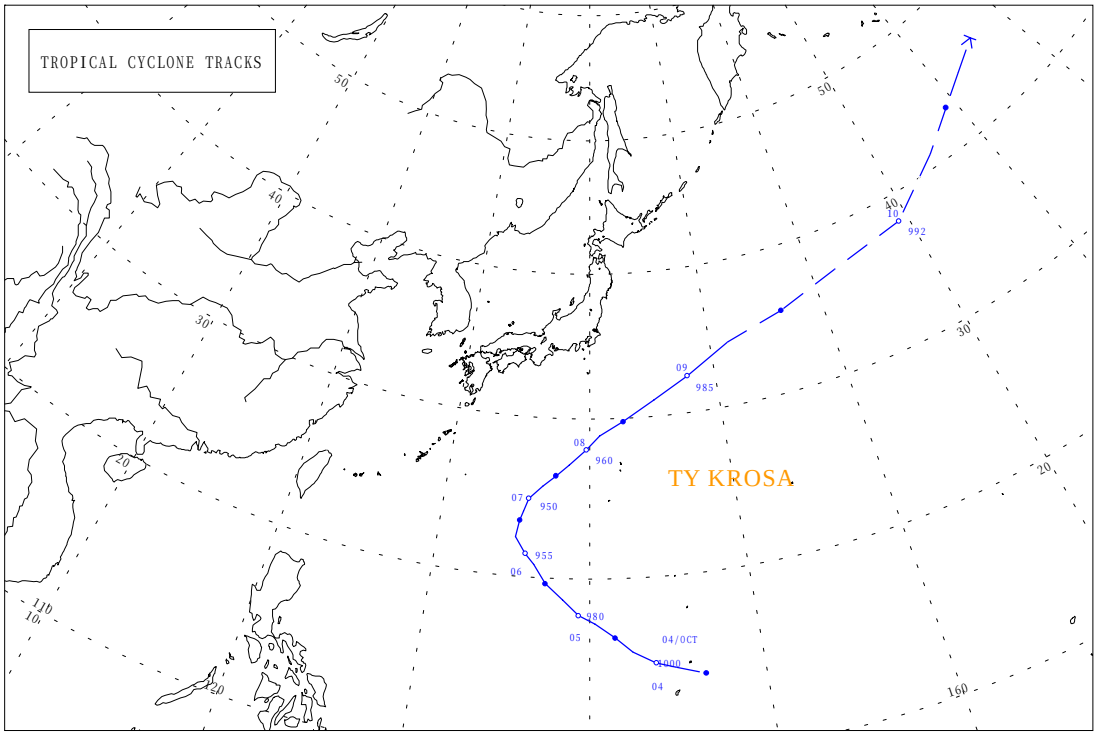
Date/Time		Center Position		Central pressure	Max Wind	Grade	Date/Time		Center Position		Central pressure	Max Wind	Grade
	(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)			(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)	
TY LEKIMA (0119)													
Sep	22/00	19.3	125.3	1002	-	TD	Sep	26/12	22.6	120.9	985	50	STS
	22/06	19.3	124.7	1002	-	TD		26/18	23.3	121.0	992	40	TS
	22/12	19.4	124.3	998	35	TS		27/00	23.6	121.1	996	40	TS
	22/18	19.4	123.6	996	35	TS		27/06	23.7	121.2	996	40	TS
	23/00	19.4	122.9	996	35	TS		27/12	23.7	121.4	998	35	TS
	23/06	19.2	122.2	990	40	TS		27/18	23.8	121.4	998	-	TD
	23/12	19.2	122.0	985	45	TS		28/00	24.2	121.4	1000	-	TD
	23/18	19.3	121.8	980	50	STS		28/06	24.6	121.3	998	-	TD
	24/00	19.7	121.6	975	60	STS		28/12	24.8	121.1	1000	-	TD
	24/06	19.8	121.5	965	70	TY		28/18	25.0	120.9	1000	-	TD
	24/12	20.0	121.7	965	70	TY		29/00	25.4	120.5	1000	-	TD
	24/18	20.2	121.9	965	70	TY		29/06	25.6	120.2	1002	-	TD
	25/00	20.4	121.9	970	65	TY		29/12	25.9	120.6	1004	-	TD
	25/06	20.8	122.0	975	60	STS		29/18	26.2	121.4	1004	-	TD
	25/12	21.2	121.8	970	65	TY		30/00	26.6	122.5	1006	-	TD
	25/18	21.4	121.7	970	65	TY		30/06	27.6	124.4	1004	-	TD
	26/00	21.6	121.5	970	65	TY		30/12					Dissip
	26/06	22.2	121.4	975	60	STS							



TY KROSA (0120)

A tropical depression formed east of the Mariana Islands at 12UTC 3 October. Moving northwestward, it steadily developed into a tropical storm west of the Islands at 06UTC 4 October and into a severe tropical storm over the same waters at 18UTC on that day. After it became a typhoon (TY) southeast of Okinotori-shima at 06 UTC 5 October, Korsa recurved north of the Island on 6 October, where it reached peak intensity of maximum sustained winds of 80 knot. It then accelerated to the northeast and gradually weakened to a severe tropical storm southeast of Japan at 18UTC 8 October. Turning to the east-northeast, the storm became an extratropical cyclone on the next day.

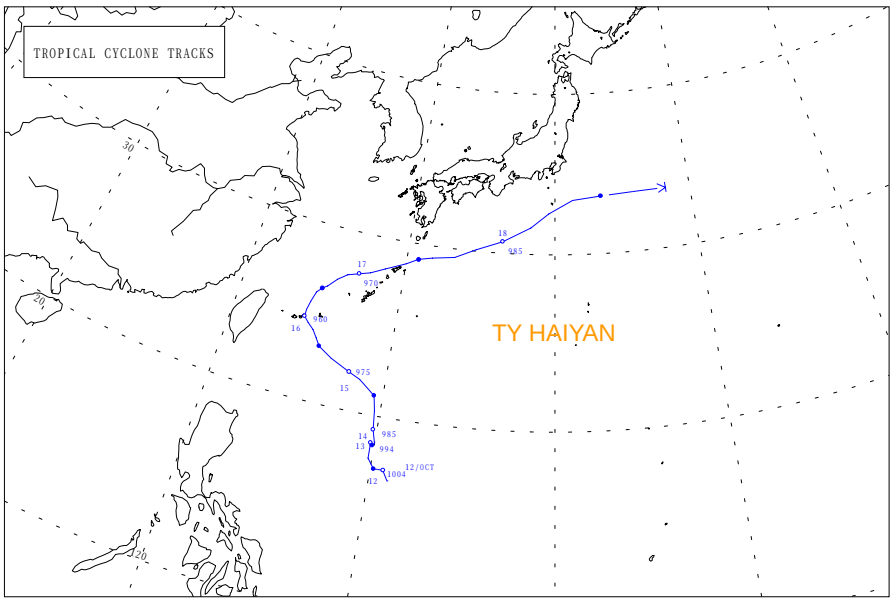
Date/Time (UTC)	Center Position Lat (N)	Lon (E)	Central pressure (hPa)	Max Wind (kt)	Grade	Date/Time (UTC)	Center Position Lat (N)	Lon (E)	Central pressure (hPa)	Max Wind (kt)	Grade
TY KROSA (0120)											
Oct 03/12	14.3	146.6	1004	-	TD	Oct 07/06	25.6	136.7	950	80	TY
03/18	14.8	144.9	1004	-	TD	07/12	26.3	137.6	955	75	TY
04/00	15.1	143.8	1000	-	TD	07/18	27.0	138.5	955	75	TY
04/06	15.8	142.5	996	35	TS	08/00	28.0	139.7	960	70	TY
04/12	16.6	141.5	990	45	TS	08/06	28.9	140.7	960	70	TY
04/18	17.4	140.3	985	50	STS	08/12	29.8	142.5	965	65	TY
05/00	17.9	139.3	980	55	STS	08/18	31.1	145.0	975	60	STS
05/06	18.8	138.3	970	65	TY	09/00	32.5	147.8	985	50	STS
05/12	19.7	137.2	960	70	TY	09/06	34.3	151.5	988	-	L
05/18	20.8	136.4	960	70	TY	09/12	35.5	156.5	992	-	L
06/00	21.4	135.8	955	75	TY	09/18	37.0	162.1	992	-	L
06/06	22.4	135.1	955	75	TY	10/00	38.1	169.1	992	-	L
06/12	23.4	135.3	950	80	TY	10/06	41.0	174.9	982	-	L
06/18	24.0	135.5	950	80	TY	10/12	43.0	178.9	972	-	L
07/00	24.8	135.8	950	80	TY	10/18	44.4	182.2	968	-	Out



TY HAIYAN (0121)

Haiyan formed as a tropical depression east of Luzon Island at 18UTC 11 October. Drifting toward the north, it developed into a tropical storm at 12UTC 12 October and then became stationary over the same waters from 00UTC until 18UTC 13 October, when it attained STS intensity and started moving northward. Haiyan turned to the northwest at 12UTC 14 October and intensified gradually. Having reached TY intensity at 15UTC 15 October, it began to recurve and passed east of Taiwan around 00UTC 16 October. Moving to the east-northeast, the typhoon gradually weakened to a severe tropical storm northwest of Okinawa at 00UTC 17 October and to a tropical storm south of Japan at 00UTC on the following day. The storm became an extratropical cyclone east of Japan soon.

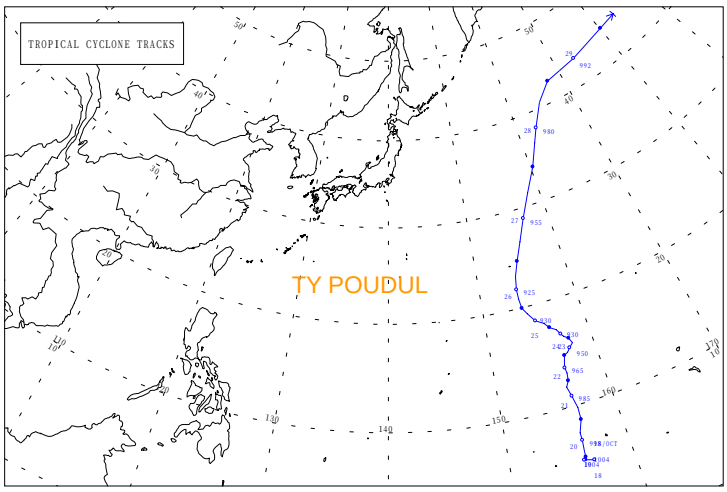
Date/Time		Center Position		Central pressure	Max Wind	Grade	Date/Time		Center Position		Central pressure	Max Wind	Grade
	(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)			(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)	
TY HAIYAN (0121)													
Oct	11/18	16.8	131.0	1004	-	TD	Oct	16/06	25.4	124.5	960	70	TY
	12/00	17.3	130.7	1004	-	TD		16/09	26.0	124.7	960	70	TY
	12/06	17.3	130.4	1002	-	TD		16/12	26.3	125.0	960	70	TY
	12/12	17.3	130.2	1000	35	TS		16/15	26.5	125.3	960	70	TY
	12/18	17.8	129.8	996	35	TS		16/18	27.0	125.8	965	65	TY
	13/00	18.6	129.8	994	40	TS		16/21	27.4	126.4	965	65	TY
	13/06	18.6	129.9	990	45	TS		17/00	27.6	127.1	970	60	STS
	13/12	18.5	129.9	990	45	TS		17/03	27.8	127.8	970	60	STS
	13/18	18.6	130.0	985	50	STS		17/06	28.2	128.7	970	55	STS
	14/00	19.3	129.8	985	50	STS		17/09	28.7	130.0	970	55	STS
	14/06	20.3	129.7	980	50	STS		17/12	29.1	130.8	975	50	STS
	14/12	21.1	129.5	975	55	STS		17/15	29.3	131.7	980	50	STS
	14/18	21.8	128.5	975	55	STS		17/18	29.5	133.2	980	50	STS
	15/00	22.1	127.8	975	55	STS		17/21	30.1	134.6	980	50	STS
	15/06	22.6	126.6	970	60	STS		18/00	30.7	136.4	985	45	TS
	15/12	23.1	125.7	970	60	STS		18/03	31.6	138.3	985	45	TS
	15/15	23.5	125.4	965	65	TY		18/06	32.5	139.6	990	45	TS
	15/18	23.9	125.1	965	65	TY		18/09	33.3	141.3	996	40	TS
	15/21	24.2	124.7	960	70	TY		18/12	33.5	143.4	1000	-	L
	16/00	24.5	124.4	960	70	TY		18/18	33.6	145.8	1004	-	L
	16/03	24.9	124.4	960	70	TY		19/00					Dissip



TY PODUL (0122)

While Haiyan was tracking south of Japan, a tropical depression formed southwest of Pohnpei Island at 00UTC 18 October. Moving westward, and then northward, it became a tropical storm west of the Island at 00UTC 20 October. On the northward track it developed into a severe tropical storm far east of the Mariana Islands at 00UTC 21 October and into a typhoon over the same waters at 18UTC on that day. After it made a half counterclockwise turn, Podul moved northwestward and reached a peak intensity of maximum sustained winds of 100 knots south of Minamitori-shima at 12UTC 25 October. It then recurved and accelerated to the north-northeast passing east of the Island on the evening of 26 October. On the north-northeast track it was downgraded to a severe tropical storm far east of Japan at 18UTC 27 October and became an extratropical cyclone soon.

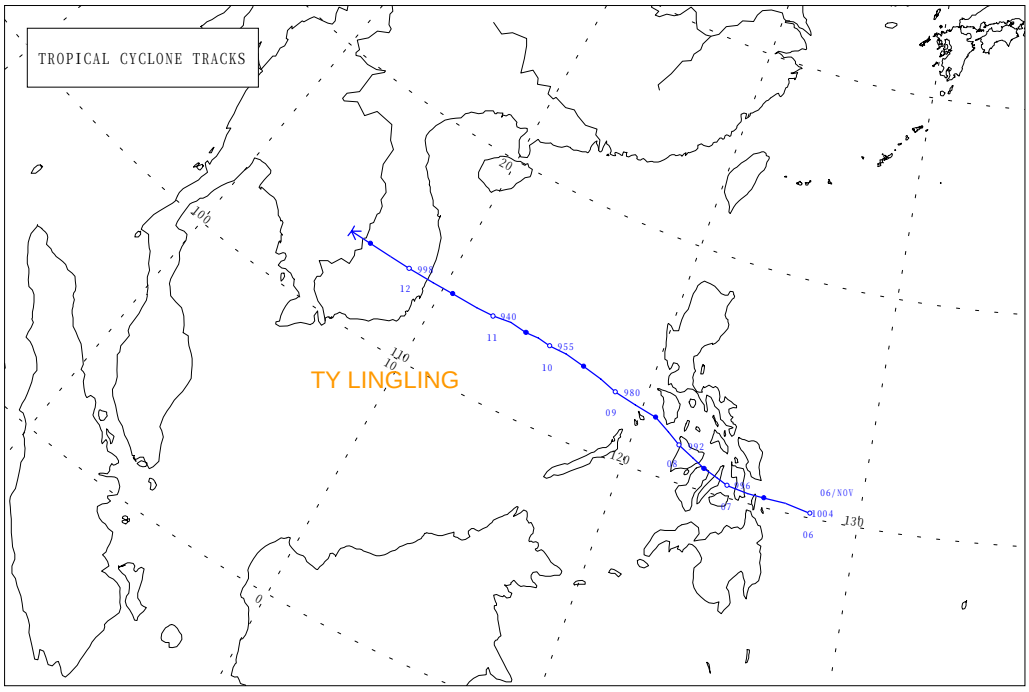
Date/Time		Center Position		Central pressure	Max Wind	Grade	Date/Time		Center Position		Central pressure	Max Wind	Grade
	(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)			(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)	
TY PODUL (0122)													
Oct	18/00	5.3	156.8	1004	-	TD	Oct	24/00	16.6	157.2	930	95	TY
	18/06	5.4	156.5	1004	-	TD		24/06	17.1	156.9	930	95	TY
	18/12	5.5	156.1	1004	-	TD		24/12	17.5	156.3	930	95	TY
	18/18	5.5	156.0	1004	-	TD		24/18	18.0	155.9	930	95	TY
	19/00	5.5	156.0	1004	-	TD		25/00	18.5	155.1	930	95	TY
	19/06	5.5	156.1	1004	-	TD		25/06	19.3	154.5	930	95	TY
	19/12	5.7	156.2	1004	-	TD		25/12	20.0	154.1	925	100	TY
	19/18	6.1	156.2	1002	-	TD		25/18	20.9	154.0	925	100	TY
	20/00	7.1	156.3	998	35	TS		26/00	21.9	154.0	925	100	TY
	20/06	7.7	156.3	996	35	TS		26/06	23.2	154.3	930	95	TY
	20/12	8.8	156.7	996	40	TS		26/12	24.7	154.9	935	90	TY
	20/18	9.8	156.7	992	45	TS		26/18	26.6	155.8	945	85	TY
	21/00	10.9	156.5	985	50	STS		27/00	28.9	157.0	955	75	TY
	21/06	11.8	156.3	980	50	STS		27/06	31.4	158.5	965	70	TY
	21/12	12.3	156.6	975	60	STS		27/12	34.0	160.3	970	65	TY
	21/18	13.0	156.7	970	65	TY		27/18	36.5	161.8	975	60	STS
	22/00	13.5	156.6	965	70	TY		28/00	38.1	162.8	980	-	L
	22/06	13.9	156.7	960	70	TY		28/06	40.7	164.9	980	-	L
	22/12	14.6	156.9	960	70	TY		28/12	42.6	167.6	984	-	L
	22/18	14.8	157.3	955	75	TY		28/18	43.0	170.3	988	-	L
	23/00	15.1	157.6	950	80	TY		29/00	43.4	173.3	992	-	L
	23/06	15.5	158.0	940	85	TY		29/06	44.0	176.8	996	-	L
	23/12	16.0	157.8	935	90	TY		29/12	44.4	180.1	1000	-	Out
	23/18	16.3	157.4	930	95	TY							



TY LINGLING (0123)

Lingling, which formed as a tropical depression northeast of Mindanao Island at 00UTC 6 November, took an almost westward track throughout its whole life of about one week. It developed into a tropical storm close to Leyte Island at 18UTC 6 November and held TS intensity until it crossed Panay Island and entered Sulu Sea at 00UTC 8 November, when it resumed developing. Lingling reached STS intensity when it entered the South China Sea at 18UTC on that day and TY intensity over the same waters at 12UTC 9 November. Having reached its peak of maximum sustained winds of 85 knots east off southern Viet Nam at 00UTC 11 November, it started to weaken and was downgraded to a severe tropical storm at 18UTC on that day. The storm made landfall on southern Viet Nam around 20UTC on the same day. It weakened to a tropical depression in the same region at 00UTC 12 November and dissipated in Cambodia soon.

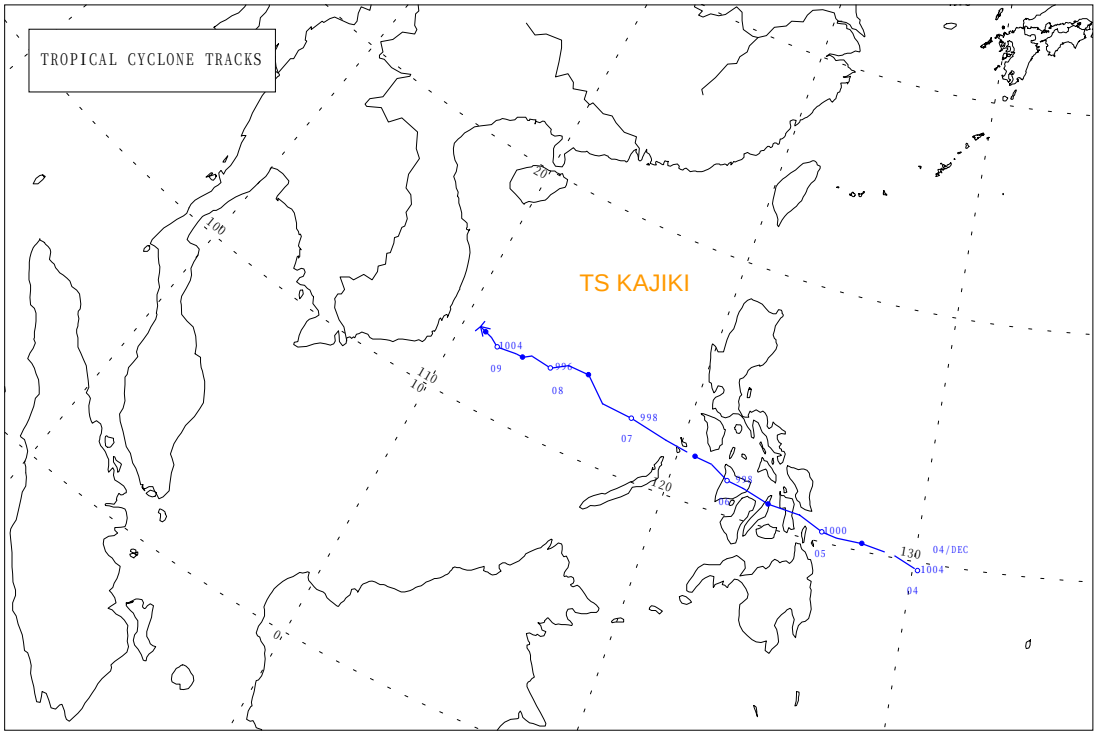
Date/Time		Center Position		Central pressure	Max Wind	Grade	Date/Time		Center Position		Central pressure	Max Wind	Grade
	(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)			(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)	
TY LINGLING (0123)													
Nov	06/00	10.2	128.0	1004	-	TD	Nov	09/12	13.2	117.0	970	65	TY
	06/06	10.4	126.9	1002	-	TD		09/18	13.4	116.1	965	70	TY
	06/12	10.4	126.0	1002	-	TD		10/00	13.4	115.3	955	75	TY
	06/18	10.4	125.3	996	35	TS		10/06	13.5	114.7	950	80	TY
	07/00	10.5	124.4	996	35	TS		10/12	13.5	114.1	945	85	TY
	07/06	10.7	123.9	994	35	TS		10/18	13.6	113.3	945	85	TY
	07/12	10.9	123.3	996	35	TS		11/00	13.5	112.5	940	85	TY
	07/18	11.2	122.7	994	35	TS		11/06	13.5	111.7	940	85	TY
	08/00	11.5	122.0	992	40	TS		11/12	13.5	110.5	955	70	TY
	08/06	11.9	121.4	990	45	TS		11/18	13.5	109.5	985	50	STS
	08/12	12.3	120.7	990	45	TS		12/00	13.5	108.3	998	-	TD
	08/18	12.5	119.7	980	55	STS		12/06	13.5	107.3	1000	-	TD
	09/00	12.7	118.7	980	55	STS		12/12	13.5	106.3	1004	-	TD
	09/06	13.0	117.9	975	60	STS		12/18					Dissip



TS KAJIKI (0124)

After about three weeks from the dissipation of Lingling, a tropical depression formed northeast of Mindanao Island at 00UTC 4 December. Moving west-northwestward, it developed into a tropical storm just east of Leyte Island at 00UTC 5 December. Kajiki passed the central part of the Philippines from the afternoon of that day to the morning of 6 December, and then slightly weakened to a tropical depression over the Sulu Sea at 06UTC 6 December. Entering the South China Sea, it resumed developing to a tropical storm at 18UTC 6 December and tracked westward with TS intensity for about one and a half days. It then became a tropical depression over the same waters at 06UTC 8 December and dissipated on the next day.

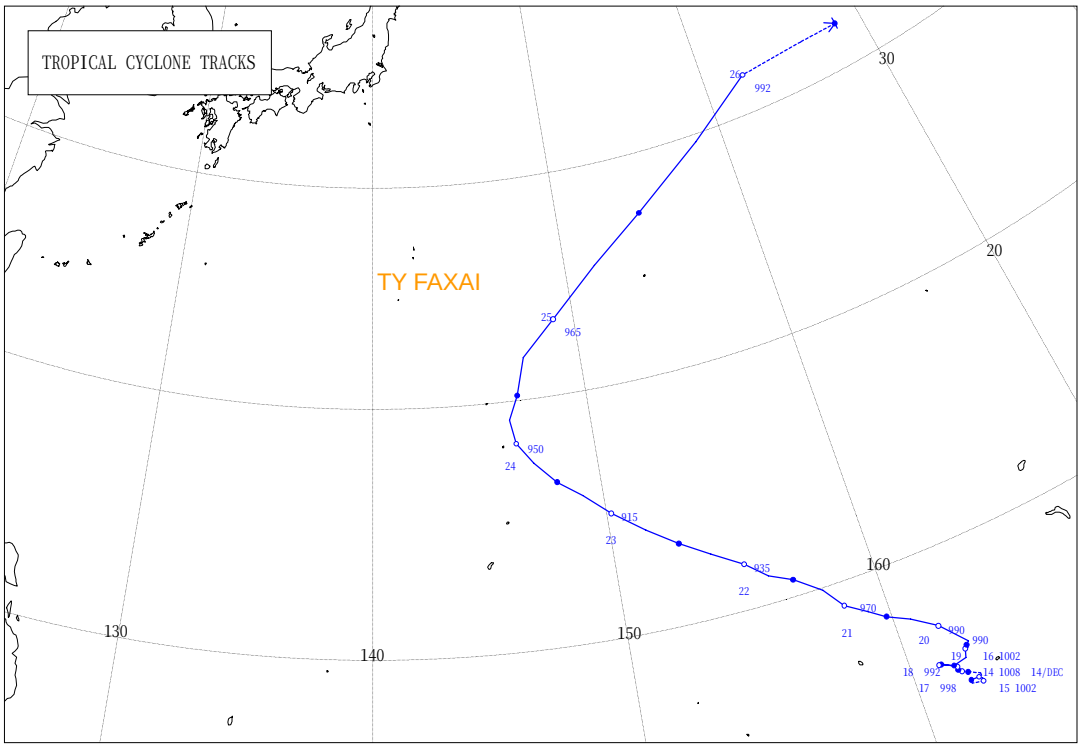
Date/Time (UTC)		Center Position Lat (N)	Lon (E)	Central pressure (hPa)	Max Wind (kt)	Grade	Date/Time (UTC)		Center Position Lat (N)	Lon (E)	Central pressure (hPa)	Max Wind (kt)	Grade
TS KAJIKI (0124)													
Dec	04/00	9.7	130.2	1004	-	TD	Dec	07/00	12.3	117.8	998	35	TS
	04/06	10.1	129.2	1002	-	TD		07/06	12.4	116.5	996	35	TS
	04/12	10.3	127.9	1004	-	TD		07/12	13.2	115.5	996	35	TS
	04/18	10.3	126.9	1002	-	TD		07/18	13.2	114.6	996	35	TS
	05/00	10.4	126.3	1000	35	TS		08/00	12.8	114.0	996	35	TS
	05/06	10.8	125.3	998	35	TS		08/06	12.9	113.1	1000	-	TD
	05/12	10.9	124.0	1000	35	TS		08/12	12.7	112.8	1002	-	TD
	05/18	11.2	122.9	998	35	TS		08/18	12.7	112.5	1002	-	TD
	06/00	11.3	122.2	998	35	TS		09/00	12.6	111.7	1004	-	TD
	06/06	11.7	121.4	1000	-	TD		09/06	12.8	111.3	1004	-	TD
	06/12	11.8	120.7	1000	-	TD		09/12	12.9	111.0	1006	-	TD
	06/18	12.0	119.4	998	35	TS		09/18					Dissip



TY FAXAI (0125)

Faxai was the most intense tropical cyclone of this season. The cyclone formed as a tropical depression southeast of Pohnpei Island at 18UTC 13 December. It first drifted very slowly over the same waters for about three days, and developed into a tropical storm at 18UTC 16 December. Keeping TS intensity, it drifted west-northwestward and then eastward for further three days until 18UTC 19 December when it began to move northwestward. Accelerating to the northwest, Faxai gradually intensified into a severe tropical storm northeast of Pohnpei Island at 06UTC 20 December and into a typhoon north of the Island at 00UTC 21 December. Having reached its peak of maximum sustained winds of 105 knots east of the Mariana Islands at 18UTC 22 December, it recurved over the north part of the Islands on 24 December. Moving to the northeast with gradual weakening, the typhoon was downgraded to a severe tropical storm west of Minamitori-shima at 06UTC 25 December. It became an extratropical cyclone far east of Japan at 00UTC on the following day.

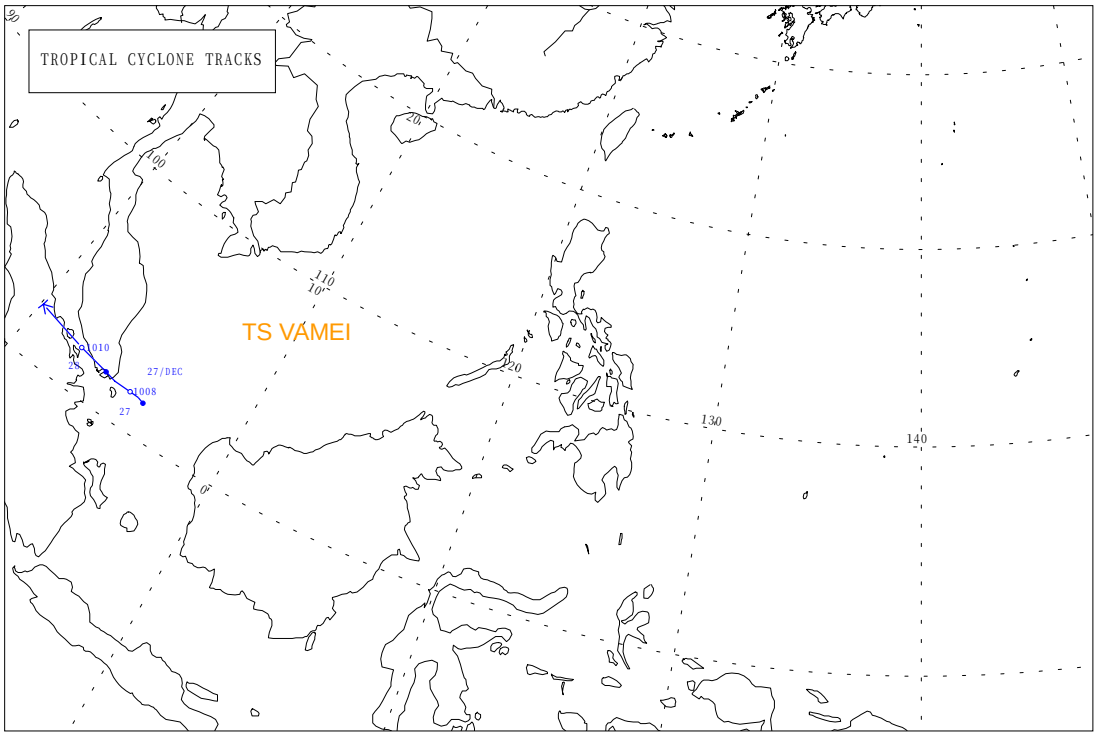
Date/Time		Center Position		Central pressure	Max Wind	Grade	Date/Time		Center Position		Central pressure	Max Wind	Grade
	(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)			(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)	
TY FAXAI(0125)													
Dec	13/18	4.9	162.3	1006	-	TD	Dec	20/06	7.8	160.6	985	50	STS
	14/00	5.0	162.2	1008	-	TD		20/12	8.2	159.8	985	50	STS
	14/06	5.0	162.0	1004	-	TD		20/18	8.6	159.2	975	60	STS
	14/12	5.0	161.9	1004	-	TD		21/00	9.1	158.4	970	65	TY
	14/18	4.9	161.9	1002	-	TD		21/06	9.9	157.8	965	70	TY
	15/00	4.8	162.3	1002	-	TD		21/12	10.6	156.8	955	75	TY
	15/06	5.1	162.3	1000	-	TD		21/18	11.0	155.9	945	85	TY
	15/12	5.3	161.9	1002	-	TD		22/00	11.7	155.1	935	90	TY
	15/18	5.3	161.9	1000	-	TD		22/06	12.4	153.9	925	95	TY
	16/00	5.4	161.7	1002	-	TD		22/12	13.1	152.7	920	100	TY
	16/06	5.5	161.6	1000	-	TD		22/18	13.9	151.5	915	105	TY
	16/12	5.5	161.6	1000	-	TD		23/00	14.8	150.2	915	105	TY
	16/18	5.5	161.6	998	35	TS		23/06	15.7	149.1	925	95	TY
	17/00	5.6	161.6	998	35	TS		23/12	16.4	148.1	940	85	TY
	17/06	5.8	161.3	994	40	TS		23/18	17.3	147.2	950	80	TY
	17/12	5.9	161.1	994	40	TS		24/00	18.2	146.5	950	80	TY
	17/18	5.9	161.0	992	40	TS		24/06	19.2	146.3	950	80	TY
	18/00	5.9	161.0	992	40	TS		24/12	20.2	146.8	955	75	TY
	18/06	5.9	161.0	992	40	TS		24/18	21.8	147.3	960	70	TY
	18/12	5.7	161.5	992	40	TS		25/00	23.3	149.0	965	65	TY
	18/18	5.8	162.0	990	45	TS		25/06	25.3	151.5	970	60	STS
	19/00	6.1	162.1	990	45	TS		25/12	27.2	154.4	980	55	STS
	19/06	6.1	162.2	990	45	TS		25/18	29.6	158.5	985	50	STS
	19/12	6.2	162.2	990	45	TS		26/00	31.8	162.3	992	-	L
	19/18	6.3	162.3	990	45	TS		26/06	32.1	166.2	996	-	L
	20/00	7.2	161.5	990	45	TS		26/12	32.1	168.5	1000	-	L


TROPICAL CYCLONE TRACKS
TY FAXAI
30
20
160
150
140
130
26
992
25
965
24
950
23
915
22
935
21
970
20
990
19
990
18
992
17
998
16
1002
14
1008
14/DEC
15
1002

TS VAMEI (0126)

Vamei reached TS intensity at record-breaking low latitude 1.5 °N close to the equator. The storm formed as a tropical depression east of Singapore at 12UTC 26 December. Moving westward, it became a tropical storm over the same waters at 00UTC 27 December and passed Singapore around 12UTC on that day. Soon after the passage it weakened to a tropical depression and dissipated over the northern part of Sumatra Island at 12UTC 28 December.

Date/Time		Center Position		Central pressure	Max Wind	Grade	Date/Time		Center Position		Central pressure	Max Wind	Grade
	(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)			(UTC)	Lat (N)	Lon (E)	(hPa)	(kt)	
TS VAMEI(0126)													
Dec	26/12	1.4	105.9	1010	-	TD	Dec	27/12	1.6	103.9	1008	35	TS
	26/18	1.5	105.6	1010	-	TD		27/18	1.7	103.2	1010	-	TD
	27/00	1.5	105.2	1008	40	TS		28/00	1.8	102.5	1010	-	TD
	27/06	1.5	104.4	1006	45	TS		28/06	2.0	101.3	1012	-	TD



Appendix 5

Code Forms of RSMC Products

(a) RSMC Tropical Cyclone Advisory (WTPQ20-25 RJTD)

WTPQ i i RJTD YYGGgg
RSMC TROPICAL CYCLONE ADVISORY
NAME class ty-No. name (common-No.)
ANALYSIS
PSTN YYGGgg UTC LaLa.La N LoLoLo.Lo E (or W) confidence
MOVE direction SpSpSp KT
PRES PPPP HPA
MXWD VmVmVm KT
50KT RdRdRd NM (or 50KT RdRdRd NM octant SEMICIRCLE RdRdRd NM ELSEWHERE)
30KT RdRdRd NM (or 30KT RdRdRd NM octant SEMICIRCLE RdRdRd NM ELSEWHERE)
FORECAST
24HF YYGGgg$_F$ UTC LaLa.La$_F$ N LoLoLo.Lo$_F$ E (or W) FrFrFr NM 70%
MOVE direction SpSpSp KT
PRES PPPP HPA
MXWD VmVmVm KT
48HF YYGGgg$_F$ UTC LaLa.La$_F$ N LoLoLo.Lo$_F$ E (or W) FrFrFr NM 70%
MOVE direction SpSpSp KT
72HF YYGGgg$_F$ UTC LaLa.La$_F$ N LoLoLo.Lo$_F$ E (or W) FrFrFr NM 70%
MOVE direction SpSpSp KT =

Notes:

a. Underlined is fixed.

b. Abbreviations

PSTN	:	Position
MOVE	:	Movement
PRES	:	Pressure
MXWD	:	Maximum wind
24HF	:	24-hour forecast
48HF	:	48-hour forecast
72HF	:	72-hour forecast

c. Symbolic letters

i i	:	'20', '21', '22', '23', '24' or '25'.
YYGGgg	:	Time of observation submitting the data for analysis. Date(YY), hour(GG) and minute(gg) are given in UTC.
class	:	Intensity classification of the tropical cyclone. 'TY', 'STS', 'TS' or 'TD'.
ty-No.	:	Domestic identification number of the tropical cyclone adopted in Japan. Given in four digits and same as the international identification number.
name	:	Name assigned to the tropical cyclone from the name list prepared by the Typhoon Committee.
common-No.	:	International identification number of the tropical cyclones given in four digits.
LaLa.La	:	Latitude of the center position in "ANALYSIS" part.
LoLoLo.Lo	:	Longitude of the center position in "ANALYSIS" part.
confidence	:	Confidence of the center position. 'GOOD', 'FAIR' or 'POOR'.
direction	:	Direction of movement given in 16 azimuthal direction as 'N', 'NNE', 'NE', 'ENE' etc.
SpSpSp	:	Speed of movement.
PPPP	:	Central pressure.
VmVmVm	:	Maximum sustained wind.
RdRdRd	:	Radii of 30knots and 50knots wind.
octant	:	Eccentric distribution of wind given in 8 azimuthal direction as 'NORTH', 'NORTHEAST', 'EAST' etc.

$YYGGgg_F$	:	Time in UTC on which the forecast is valid.
$LaLa.La_F$	:	Latitude of the center of 70% probability circle in "FORECAST" part.
$LoLoLo.Lo_F$	:	Longitude of the center of 70% probability circle in "FORECAST" part.
FrFrFr	:	Radius of 70% probability circle.

d. MOVE is optionally described as 'ALMOST STATIONARY' or '(direction) SLOWLY' depending on the speed of movement.

Example:

WTPQ20 RJTD 180000
RSMC TROPICAL CYCLONE ADVISORY
NAME TY 0001 DAMREY (0001)
ANALYSIS
PSTN 180000UTC 14.8N 127.2E GOOD
MOVE W 12KT
PRES 905HPA
MXWD 105KT
50KT 180NM SOUTHEAST SEMICIRCLE 150NM ELSEWHERE
30KT 300NM
FORECAST
24HF 190000UTC 16.3N 125.7E 90NM 70%
MOVE NNW 06KT
PRES 910HPA
MXWD 100KT
48HF 200000UTC 18.5N 126.5E 180NM 70%
MOVE NNE 06KT
72HF 210000UTC 20.5N 129.0E 270NM 70%
MOVE NE 08KT =

b) RSMC Guidance for Forecast (FXPQ20-25 RJTD)

FXPQ i i RJTD YYGGgg
RSMC GUIDANCE FOR FORECAST
NAME class ty-No. name (common-No.)
PSTN YYGGgg UTC LaLa.La N LoLoLo.Lo E (or W)
PRES PPPP HPA
MXWD WWW KT
FORECAST BY TYPHOON (or GLOBAL) MODEL
TIME PSTN PRES MXWD
(CHANGE FROM T=0)
T=06 LaLa.La N LoLoLo.Lo E (or W) appp HPA awww KT
T=12 LaLa.La N LoLoLo.Lo E (or W) appp HPA awww KT
T=18 LaLa.La N LoLoLo.Lo E (or W) appp HPA awww KT
:
:
T=78 (or 84) LaLa.La N LoLoLo.Lo E (or W) appp HPA awww KT=

Notes:

a. Underlined is fixed.

b. Symbolic letters

i i	:	'20', '21', '22', '23', '24' or '25'.
YYGGgg	:	Initial time of the model in UTC.
PPPP	:	Central pressure in hPa.
WWW	:	Maximum wind speed in knots.
a	:	Sign of ppp and www (+, - or blank).
ppp	:	Absolute value of change in central pressure from T=0, in hectopascals.
www	:	Absolute value of change in maximum wind speed from T=0, in knots.

c. The prediction terminates in T=78 for Typhoon Model and in T=84 for Global Model.

Example:

FXPQ20 RJTD 180600
RSMC GUIDANCE FOR FORECAST
NAME T 0001DAMREY (0001)
PSTN 180000UTC 15.2N 126.3E
PRES 905HPA
MXWD 105KT
FORECAST BY GLOBAL MODEL
TIME PSTN PRES MXWD
(CHANGE FROM T=0)
T=06 15.4N 125.8E +018HPA -008KT
T=12 15.5N 125.6E +011HPA -011KT
T=18 15.8N 125.7E +027HPA -028KT
:
:
T=78 20.7N 128.8E +021HPA -022KT=

(c) SAREP (TCNA20/21 RJTD)

TCNA i i RJTD YYGGgg
CCAA YYGGg 47644 name (common-No.) nt nt LaLaLa Qc LoLoLoLo 1At Wt at tm
2St St // (9ds ds fs fs)=

Notes:

a. Underlined is fixed.

b. Symbolic letters

i i	:	20 for the observation at 03, 09, 15 and 21 UTC. 21 for the observation at 00, 06, 12 and 18 UTC.
YYGGgg	:	Time of observation submitting the data for analysis. Date(YY), hour(GG) and minute(gg) are given in UTC.
nt nt	:	Serial number of the tropical cyclone in order of the time of its formation in the year. Given in '01' - '99' irrespective of TS attainment in intensity.
LaLaLa	:	Latitude given in 0.1E
Qc	:	Quadrant of the earth. 1:N/E, 2:S/E, 3:S/W and 4:N/W.
LoLoLoLo	:	Longitude in 0.1E.
At	:	Confidence. 0: ≦10km 1: ≦20km 2: ≦50km 3: ≦100km 4: ≦200km 5: ≦300km /: unable to determine
Wt	:	Mean diameter (d: degree in latitude) of cloud system. 0: d<1° 1: 1°≦d<2° 2: 2°≦d<3° 3: 3°≦d<4° 4: 4°≦d<5° 5: 5°≦d<6° 6: 6°≦d<7° 7: 7°≦d<8° 8: 8°≦d<9° 9: 9°≦d /: unable to determine
at	:	24-hour intensity inclination. 0: further weakening 1: weakening 2: no change 3: intensifying 4: further intensifying 9: no former observation /: unable to determine
tm	:	Time interval (t: hour) for determination of movement. 0: t<1 1: 1≦t<2 2: 2≦t<3 3: 3≦t<6 4: 6≦t<9 5: 9≦t<12 6: 12≦t<15 7: 15≦t<18 8: 18≦t<21 9: 21≦t<30 /: no (9dsdsfsfs) group
StSt	:	Intensity. 00: weakening 15, 20, 25 … 80: CI-number (in 0.1) 99: under extratropical transformation //: unable to determine
dsds	:	Direction of movement (in 10°).
fsfs	:	Speed of movement (knots).

Example:

TCNA21 RJTD 180000
CCAA 18000 47644
DAMREY(0001) 29149 11272
11334 275// 92811=

(d) RSMC Prognostic Reasoning (WTPQ30-35 RJTD)

Example:

WTPQ30 RJTD 180000

RSMC TROPICAL CYCLONE PROGNOSTIC REASONING
REASONING NO. 9 FOR TY 0001 DAMREY (0001)
1.GENERAL COMMENTS
REASONING OF PROGNOSIS THIS TIME IS SIMILAR TO PREVIOUS ONE.
POSITION FORECAST IS MAINLY BASED ON NWP AND PERSISTENCY.
2.SYNOPTIC SITUATION
SUBTROPICAL RIDGE WILL NOT CHANGE ITS LOCATION AND STRENGTH FOR THE NEXT 24 HOURS.
3.MOTION FORECAST
POSITION ACCURACY AT 180000 UTC IS GOOD.
TY WILL DECELERATE FOR THE NEXT 12 HOURS.
TY WILL RECURVE WITHIN 60 HOURS FROM 180000 UTC.
TY WILL MOVE WEST FOR THE NEXT 12 HOURS THEN MOVE GRADUALLY TO WEST-NORTHWEST.
4.INTENSITY FORECAST
TY WILL KEEP PRESENT INTENSITY FOR NEXT 24 HOURS.
FI-NUMBER WILL BE 7.0 AFTER 24 HOURS.=

(e) Tropical Cyclone Advisory for SIGMET (FKPQ30-35 RJTD)

FKPQ i i RJTD YYGGgg
TROPICAL CYCLONE ADVISORY FOR SIGMET
TROPICAL CYCLONE ADVISORY CENTRE TOKYO
NAME class ty-No. name (common-No.)
ANALYSIS
TIME YYGGggUTC
PSTN LaLa.La N LoLoLo.Lo E
MOVE direction SpSpSp KT
PRES PPPPHPA
MXWD WWWKT
12HR-FCST
TIME YYGGggUTC
PSTN LaLa.La N LoLoLo.Lo E
MOVE direction SpSpSp KT
PRES PPPPHPA
MXWD WWWKT
24HR-FCST
TIME YYGGggUTC
PSTN LaLa.La N LoLoLo.Lo E
MOVE direction SpSpSp KT
PRES PPPPHPA
MXWD WWWKT=

Notes:

a. Underlined is fixed.

b. Abbreviations

PSTN	:	Position
MOVE	:	Movement
PRES	:	Pressure
MXWD	:	Maximum wind

c. Symbolic letters

i i	:	'30', '31', '32', '33', '34' or '35'.
YYGGgg	:	Time of observation submitting the data for analysis. Date(YY), hour(GG) and minute(gg) are given in UTC.
class	:	Intensity classification of the tropical cyclone. 'TY', 'STS', 'TS' or 'TD'.
ty-No.	:	Domestic identification number of the tropical cyclone adopted in Japan. Given in four digits and same as the international identification number.
name	:	Name assigned to the tropical cyclone by JTWC (Joint Typhoon Warning Center, Guam). But for assignment, this is indicated as 'NAMELESS'.
common-No.	:	International identification number of the tropical cyclones given in four digits.
LaLa.La	:	Latitude of the center position.
LoLoLo.Lo	:	Longitude of the center position.
direction	:	Direction of movement given in 16 azimuthal direction as 'N', 'NNE', 'NE', 'ENE' etc.
SpSpSp	:	Speed of movement.
PPPP	:	Central pressure.
WWW	:	Maximum sustained wind.

d. MOVE is optionally described as 'ALMOST STATIONARY' or '(direction) SLOWLY' depending on the speed of movement.

Example:

FKPQ30 RJTD 180000
TROPICAL CYCLONE ADVISORY FOR SIGMET
TROPICAL CYCLONE ADVISORY CENTRE TOKYO
NAME TY 0001 DAMREY (0001)
ANALYSIS
TIME 180000UTC
PSTN 14.8N 127.2E
MOVE WEST 012KT
PRES 0905HPA
MXWD 105KT
12HR-FCST
TIME 181200UTC
PSTN 15.5N 126.2E
MOVE WNW 009KT
PRES 0910HPA
MXWD 105KT
24HR-FCST
TIME 190000UTC
PSTN 16.3N 125.7E
MOVE NNW 006KT
PRES 0910HPA
MXWD 100KT =

(f) RSMC Tropical Cyclone Best Track (AXPQ20 RJTD)

AXPQ20 RJTD YYGGgg
RSMC TROPICAL CYCLONE BEST TRACK
NAME ty-No. name (common-No.)
PERIOD FROM MMMDDTTUTC TO MMMDDTTUTC
DDTT LaLa.LaN LoLoLo.LoE PPPHPA WWWKT DDTT LaLa.LaN LoLoLo.LoE PPPHPA WWWKT
DDTT LaLa.LaN LoLoLo.LoE PPPHPA WWWKT DDTT LaLa.LaN LoLoLo.LoE PPPHPA WWWKT
:
:
DDTT LaLa.LaN LoLoLo.LoE PPPHPA WWWKT DDTT LaLa.LaN LoLoLo.LoE PPPHPA WWWKT
REMARKS[1)]
TD FORMATION AT MMMDDTTUTC
FROM TD TO TS AT MMMDDTTUTC
:
:
DISSIPATION AT MMMDDTTUTC=

Notes:

a. Underlined is fixed.

b. [1)] REMARKS is given optionally.

c. Symbolic letters

MMM	:	Month in UTC. Given as 'JAN', 'FEB', etc.
DD	:	Date in UTC.
TT	:	Hour in UTC.
PPP	:	Central pressure.
WWW	:	Maximum wind speed.

Example:

AXPQ20 RJTD 020600

RSMC TROPICAL CYCLONE BEST TRACK
NAME 0001 DAMREY (0001)
PERIOD FROM OCT1300UTC TO OCT2618UTC
1300 10.8N 155.5E 1008HPA //KT 1306 10.9N 153.6E 1006HPA //KT
1312 11.1N 151.5E 1004HPA //KT 1318 11.5N 149.8E 1002HPA //KT
1400 11.9N 148.5E 1000HPA //KT 1406 12.0N 146.8E 998HPA 35KT
:
:
1712 14.6N 129.5E 905HPA 105KT 1718 14.7N 128.3E 905HPA 105KT
:
:
2612 32.6N 154.0E 1000HPA //KT 2618 33.8N 157.4E 1010HPA //KT
REMARKS
TD FORMATION AT OCT1300UTC
FROM TD TO TS AT OCT1406UTC
FROM TS TO STS AT OCT1512UTC
FROM STS TO TY AT OCT1600UTC
FROM TY TO STS AT OCT2100UTC
FROM STS TO TS AT OCT2112UTC
FROM TS TO L AT OCT2506UTC
DISSIPATION AT OCT2700UTC=

Appendix 6

List of GPV products and data on the RSMC Data Serving System

Area	20S-60N,80E-160W	20S-60N,60E-160W	global area	
Resolution	2.5×2.5 deg	1.25×1.25 deg	2.5×2.5 deg	
Level & Elements	surface(P,U,V,T,TTd,R) 850hPa(Z,U,V,T,TTd,ω) 700hPa(Z,U,V,T,TTd,ω) 500hPa(Z,U,V,T,TTd, ζ) 300hPa(Z,U,V,T) 250hPa(Z,U,V,T) 200hPa(Z,U,V,T) 150hPa(Z,U,V,T) 100hPa(Z,U,V,T)	surface(P,U,V,T,TTd,R) 1000hPa(Z,U,V,T,TTd) 925hPa(Z,U,V,T,TTd,ω) 850hPa(Z**,U**,V**,T**,TTd**,ω,ψ,χ) 700hPa(Z**,U**,V**,T**,TTd**,ω) 500hPa(Z**,U**,V**,T**,TTd**, ζ) 400hPa(Z,U,V,T,TTd) 300hPa(Z,U,V,T,TTd) 250hPa(Z,U,V,T) 200hPa(Z**,U**,V**,T**,ψ,χ) 150hPa(Z,U,V,T) 100hPa(Z,U,V,T) 70hPa(Z,U,V,T) 50hPa(Z,U,V,T) 30hPa(Z,U,V,T) 20hPa(Z,U,V,T) 10hPa(Z,U,V,T)	surface(P,U,V,T,R) 850hPa(Z,U,V,T,TTd)* 700hPa(Z,U,V,T,TTd)* 500hPa(Z,U,V,T)* 300hPa(Z,U,V,T) 250hPa(Z,U,V,T) 200hPa(Z,U,V,T)* 100hPa(Z,U,V,T)	surface(P,U,V,T,TTd) 1000hPa(Z,U,V,T,TTd) 850hPa(Z,U,V,T,TTd) 700hPa(Z,U,V,T,TTd) 500hPa(Z,U,V,T,TTd) 400hPa(Z,U,V,T,TTd) 300hPa(Z,U,V,T,TTd) 250hPa(Z,U,V,T) 200hPa(Z,U,V,T) 150hPa(Z,U,V,T) 100hPa(Z,U,V,T) 70hPa(Z,U,V,T) 50hPa(Z,U,V,T) 30hPa(Z,U,V,T) 20hPa(Z,U,V,T) 10hPa(Z,U,V,T)
FCST Hours	00,06,12,18,24,30,36,48,60,72	00,06,12,18,24,30,36,42,48,54,60,66,72 12UTC: Surface(P,U,V,T,TTd,R), from 78 to 192 hours, every 6 hours ** ; 96,120,144,168,192(12UTC only)	00UTC : 24,48,72 12UTC : 00,24,48,72,96,120 * ; 144,168,192(12UTC only)	00UTC : 00
Time/Day	2 times (00 and 12 UTC)	2 times (00 and 12 UTC)	2 times (00 and 12 UTC)	

Note: P : pressure reduced to MSL Z : geopotential height ζ : relative vorticity U : u-component of wind
V : v-component of wind ψ : stream function R : total precipitation T : temperature
χ : velocity potential TTd : dew point depression ω : vertical velocity

Products /Data	GMS Data	Typhoon Information	Global Wave Model	Observations data
Contents	(a) Digital data (GRIB) •Cloud amount •Convective cloud amount •Equivalent blackbody temperature (b) Satellite-derived high density cloud motion vectors (BUFR)	Tropical cyclone related information (BUFR) ・Position, etc.	•Wave height •Wave period •Prevailing wave direction Forecast Times: Initial,06,12,18,24,30,36, 42,48,54,60,72 (00&12UTC), 96,120,144,168,192 (12UTC)	(a) Surface data (SYNOP) (b) Upper air data (TEMP, Part A-D) (PILOT, Part A-D)
Frequency (initial time(s))	(a) 4 times (00, 06, 12 and 18UTC) a day (b) Once (04UTC) a day	4 times (00, 06, 12 and 18 UTC) a day	2 times (00 and 12 UTC) a day	(a) Mainly 4 times a day (b) Mainly 2 times a day

Appendix 7

User’s Guide to the CD-ROM

1) This CD-ROM should not be reproduced and not be provided to any third party.
2) The source should be properly acknowledged in any work obtained with this CD-ROM.

JMA does not accept liability for any direct and/or indirect loss or damage to the user caused by the use of the software, data or documents in this CD-ROM.

Preface

This CD-ROM contains all the texts, tables, charts in this report and GMS-5 satellite images of the tropical cyclones that attained TS intensity or higher in the western North Pacific and the South China Sea in 2001. This document is a brief user's guide for the CD-ROM. The CD-ROM was mastered in ISO-9660 format.

Directory and File layout

```
|------ar405eng.exe (Acrobat Reader Installer)
  |------Readme.txt (belief explanation about the CD-ROM)
  |------Report_Contents.pdf (contents of Annual Report 2001 in PDF)
  |------TopMenu.exe (Start menu setup program)
  |------Users_Manual.htm (user’s manual of a satellite image viewer)
  |------Annual_Report
            |---Text
                  |--Text2001.pdf (text of Annual Report 2001 in PDF)
                  |--Text2001.doc (text of Annual Report 2001 for MS Word)
            |---Figure (figures for MS PowerPoint)
            |---Table (tables for MS Excel)
            |---Appendix (appendixes for MS Excel, PowerPoint)
  |------Programs
            |---Gmslpd
                  |--Gmslpd.exe (Viewer; tropical cyclone version in English)
                  |--Gsetup.exe, etc. (Setup program, etc.)
  |------Satellite_Image_Data
            |---2001_1 (3-hourly GMS image data)
            |---2001_2 (    to 2001_26)
  |------Users_Manual
                  |--Gmanual.doc (User’s Manual for MS Word)
  |------Andata
                  |--Best2001.txt (Best track data for the year 2001)
```

How to use this CD-ROM

When you set the CD-ROM, start menu will be presented automatically with a panel which has "Annual Report 2001", "GMS Satellite Images", "About CD-ROM" and "Close" buttons and a file list box for some introductory documents. Choose and click a button or file which you want to see and follow instructions on your display.

Required hardware/OS for the CD-ROM are:

Hardware : DOS-V, NEC PC-9800 Series or their compatible
OS : Microsoft Windows Ver. 3.1 or later

< Annual Report 2001 >

Annual Report 2001 is prepared in the following two formats: "PDF files" and "MS Word/Excel/PowerPoint files".

- PDF files:

Click the "Annual Report 2001" button to open the annual report 2001 in PDF. If you can not open the PDF file, install 'Adobe Acrobat Reader' with its installer (ar405eng.exe) in the file list box on a start menu window, and try again. 'Adobe Acrobat Reader' (or 'Adobe Acrobat') is required to view PDF files.

- Word/Excel/PowerPoint files:

Original texts, figures and tables prepared with Microsoft Word, Excel or PowerPoint are stored in Annual_Report folder of the CD-ROM.

< GMS Satellite Images >

- Installation of a program for displaying satellite images:

Click the "GMS Satellite Image" button to run a setup program (Gsetup.exe) of a satellite image viewer. If you follow some instructions, the viewer 'Gmslpd.exe', which is a program for displaying satellite images, will be installed into the harddisk of your computer and a list of the tropical cyclones in 2001 is displayed in the 'Selection window' of satellite images for tropical cyclones.

- Displaying satellite images:

Choose a tropical cyclone from the list and click the name, and 3-hourly satellite images for the tropical cyclone will be displayed. You can display the track of the tropical cyclone superimposed on the satellite image and measure the intensity of the tropical cyclone using Dvorak's technique.

- User's manual for the viewer:

Besides the above functions, the viewer has many useful ones. See the User's Manual (Users_Manual.htm or /Users_Manual/Gmanual.doc) about further detailed operations.

- Explanation of satellite image data

Period : From Generating Stage to Weakening Stage of each tropical cyclone.
Images : Infrared images (00, 03, 06, 09, 12, 15, 18, 21UTC)
Visible images (00, 03, 06, 09, 21UTC)
Range : 40 degrees in both latitude and longitude.
(The image window moves following a tropical cyclone's track so that the center of a tropical cyclone is fixed at the center of the image window.)
Time interval : 3-hourly
Resolution : 0.08 degrees in both latitude and longitude.
Compression of file : Compressed using 'compress.exe' command of Microsoft Windows.

< About CD-ROM >

Click the "About CD-ROM" button to open ReadmeE.txt file.

< Close >

Click the "Close" button to close start menu window.

< file list box >

You can open introductory document files from a file list box on the start menu window. Choose a file and click the "Open" button or double click the file name.

For further information, please contact the following address:

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