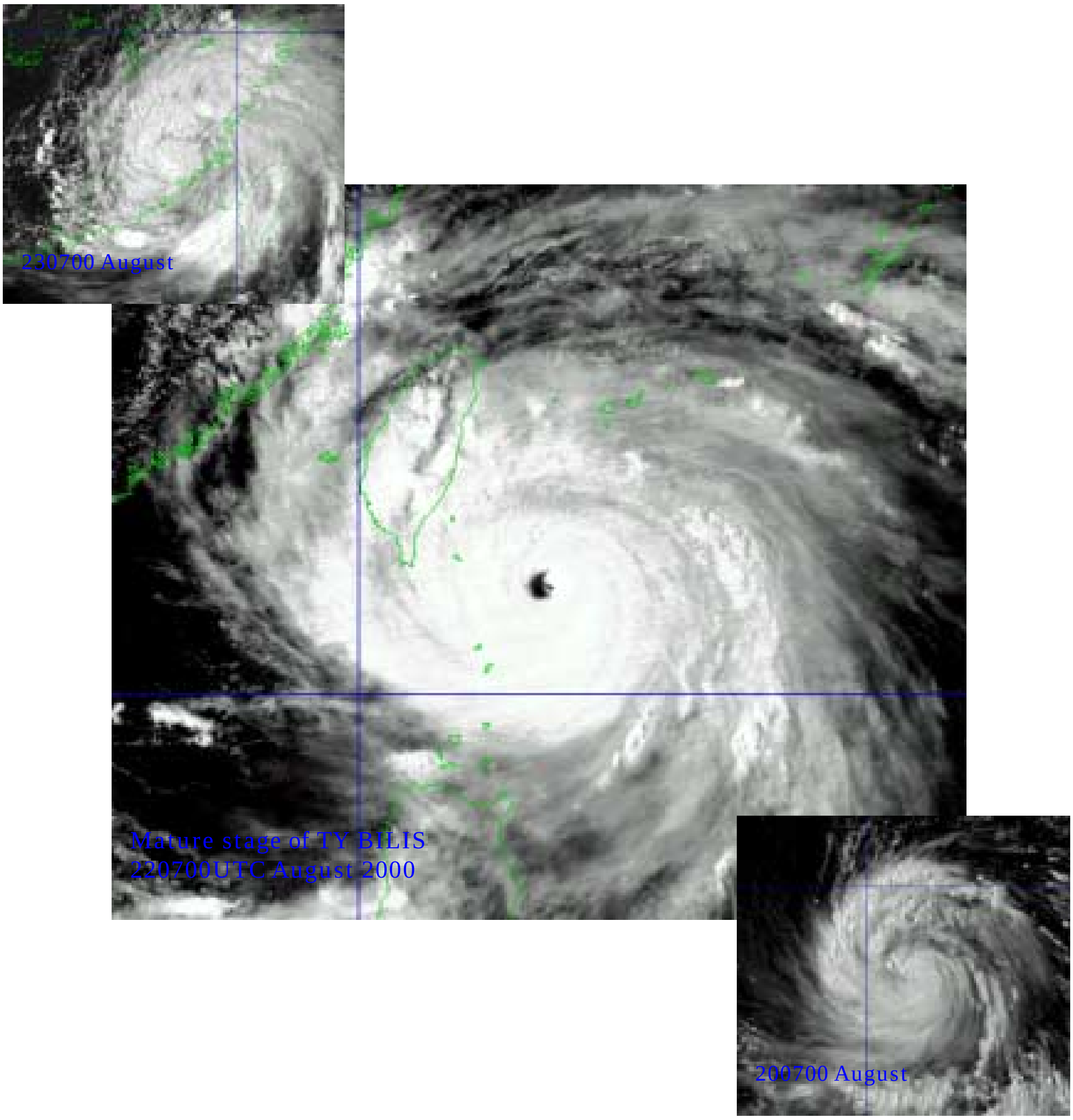
Annual Report on Activities of the RSMC Tokyo – Typhoon Center 2000



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 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 2000 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 2000. Chapter 3 describes atmospheric and oceanic conditions in the tropics and gives the highlights of the tropical cyclone activities in 2000. 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 2000 are shown in table and chart forms in Appendices. All the texts, tables, charts and appendixes are included in a CD-ROM attached to this report.

The CD-ROM contains 3-hourly cloud images of all the tropical cyclones in 2000 with 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 2000

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).

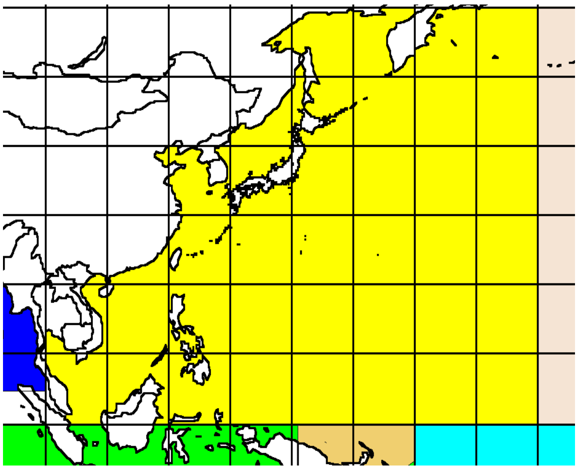


Figure 1.1
Area of responsibility (yellow) of the RSMC Tokyo – Typhoon Center

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 movement of a tropical cyclone are determined primarily from the six-hourly displacement 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 the cloud motion 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 analysis, 24-hour, 48-hour and 72-hour forecasts of a tropical cyclone for the following elements:

Analysis Center position of a tropical cyclone
Accuracy of determination of the center position
Direction and speed of movement
Central pressure
Maximum sustained wind speed (10-minute averaged)
Radii of over 50- and 30-knot wind areas

24-hour forecast
Center position and radius of the probability circle*
Direction and speed of movement
Central pressure
Maximum sustained wind speed (10-minute averaged)

48- and 72-hour forecast
Center position and radius of the probability circle*
Direction and speed of 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 twice a day with initial analyses at 06 and 18 UTC. The Guidance presents GSM's six-hourly predictions of a tropical cyclone up to 84 hours for 00 and 12 UTC and TYM's six-hourly predictions up to 78 hours for 06 and 18 UTC. It includes:

NWP prediction (T=06 to 78 or 84)
- 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 movement

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 tropical cyclones, and some relevant remarks are described 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 distributed generally 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 analysis, 12-hour, 24-hour forecasts of a tropical cyclone for the following elements:

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 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)

24- and 48-hour prognostic charts of 850-hPa and 200-hPa streamlines as well as 850-hPa and 200-hPa analyses are broadcast via the JMA's HF radio facsimile (JMH). These prognoses are produced with GSM at 00 and 12 UTC over the area, 20°S to 60°N in latitude and 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 Grid Point Values (GPVs) and observational data through the Internet or the Integrated Service Digital Network (ISDN) since 1995. The products and data being 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 2000

2.1 Dissemination of RSMC Products

In 2000, 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 2000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TCNA20	0	0	0	0	27	0	83	136	136	42	37	9	470
TCNA21	0	0	0	0	34	0	96	144	151	47	40	12	524
WTPQ20-25	0	0	0	0	37	0	102	151	157	50	40	12	549
WTPQ30-35	0	0	0	0	19	0	49	73	77	24	20	6	268
FXPQ20-25	0	0	0	0	32	0	96	147	138	50	26	0	489
FKPQ30-35	0	0	0	0	34	0	100	146	150	50	39	11	530
AXPQ20	0	0	0	0	0	1	1	0	0	0	6	28	36
AUXT85/20	62	58	62	60	62	60	62	62	60	62	60	62	732
FUXT852/854	62	58	62	60	62	60	62	62	60	62	60	62	732
FUXT202/204	62	58	62	60	62	60	62	62	60	62	60	62	732

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 “Annual Report on Activities of the RSMC Tokyo-Typhoon Center in 1999” in November 2000 with a CD-ROM, which contains data and GMS images of all the tropical cyclones in 1999.

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 20 August to 18UTC 24 August (for Typhoon Bilis (0010))
2. from 00UTC 28 August to 18UTC 1 September (for Typhoon Prapiroon (0012))

The results were distributed to all the Typhoon Committee Members in February 2001, 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 2000

3.1 Summary of Atmospheric and Oceanographic Conditions in the Tropics

Sea surface temperatures (SSTs) were below normal in the central and eastern Pacific throughout the year 2000, as in 1999. In January, negative SST anomalies exceeding –1°C were found from the date line to 90°W, then this negative anomaly weakened to nearly 0°C from spring to summer. The below-normal condition become stronger again after the mid-autumn, and SST anomalies exceeding -1°C appeared around 160°W and 140°W in December. In the western part, SSTs were above normal by more than 0.5°C throughout the year. The SST normally for a El Niño monitoring region (4°N - 4°S, 150°W - 90°W) was less than –0.5°C in January, February, November and December. The five-month running average of the anomaly was –0.5°C from June 1999 to March 2000. La Niña condition continued from the summer of 1999 to the spring of 2000. Maps of monthly mean SST anomalies are held on the attached CD-ROM.

Convective activities were above normal from the Indian Ocean to Southeast Asia and Australia, while below normal over the central Pacific. This anomalous distribution pattern typical in La Niña conditions was observed throughout this year. The inter tropical convergence zone (ITCZ) from the central to eastern Pacific was weak in the beginning of this year, and enhanced after spring and throughout summer, in the eastern and central Pacific, respectively.

The center of large-scale divergence at 200 hPa had been shifted westward from its normal position except in July and August. At 850 hPa wind field, anomalous westerly was dominant from the equatorial Indian Ocean to Indonesia, while anomalous easterly was enhanced along the western to central Pacific. At 200 hPa, wind anomalies opposite of those at 850 hPa was prevailed from the Indian Ocean to the Pacific along the equator. Associated with these wind anomalies, Walker Circulation was stronger than normal throughout 2000.

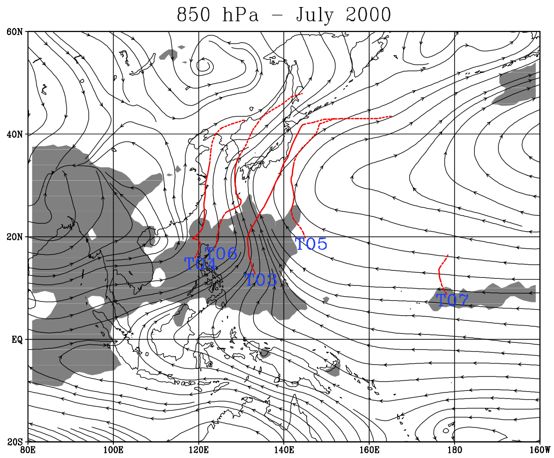


Figure 3.1 Monthly mean stream line at 850 hPa and area of high-cloud amount greater than 30% (shaded) in July 2000. Tracks of the tropical cyclones (red lines) formed in July are superimposed.

In summer the sub-tropical high sifted to the north and its extension toward the west was weak compared to the normal year. In consequence many tropical cyclones moved northward without recurving along the western periphery of the high. Figure 3.1 presents monthly mean stream line and tropical cyclone tracks in July.

Other maps of monthly mean stream lines at 850 hPa and 200 hPa, and high-cloud amounts for the months from April to December are included in the attached CD-ROM.

3.2 Tropical Cyclones in 2000

In 2000, 23 tropical cyclones of tropical storm (TS) intensity or higher were tracked in the area of responsibility of the RSMC Tokyo – Typhoon Center. The total number is smaller than the thirty-year-average of 27.8 for 1961-90. Thirteen cyclones out of them (57% of the total) reached typhoon (TY) intensity; the percentage is slightly larger than normal (54%). Three out of the remainder attained severe tropical storm (STS) intensity and seven of the rest remained at TS intensity (see Table 3.1).

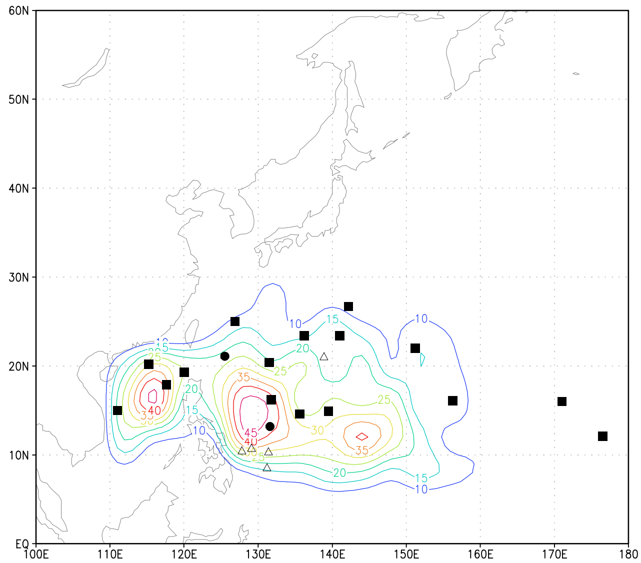


Figure 3.2 Genesis points of 23 tropical cyclones in 2000 (dots) and frequency distribution of the genesis points of tropical cyclones for 1951-2000 (contour), unit: number of TCs in each 4°x4° square.

The tropical cyclone season of this year began in early May, about one month and a half later than normal, with the development of Damrey. After the second cyclone formed near the Philippines in mid-May, tropical cyclone activity in the western North Pacific and the South China Sea was suppressed for more than one month. No tropical cyclone of TS intensity or higher was generated in June.

In July cyclogenesis became active and five storms formed in total within the month. Four of them took northward tracks along the western periphery of the sub-tropical high. Among the four Kirogi, Tembin and Bolaven passed by the Japanese Archipelago. Bolaven hit the southern edge of the Korean Peninsula and Kai-tak skirted the eastern coast of the central China.

From August to September tropical cyclone activity was normal. Six and five storms were generated in August and September, respectively. Among them Jelawat, Bilis and Maria made landfall on China, Kaemi and Wukong on the Indo-China Peninsula, and Prapiroon and Saomai on the Korean Peninsula during the period. These storms caused major damage to these regions. In particular Bilis, the most intense typhoon of this season, affected Taiwan seriously.

In late September cyclone activity was depressed again and no tropical cyclone of TS intensity or higher was tracked for almost one month until Yagi formed in late October. All the four tropical cyclones after Yagi became tropical storms east of the Philippines and three of them (Xangsane, Bebinca and Rumbia) made landfall on the Philippines in succession.

Other features of the tropical cyclone activity in 2000 were as follows:

- Tropical cyclones in 2000 tended to form in higher latitudes following a similar tendency in the last season. Nine storms (39%) out of the total of 23 formed in latitudes higher than 20°N in contrast with 24% in the normal year (see Figure 3.2);

- Movement of tropical cyclones was slower than normal particularly in waters of higher latitudes; and

- There were many tropical cyclones which moved persistently northward through their lives without recurving.

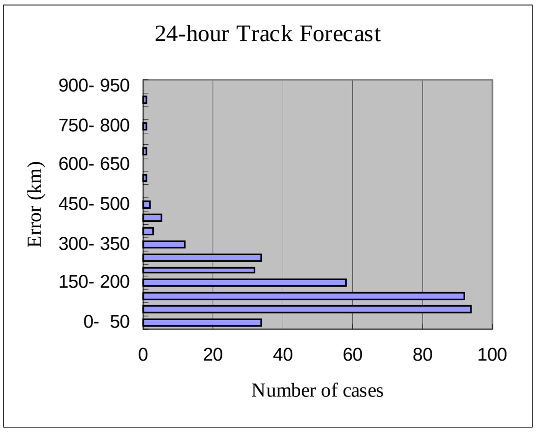
RSMC best track data for the tropical cyclones in 2000 and maps of their tracks are shown in Appendices 1 and 3, respectively. Appendix 4 indicates the monthly and annual frequency of tropical cyclones that attained TS intensity or higher in the western North Pacific and the South China Sea for 1951- 2000.

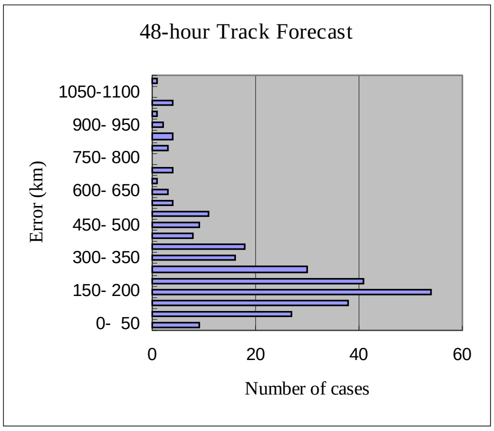
Table 3.1 List of the tropical cyclones which attained TS intensity or higher in 2000

Tropical Cyclone			Duration (UTC)					Minimum Pressure & Max. Wind				
								(UTC)	(N)	(E)	(hPa)	(kt)
TY	DAMREY	(0001)	070000	May	-	120600	May	091200	17.3	135.3	930	90
TS	LONGWANG	(0002)	190000	May	-	200000	May	191800	24.7	130.8	990	45
TY	KIROGI	(0003)	030600	Jul	-	081800	Jul	050000	20.8	131.9	940	85
TY	KAI-TAK	(0004)	051800	Jul	-	101200	Jul	070000	19.6	118.6	960	75
TS	TEMBIN	(0005)	190000	Jul	-	211200	Jul	191800	29.4	142,1	992	40
STS	BOLAVEN	(0006)	251800	Jul	-	302100	Jul	290600	29.1	128.7	980	50
TS	CHANCHU	(0007)	281800	Jul	-	291200	Jul	290000	13.0	176.4	996	35
TY	JELAWAT	(0008)	011200	Aug	-	101200	Aug	030000	23.6	145.5	940	85
TY	EWINIAR	(0009)	091800	Aug	-	180600	Aug	151800	36.1	150.8	975	65
TY	BILIS	(0010)	190600	Aug	-	230600	Aug	211800	20.3	125.1	920	110
TS	KAEMI	(0011)	211200	Aug	-	220600	Aug	220000	15.5	109.2	985	40
TY	PRAPIROON	(0012)	261800	Aug	-	010600	Sep	301200	29.8	123.2	965	70
TS	MARIA	(0013)	281200	Aug	-	010000	Sep	310000	20.2	116.1	985	40
TY	SAOMAI	(0014)	021200	Sep	-	160000	Sep	101200	24.3	132.4	925	95
TS	BOPHA	(0015)	061800	Sep	-	101800	Sep	091200	24.3	123.8	988	45
TY	WUKONG	(0016)	060000	Sep	-	100600	Sep	080600	18.8	113.4	955	75
STS	SONAMU	(0017)	150300	Sep	-	180000	Sep	170300	32.1	141.8	980	55
TY	SHANSHAN	(0018)	181200	Sep	-	241200	Sep	211200	22.9	165.6	925	95
TY	YAGI	(0019)	220000	Oct	-	262100	Oct	241800	24.1	125.5	965	70
TY	XANGSANE	(0020)	260600	Oct	-	010900	Nov	300600	16.7	118.8	960	75
STS	BEBINCA	(0021)	010000	Nov	-	061800	Nov	051200	18.5	116.8	980	60
TS	RUMBIA	(0022)	281200	Nov	-	301200	Nov	281800	8.5	130.8	990	40
TY	SOULIK	(0023)	300000	Dec	-	041200	Jan	031200	17.9	135.9	955	80

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 (%)
TY	DAMREY	(0001)	173	81	18	78	250	124	14	46	290	144	10	25
TS	LONGWANG	(0002)	134	-	1	-	-	-	0	-	-	-	0	-
TY	KIROGI	(0003)	144	74	19	70	206	80	15	37	214	92	11	22
TY	KAI-TAK	(0004)	171	127	16	63	491	324	12	67	589	265	8	52
TS	TEMBIN	(0005)	104	70	7	66	221	42	3	1017	-	-	-	-
STS	BOLAVEN	(0006)	131	56	17	78	225	113	13	55	299	130	9	47
TS	CHANCHU	(0007)	-	-	0	-	-	-	0	-	-	-	0	-
TY	JELAWAT	(0008)	82	31	33	70	143	41	29	45	203	62	25	39
TY	EWINIAR	(0009)	196	166	31	42	294	248	27	27	402	269	23	24
TY	BILIS	(0010)	103	34	13	71	188	96	9	90	309	79	5	76
TS	KAEMI	(0011)	-	-	0	-	-	-	0	-	-	-	0	-
TY	PRAPIROON	(0012)	145	64	19	46	222	50	15	30	399	155	11	34
TS	MARIA	(0013)	227	57	11	107	538	47	7	91	973	88	3	71
TY	SAOMAI	(0014)	162	158	48	66	339	293	44	67	437	414	40	57
TS	BOPHA	(0015)	142	97	13	50	449	288	9	55	1406	409	5	139
TY	WUKONG	(0016)	98	41	14	84	142	76	10	41	218	71	6	40
STS	SONAMU	(0017)	133	61	8	22	238	72	4	14	-	-	0	-
TY	SHANSHAN	(0018)	157	84	21	58	273	210	17	46	369	338	13	41
TY	YAGI	(0019)	194	99	16	94	419	185	11	80	742	177	7	81
TY	XANGSANE	(0020)	188	105	21	77	360	144	17	58	561	208	13	53
STS	BEBINCA	(0021)	142	76	20	84	220	100	16	53	276	82	12	33
TS	RUMBIA	(0022)	188	40	5	59	241	-	1	-	-	-	0	-
TY	SOULIK	(0023)	184	89	19	73	257	133	15	45	317	172	11	35
Annual Mean (Total)			153	107	370	64	282	212	288	50	404	330	212	43

Table 4.1 Mean position errors of 24-, 48- and 72- hour operational forecasts for each tropical cyclone in 2000





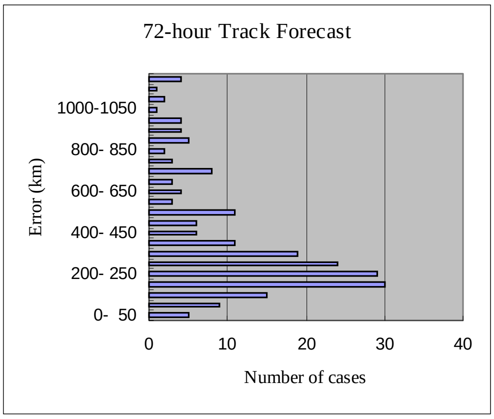


Figure 4.2 Position error distribution of 24-, 48- and 72-hour operational forecasts of tropical cyclones in 2000.

Table 4.3 presents mean hitting ratios and radii of 70% probability circles of operational forecasts for each tropical cyclone in 2000. The annual mean radius of 70% probability circles issued for 24-hour position forecasts was 187 km, and their hitting ratio was 72% (in 268 out of 370 cases, a tropical cyclone actually located within the issued probability circle). As for 48-hour forecasts, those are 327 km and 71% (in 204 out of 288 cases) respectively, and for 72-hour forecasts, 482 km and 73% (in 154 out of 212 cases) respectively. The hitting ratios for 24-hour and 48-hour forecasts were 16% and 12% higher respectively, while the one for 72-hour forecasts was the same, compared to the ratio in 1999.

Tropical Cyclone			24-hour Forecast			48-hour Forecast			72-hour Forecast		
			hitting cases / number of cases	Ratio (%)	Radius (km)	hitting cases / number of cases	Ratio (%)	Radius (km)	hitting cases / number of cases	Ratio (%)	Radius (km)
TY	DAMREY	(0001)	10/18	56	177	9/14	64	328	9/10	90	491
TS	LONGWANG	(0002)	1/1	100	241	-	-	-	-	-	-
TY	KIROGI	(0003)	14/19	74	191	15/15	100	373	11/11	100	539
TY	KAI-TAK	(0004)	11/16	69	175	5/12	42	332	5/8	63	510
TS	TEMBIN	(0005)	5/7	71	177	3/3	100	321	-	-	-
STS	BOLAVEN	(0006)	15/17	88	185	10/13	77	331	8/9	89	513
TS	CHANCHU	(0007)	-	-	-	-	-	-	-	-	-
TY	JELAWAT	(0008)	33/33	100	184	29/29	100	311	25/25	100	461
TY	EWINIAR	(0009)	20/31	65	189	21/27	78	319	16/23	70	492
TY	BILIS	(0010)	13/13	100	202	8/9	89	342	5/5	100	463
TS	KAEMI	(0011)	0/0	-	-	-	-	-	-	-	-
TY	PRAPIROON	(0012)	11/19	58	191	15/15	100	345	7/11	64	481
TS	MARIA	(0013)	3/11	27	184	0/7	0	323	0/3	0	463
TY	SAOMAI	(0014)	37/48	77	193	27/44	61	321	27/40	68	464
TS	BOPHA	(0015)	9/13	69	191	4/9	44	323	0/5	0	517
TY	WUKONG	(0016)	14/14	100	184	10/10	100	315	6/6	100	451
STS	SONAMU	(0017)	7/8	88	192	3/4	75	417	-	-	-
TY	SHANSHAN	(0018)	16/21	76	190	13/17	77	318	10/13	77	472
TY	YAGI	(0019)	8/16	50	185	4/11	36	327	0/7	0	463
TY	XANGSANE	(0020)	11/21	52	188	5/17	29	318	4/13	31	456
STS	BEBINCA	(0021)	16/20	80	186	12/16	75	327	12/12	100	502
TS	RUMBIA	(0022)	3/5	60	189	1/1	100	315	-	-	-
TY	SOULIK	(0023)	11/19	58	179	10/15	67	327	9/11	82	504
Annual Mean (Total)			268/370	72	187	204/288	71	327	154/212	73	482

Table 4.3 Mean hitting ratios(%) and radii (km) of 70% probability circles issued for 24-, 48- and 72-hour operational forecasts for each tropical cyclone in 2000

4.1.2 Central pressure and maximum wind speed

Figure 4.3 (left) presents the histogram of central pressure errors for 24-hour forecasts. The annual mean error was -1.2 hPa (-0.8 hPa in 1999) with a root mean square error (RMSE) of 13.0 hPa (9.3 hPa). The ratio of absolute errors smaller than 7.5 hPa was 54% (64%). The histogram of maximum wind speed errors for 24-hour forecasts is also shown in the right side of the Figure. The annual mean error was +0.8 m/s (+0.3 m/s in 1999) with a RMSE of 5.9 m/s (4.6 m/s). 54% (65%) of total forecasts had errors smaller than 3.75 m/s. The overall performance of intensity forecasts in 2000 was slightly worse than that in 1999. TY Bilis and TY Soulik, which made rapid development and weakening, were particularly difficult in their intensity forecasts.

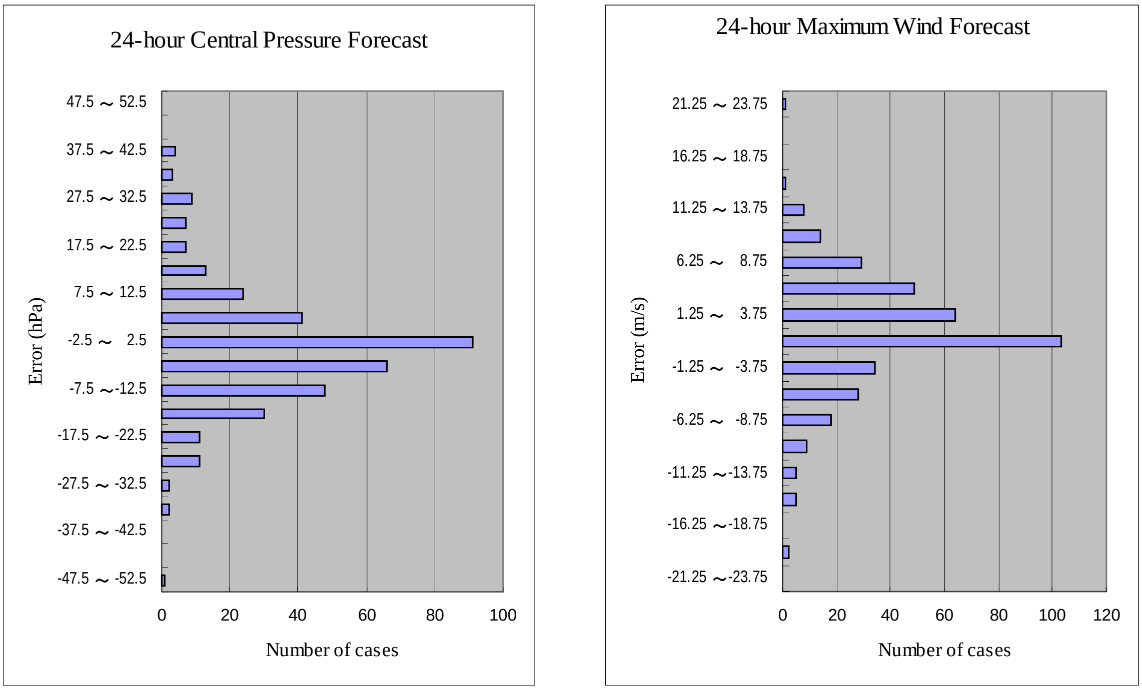


Figure 4.3 Error distribution of 24-hour central pressure (hPa) and maximum wind speed (m/s) forecasts of tropical cyclones in 2000.

4.2 TYM and GSM Predictions

JMA's Typhoon Model (TYM) and Global Spectral Model (GSM) provide primary information for forecasters at the RSMC Tokyo – Typhoon Center to make operational track and intensity forecasts. Track predictions by TYM and GSM up to 78 and 84 hour, respectively, were verified with the best track data and predictions by the persistency (PER) method. 24-hour, 48-hour and 72-hour intensity predictions by TYM and GSM were also verified with these data. The PER-method assumes that a tropical cyclone holds its intensity and movement throughout the forecast period 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 since 1996 are indicated in Figure 4.4. In 2000, a total of 224 predictions were made by TYM and errors for 30-hour*, 54-hour* and 78-hour* predictions in 2000 were 173 km, 313 km and 502 km, respectively. The performance of TYM track prediction in 2000 was almost the same as in 1999 for the forecast period for 30-hours, but worse from 42-hours to 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.

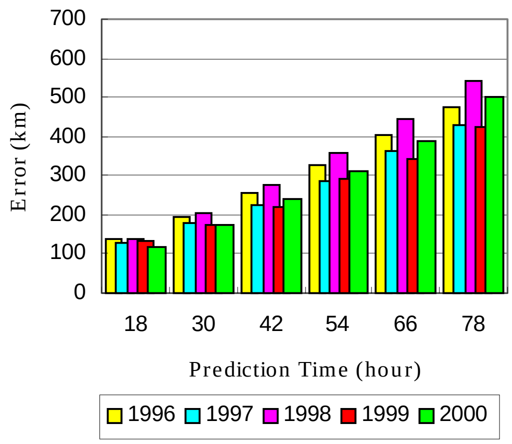


Figure 4.4 TYM annual mean position errors since 1996.

Note: 30-, 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.

Table 4.4 Mean position errors (km) of TYM for each tropical cyclone in 2000.

Tropical Cyclone		T=18		T=30		T=42		T=54		T=66		T=78	
TY	0001 DAMREY	158.3	(11)	231.0	(10)	293.7	(9)	348.4	(8)	393.4	(7)	403.6	(6)
TS	0002 LONGWANG	201.7	(1)	-	(-)	-	(-)	-	(-)	-	(-)	-	(-)
TY	0003 KIROGI	82.8	(10)	117.7	(9)	129.4	(8)	241.4	(7)	294.8	(6)	249.6	(5)
TY	0004 KAI-TAK	125.5	(12)	201.1	(11)	301.7	(10)	414.0	(9)	581.2	(8)	877.0	(7)
TS	0005 TEMBIN	111.8	(5)	105.4	(4)	181.6	(3)	208.8	(2)	271.6	(1)	-	(-)
STS	0006 BOLAVEN	103.9	(10)	132.6	(9)	167.3	(8)	208.4	(7)	250.4	(6)	344.5	(5)
TS	0007 CHANCHU	370.3	(3)	418.3	(2)	547.3	(1)	-	(-)	-	(-)	-	(-)
TY	0008 JELAWAT	57.9	(19)	90.8	(18)	139.4	(17)	193.0	(16)	251.4	(15)	308.9	(14)
TY	0009 EWINIAR	119.0	(19)	172.0	(18)	198.6	(17)	239.0	(16)	315.9	(15)	431.7	(14)
TY	0010 BILIS	82.8	(8)	79.0	(7)	109.4	(6)	200.9	(5)	213.1	(4)	343.4	(3)
TS	0011 KAEMI	181.1	(2)	216.9	(1)	-	(-)	-	(-)	-	(-)	-	(-)
TY	0012 PRAPIROON	111.5	(12)	147.6	(11)	185.9	(10)	286.7	(9)	383.2	(8)	476.2	(7)
TS	0013 MARIA	106.2	(8)	190.0	(7)	292.3	(6)	436.9	(4)	554.4	(3)	887.3	(2)
TY	0014 SAOMAI	140.5	(18)	268.1	(17)	420.1	(16)	570.5	(15)	719.7	(14)	850.3	(13)
TS	0015 BOPHA	115.3	(11)	156.6	(8)	270.9	(8)	403.3	(7)	504.9	(6)	779.9	(4)
TY	0016 WUKONG	84.7	(8)	143.7	(8)	163.1	(7)	193.3	(6)	232.2	(5)	369.7	(4)
STS	0017 SONAMU	118.4	(5)	192.5	(4)	253.0	(3)	190.7	(2)	325.7	(1)	-	(-)
TY	0018 SHANSHAN	104.4	(12)	140.5	(11)	178.9	(10)	240.7	(9)	276.8	(8)	411.2	(7)
TY	0019 YAGI	167.8	(10)	220.0	(6)	356.7	(6)	532.0	(6)	581.5	(5)	724.0	(4)
TY	0020 XANGSANE	112.0	(11)	174.6	(10)	264.1	(9)	351.8	(8)	461.0	(7)	623.2	(6)
STS	0021 BEBINCA	134.8	(12)	212.1	(11)	244.0	(10)	275.7	(9)	317.3	(8)	318.1	(7)
TS	0022 RUMBIA	108.6	(6)	203.3	(5)	287.2	(4)	313.9	(3)	275.9	(2)	221.1	(1)
TY	0023 SOULIK	128.0	(11)	194.6	(10)	274.0	(9)	255.0	(8)	267.3	(7)	338.5	(6)
	Annual Mean	118.2	(224)	173.2	(197)	238.9	(177)	313.3	(156)	389.2	(136)	501.6	(115)

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 30% for 18-hour, 40% for 30-hour, 45% for 42-hour and 50% for 54-hour to 78-hour predictions. Looking at the results of respective stages, improvement rates were relatively higher in "During" and "After" stages in which position errors were larger compared with "Before" stage.

Figure 4.5 (in the attached CD-ROM) presents histograms of the position errors of 30-, 54- and 78-hour predictions of TYM. The ratio of 24-hour prediction errors smaller than 150 km was 47% (46% in 1999), the ratio of 54-hour prediction errors smaller than 300 km was 61% (67%) and the ratio of 78-hour prediction errors smaller than 450 km was 57% (58%).

TIME	MODEL	Before		During		After		All	
(moving direction)		(180°-320°)		(320°-10°)		(10°-180°)		(0°-360°)	
T=18	TYM	110.2	(102)	124.0	(45)	125.3	(77)	118.2	(224)
	PER	140.3	(102)	179.3	(45)	190.2	(77)	165.3	(224)
	IMPROV	21.5 %		30.8 %		34.1 %		28.5 %	
T=30	TYM	167.6	(91)	160.7	(37)	187.3	(69)	173.2	(197)
	PER	246.0	(91)	306.4	(37)	337.8	(69)	289.5	(197)
	IMPROV	31.8 %		47.6 %		44.6 %		40.2 %	
T=42	TYM	222.2	(79)	226.5	(33)	265.7	(65)	238.9	(177)
	PER	355.5	(79)	428.2	(33)	553.2	(65)	441.7	(177)
	IMPROV	37.5 %		47.1 %		52.0 %		45.9 %	
T=54	TYM	301.1	(66)	306.8	(29)	329.7	(61)	313.3	(156)
	PER	503.8	(66)	581.1	(29)	771.0	(61)	622.7	(156)
	IMPROV	40.2 %		47.2 %		57.2 %		49.7 %	
T=66	TYM	370.5	(53)	415.5	(27)	394.3	(56)	389.2	(136)
	PER	600.6	(53)	774.6	(27)	1013.5	(56)	805.1	(136)
	IMPROV	38.3 %		46.4 %		61.1 %		51.7 %	
T=78	TYM	441.0	(41)	465.4	(24)	568.7	(50)	501.6	(115)
	PER	827.1	(41)	824.7	(24)	1212.7	(50)	994.2	(115)
	IMPROV	46.7 %		43.6 %		53.1 %		49.6 %	

Table 4.5 Mean position errors (km) of TYM and PER predictions for the tropical cyclones in 2000 in each stage of motion. Number of samples is given in parentheses

2) Central pressure and maximum wind speed

TYM has a certain plus bias in the central pressure prediction and that for 30-hour predictions in 2000 was +5.2 hPa with a root mean square error (RMSE) of 15.6 hPa. Meanwhile the bias for 30-hour maximum wind speed predictions was –1.4 m/s with a RMSE of 7.1 m/s. Figure 4.6 shows histograms of the errors of 30-hour central pressure and maximum wind speed predictions. About 52% of the central pressure predictions had errors with absolute values less than 7.5 hPa, while 44% of the maximum wind speed predictions with absolute values less than 3.75 m/s.

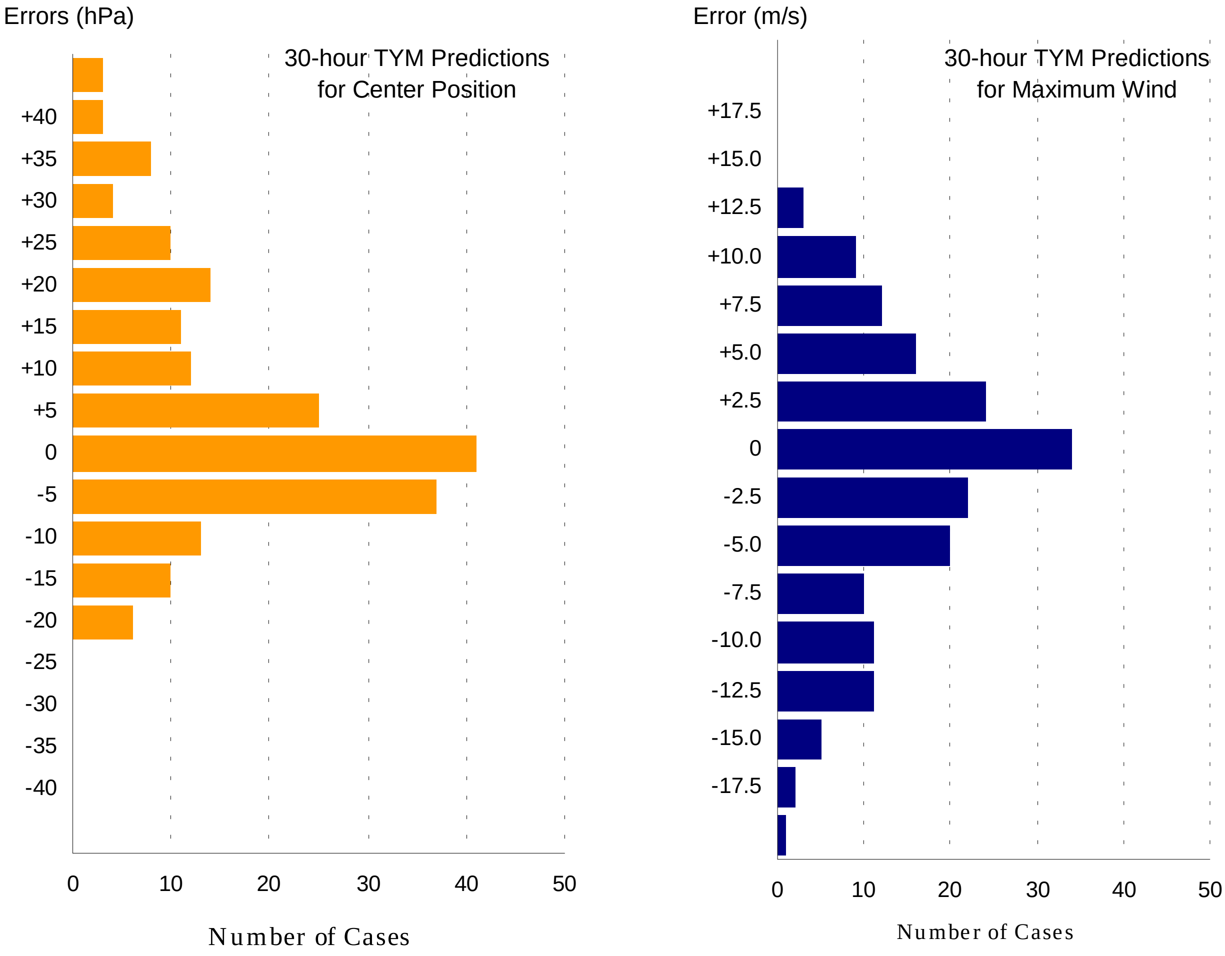


Figure 4.6 Error distribution of TYM 30-hour intensity predictions of tropical cyclones

4.2.2 GSM Prediction

1) Center position

GSM annual mean position errors since 1996 indicated in Figure 4.7 show that the overall performance of GSM track predictions in 2000 was the best in the years. The errors for 30-hour, 54-hour and 78-hour predictions were 165 km, 276 km and 402 km, respectively. Although prediction cases of GSM and TYM were not homogeneous, the errors of GSM were smaller than TYM particularly in later hours of forecast period. The improvement of the performance of GSM in 2000 owes to the recent version-up of GSM made in December 1999. The version-up included the incorporation of cloud water content as a prognostic variable, a modification of the prognostic Arakawa-Schubert cumulus parameterization, and the calculation of direct effect of aerosols on short-wave radiation.

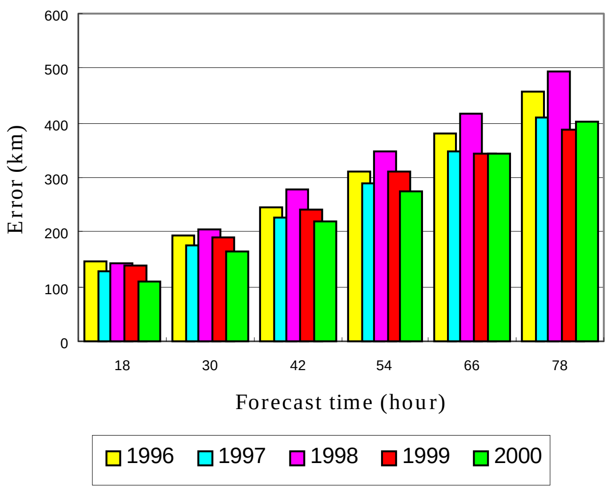


Figure 4.7 GSM annual mean position errors since 1996.

A total of 239 predictions was made by GSM in 2000 and mean position errors of the 18-, 30-, 42-, 54-, 66- and 78-hour predictions for each tropical cyclone are given in Table 4.6.

Table 4.7 gives GSM's relative performance compared to the PER-method. Improvement rates were roughly 35% for 18-hour, 45% for 30-hour, 55% for 42-hour, 55% to 60% for 54-, 66- and 78-hour predictions. The percentage is relatively high in “during” and “After” stage. The rates were about 5% to 10% higher than TYM in almost whole stages at each prediction time.

Tropical Cyclone		T=18		T=30		T=42		T=54		T=66		T=78	
TY	0001 DAMREY	129.8	(11)	202.8	(10)	228.5	(9)	250.9	(8)	263.2	(7)	273.0	(6)
TS	0002 LONGWANG	195.2	(1)	-	(-)	-	(-)	-	(-)	-	(-)	-	(-)
TY	0003 KIROGI	43.6	(10)	88.5	(9)	162.6	(8)	203.1	(7)	225.7	(6)	199.2	(5)
TY	0004 KAI-TAK	120.3	(13)	188.7	(12)	275.8	(11)	406.8	(10)	589.7	(9)	855.1	(8)
TS	0005 TEMBIN	97.2	(5)	96.5	(4)	156.4	(3)	208.7	(2)	425.5	(1)	-	(-)
STS	0006 BOLAVEN	97.1	(11)	146.6	(10)	225.3	(9)	314.1	(8)	413.3	(7)	301.5	(5)
TS	0007 CHANCHU	347.0	(2)	471.2	(1)	-	(-)	-	(-)	-	(-)	-	(-)
TY	0008 JELAWAT	63.4	(18)	102.7	(17)	139.8	(16)	141.7	(15)	161.4	(14)	178.2	(13)
TY	0009 EWINIAR	109.8	(20)	134.4	(19)	160.0	(18)	208.1	(17)	238.8	(16)	329.3	(15)
TY	0010 BILIS	100.9	(9)	126.5	(8)	138.7	(7)	193.5	(6)	254.1	(5)	295.1	(4)
TS	0011 KAEMI	144.3	(2)	100.6	(1)	-	(-)	-	(-)	-	(-)	-	(-)
TY	0012 PRAPIROON	133.0	(12)	173.1	(11)	181.6	(10)	218.8	(9)	239.8	(8)	276.7	(7)
TS	0013 MARIA	108.2	(8)	184.3	(7)	313.9	(6)	406.1	(4)	510.0	(2)	-	(-)
TY	0014 SAOMAI	101.0	(26)	167.1	(25)	263.0	(24)	394.2	(23)	502.2	(21)	556.2	(19)
TS	0015 BOPHA	117.1	(11)	141.3	(10)	215.2	(9)	300.3	(8)	367.7	(6)	606.3	(4)
TY	0016 WUKONG	78.0	(10)	117.4	(9)	147.0	(8)	203.0	(7)	287.3	(6)	446.5	(5)
STS	0017 SONAMU	140.3	(6)	185.2	(5)	133.9	(3)	185.1	(2)	311.8	(1)	-	(-)
TY	0018 SHANSHAN	101.8	(12)	177.2	(11)	248.5	(10)	282.2	(9)	298.2	(8)	332.5	(7)
TY	0019 YAGI	112.1	(10)	219.5	(9)	270.3	(7)	243.8	(5)	410.9	(5)	441.8	(3)
TY	0020 XANGSANE	127.8	(12)	209.5	(11)	265.4	(10)	286.7	(9)	355.8	(8)	406.4	(7)
STS	0021 BEBINCA	124.5	(12)	183.3	(11)	213.8	(10)	258.1	(9)	301.3	(8)	310.4	(7)
TS	0022 RUMBIA	126.6	(6)	245.7	(5)	376.1	(4)	455.4	(3)	484.4	(2)	562.9	(1)
TY	0023 SOULIK	172.4	(12)	242.5	(11)	274.0	(10)	305.7	(9)	383.4	(8)	515.2	(7)
	Annual Mean	111.3	(239)	165.4	(216)	218.3	(192)	275.8	(170)	342.1	(148)	401.8	(123)

Table 4.6 Mean position errors (km) of GSM for each tropical cyclone in 2000

TIME (moving direction)	MODEL	Before (180°-320°)	During (320°-10°)	After (10°-180°)	All (0°-360°)
T=18	GSM	103.9 (108)	108.7 (52)	123.2 (79)	111.3 (239)
	PER	150.5 (108)	205.5 (52)	183.2 (79)	173.3 (239)
	IMPROV	31.0 %	47.1 %	32.8 %	35.8 %
T=30	GSM	159.8 (96)	170.2 (46)	169.7 (74)	165.4 (216)
	PER	256.2 (96)	352.4 (46)	356.5 (74)	311.0 (216)
	IMPROV	37.6 %	51.7 %	52.4 %	46.8 %
T=42	GSM	201.1 (85)	214.6 (38)	241.6 (69)	218.3 (192)
	PER	387.2 (85)	534.8 (38)	532.1 (69)	468.5 (192)
	IMPROV	48.1 %	59.9 %	54.6 %	53.4 %
T=54	GSM	258.8 (76)	293.2 (33)	287.5 (61)	275.8 (170)
	PER	508.7 (76)	777.5 (33)	727.1 (61)	639.2 (170)
	IMPROV	49.1 %	62.3 %	60.5 %	56.9 %
T=66	GSM	308.8 (62)	374.6 (29)	361.8 (57)	342.1 (148)
	PER	648.2 (62)	890.1 (29)	961.2 (57)	816.1 (148)
	IMPROV	52.4 %	57.9 %	62.4 %	58.1 %
T=78	GSM	356.0 (48)	399.1 (27)	449.1 (48)	401.8 (123)
	PER	771.2 (48)	869.8 (27)	1272.9 (48)	988.7 (123)
	IMPROV	53.8 %	54.1 %	64.7 %	59.4 %

Table 4.7
Mean position errors (km) of GSM and PER predictions for the tropical cyclones in 2000 in each stage of motion

Figure 4.8 (in the attached 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 58% (43% in 1999), the ratio of 54-hour prediction errors smaller than 300 km was 70% (58%) and the ratio of 78-hour prediction errors smaller than 450 km was 72% (70%). The overall performance of track forecasts in 2000 was better than that in 1999 as already described in the first paragraph of this section.

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. About 45% of the predictions had absolute errors less than 7.5 hPa, while predictions with errors smaller than 3.75 m/s account for 30% of the total. The performance of intensity predictions in 2000 was considerably improved due to the version-up of GSM in December 1999. However, the histograms show that GSM still underestimates the intensity of tropical cyclones in its 30-hour predictions.

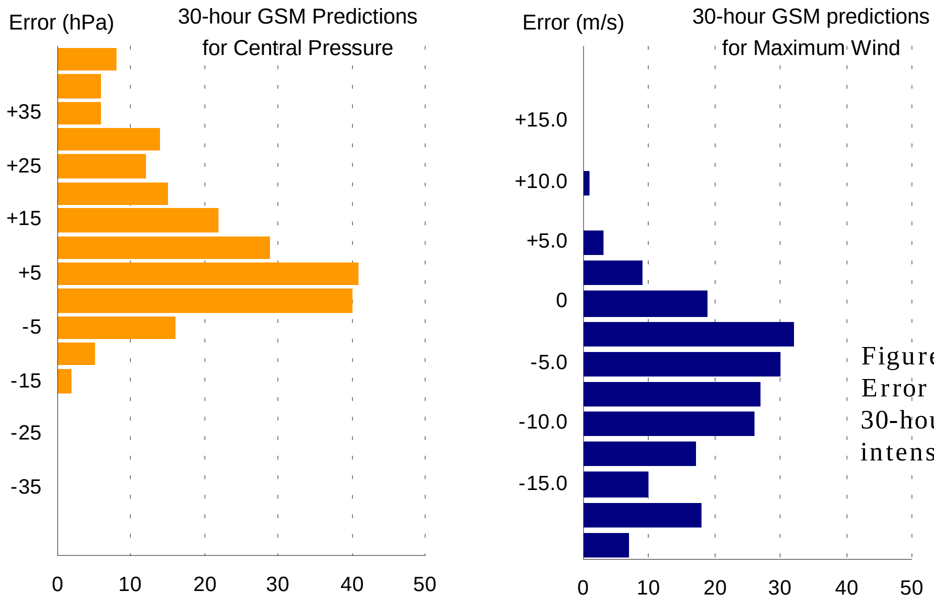


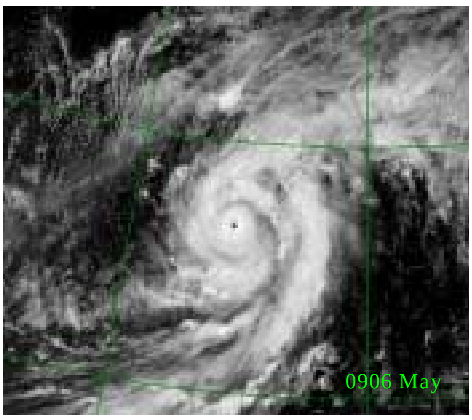
Figure 4.9
Error distribution of 30-hour GSM intensity predictions

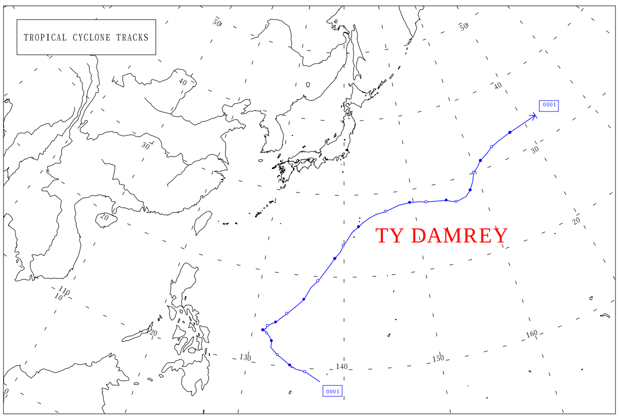
TY DAMREY (0001)

A tropical depression formed east-northeast of Palau Islands at 18UTC 4 May 2000. Moving northwestward, the depression attained TS intensity at 00UTC 7 May and was named Damrey, the first one from the new name list that became effective 1 January 2000 for tropical cyclones in the western North Pacific and the South China Sea. It then began to move northeastward east of the Philippines and developed into a typhoon on the following day. Accelerating gradually, Damrey reached peak intensity with maximum sustained winds of 90 knots at 06UTC 9 May. It further continued to move northeastward for a couple of days with gradual weakening and crossed around Ogasawara-shoto (islands) south of Japan around 12UTC 11 May. Turning to the east, it downgraded to a tropical storm at 06UTC on the following day and became an extra-tropical cyclone at 12UTC of the day.

TY DAMREY (0001)

Date/Time (UTC)	Center position Lat. (N)	Center position Lon. (E)	Central pressure (hPa)	Max. wind (kt)	Grade	Date/Time (UTC)	Center position Lat. (N)	Center position Lon. (E)	Central pressure (hPa)	Max. wind (kt)	Grade
May 04/18	8.8	137.5	1004	-	TD	May 11/06	25.3	141.0	970	65	TY
05/00	9.7	136.0	1004	-	TD	11/09	25.5	141.3	970	65	TY
05/06	9.9	135.0	1004	-	TD	11/12	26.0	142.0	975	60	STS
05/12	10.2	134.4	1004	-	TD	11/15	26.5	142.6	975	55	STS
05/18	10.7	133.7	1002	-	TD	11/18	27.0	143.5	980	55	STS
06/00	11.1	133.0	1000	-	TD	11/21	27.4	144.5	980	55	STS
06/06	11.8	132.2	1000	-	TD	12/00	27.7	145.9	985	50	STS
06/12	12.5	132.2	1000	-	TD	12/06	28.3	147.9	994	35	TS
06/18	13.0	131.8	996	-	TD	12/12	28.4	149.5	996	-	L
07/00	13.2	131.6	992	45	TS	12/18	28.3	150.8	996	-	L
07/06	13.5	131.2	985	55	STS	13/00	28.1	151.8	996	-	L
07/12	13.5	131.1	980	55	STS	13/06	27.9	153.4	996	-	L
07/18	13.7	131.4	975	60	STS	13/12	27.7	154.7	1000	-	L
08/00	14.0	131.5	970	65	TY	13/18	27.4	155.4	1004	-	L
08/06	14.3	132.0	965	70	TY	14/00	27.2	156.0	1004	-	L
08/12	14.5	132.4	960	75	TY	14/06	27.5	157.5	1004	-	L
08/18	15.1	133.0	955	75	TY	14/12	28.1	158.4	1004	-	L
09/00	15.6	133.5	945	80	TY	14/18	29.0	159.1	1004	-	L
09/06	16.4	134.4	935	90	TY	15/00	30.1	159.7	1004	-	L
09/12	17.3	135.3	930	90	TY	15/06	30.6	160.5	1004	-	L
09/18	18.7	136.0	930	90	TY	15/12	31.2	161.3	1004	-	L
10/00	19.5	136.8	935	85	TY	15/18	31.7	162.5	1004	-	L
10/06	20.8	137.8	945	80	TY	16/00	32.3	163.7	1004	-	L
10/12	22.2	138.8	955	75	TY	16/06	32.7	165.2	1004	-	L
10/18	23.0	139.5	960	75	TY	16/12	33.0	167.3	1004	-	L
11/00	23.7	139.9	965	70	TY	16/18	33.2	169.7	1008	-	L
11/03	24.5	140.5	970	65	TY	17/00	-	-	-	-	Dissip





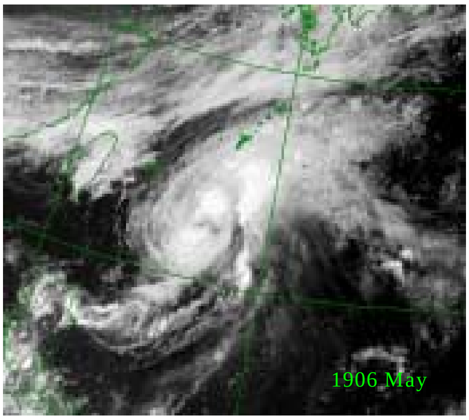
TS LONGWANG (0002)

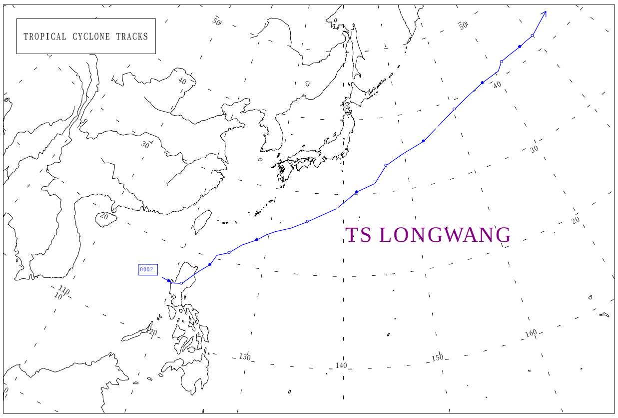
Longwang formed as a tropical depression in the South China Sea near the western coast of Luzon at 06UTC 17 May. It moved northeastward and became a tropical storm south of Japan at 00UTC 19 May. On the northeastward track, Longwang kept TS intensity until 06UTC 20 May, when it transformed into an extra-tropical cyclone south of Japan. The cyclone continued to move northeastward for further several days and crossed the International Date Line.

TS LONGWANG (0002)

17 May - 24 May

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
May 17/06	16.1	118.8	1002	-	TD	May 20/18	31.3	144.8	1000	-	L
17/12	16.0	119.6	1002	-	TD	21/00	33.5	146.8	1000	-	L
17/18	15.9	120.0	1002	-	TD	21/06	34.7	149.8	1000	-	L
1/800	16.2	121.1	1002	-	TD	21/12	35.8	153.6	1000	-	L
18/06	18.0	122.5	1000	-	TD	21/18	37.1	156.2	1000	-	L
18/12	19.2	123.6	1000	-	TD	22/00	38.8	160.3	1000	-	L
18/18	20.4	124.1	1000	-	TD	22/06	39.8	163.4	996	-	L
19/00	21.1	125.5	998	35	TS	22/12	40.6	167.0	994	-	L
19/06	22.3	126.8	994	40	TS	22/18	41.0	170.6	992	-	L
19/12	23.3	128.6	994	40	TS	23/00	41.9	172.1	992	-	L
19/15	24.1	129.7	992	40	TS	23/06	42.1	174.1	992	-	L
19/18	24.7	130.8	990	45	TS	23/12	42.2	176.7	992	-	L
19/21	25.4	132.8	992	40	TS	23/18	42.3	178.4	990	-	L
20/00	26.4	135.0	994	40	TS	24/00	42.3	179.9	992	-	L
20/06	28.2	139.0	996	-	L	24/06	43.0	182.5	992	-	Out
20/12	30.3	142.0	1000	-	L						



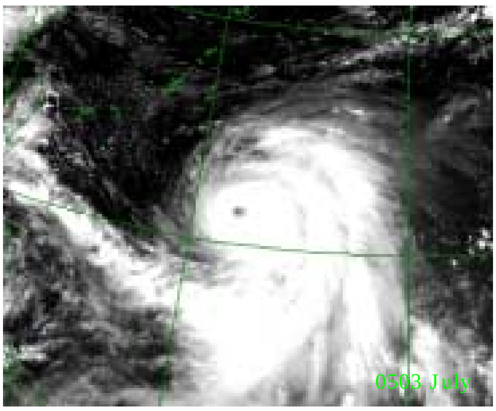


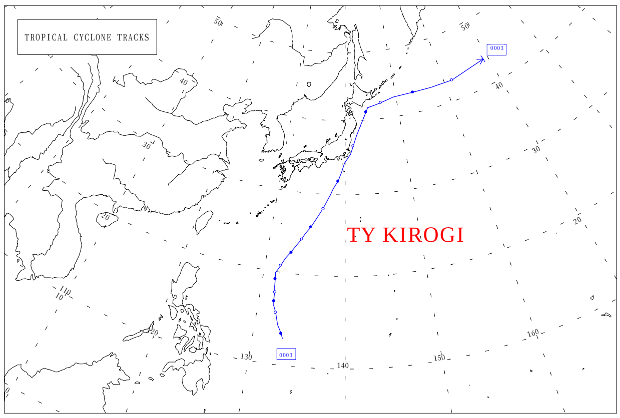
TY KIROGI (0003)

After one-month rest of tropical cyclone activity in June, a tropical depression formed east of the Philippines at 06UTC 2 July. Moving northward, it attained TS intensity at 06UTC 3 July and developed rapidly into a typhoon southwest of Okinotorishima at 18UTC of the day. Kirogi then changed its movement to the north-northeast and reached its peak with maximum sustained winds of 85 knots west of the island at 00UTC 5 July. On the north-northeastward track, it passed between small islands, south of Japan on the midnight of 8 July and approached the eastern coast of Japan. During the passage, a wind gust of 49.3 m/s was observed at Hachijo-jima (47678). Weakening to STS intensity, it moved along the eastern coast of Japan and turned to the east around 18UTC 9 July. Shortly after the turn it transformed into an extra-tropical cyclone.

TY KIROGI (0003)

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
02 Jul - 10 Jul						02 Jul - 10 Jul					
Jul 02/06	12.8	133.2	1002	-	TD	Jul 07/09	30.8	138.2	955	75	TY
02/12	13.3	133.0	1000	-	TD	07/12	31.8	138.9	955	75	TY
02/18	14.2	132.5	996	-	TD	07/15	33.0	139.4	955	75	TY
03/00	15.5	132.1	994	-	TD	07/18	34.2	139.9	955	75	TY
03/06	16.2	131.8	990	40	TS	07/21	35.4	140.9	960	70	TY
03/12	16.7	131.7	985	50	STS	08/00	36.5	141.3	970	60	STS
03/18	17.1	131.7	970	65	TY	08/03	38.0	142.0	975	55	STS
04/00	17.7	131.7	960	70	TY	08/06	39.2	142.7	975	55	STS
04/06	18.3	131.6	950	80	TY	08/09	40.4	143.4	980	50	STS
04/12	19.2	131.5	945	80	TY	08/12	41.2	143.9	985	50	STS
04/18	19.9	131.4	945	80	TY	08/15	41.8	144.3	985	50	STS
05/00	20.8	131.9	940	85	TY	08/18	41.9	144.7	985	50	STS
05/06	21.7	132.4	940	85	TY	08/21	42.1	145.7	986	-	L
05/12	22.5	133.0	940	85	TY	09/00	42.3	146.9	988	-	L
05/18	23.4	133.6	945	80	TY	09/06	42.9	149.5	992	-	L
06/00	24.2	134.2	950	80	TY	09/12	43.0	153.4	994	-	L
06/06	24.9	134.6	955	75	TY	09/18	43.0	157.1	996	-	L
06/12	25.8	135.3	955	75	TY	10/00	43.0	161.5	996	-	L
06/18	26.9	136.0	955	75	TY	10/06	43.5	165.2	998	-	L
07/00	28.2	136.8	955	75	TY	10/12	-	-	-	-	Dissip
07/06	29.9	137.7	955	75	TY						



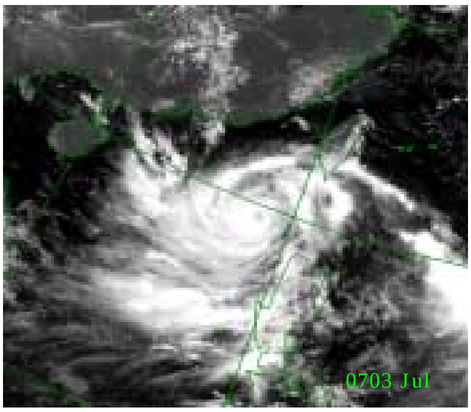


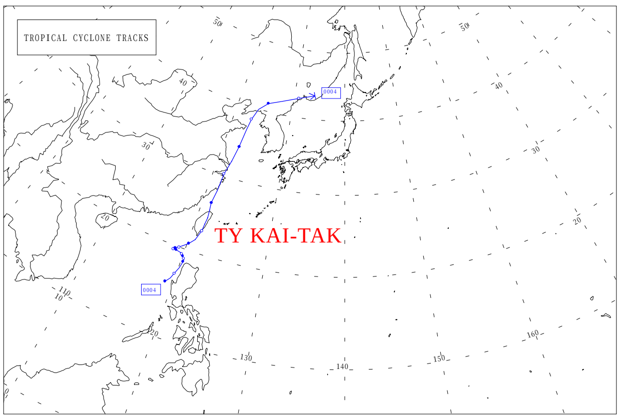
TY KAI-TAK (0004)

Kai-tak was the first typhoon developed in the South China Sea in this season. It formed as a tropical depression west of Luzon at 12UTC 3 July and initially took a northward track. It then slowed down northwest of Luzon and quickly developed to a tropical storm at 18UTC 5 July, to a typhoon at 12UTC 6 July. Kai-tak reached peak intensity at 00UTC 7 July and maximum sustained winds of 75 knots were estimated. Right after reaching its peak, it began to move northeastward and made landfall on the eastern part of Taiwan around 00UTC 9 July. During the passage it turned to the north with weakening and crossed the eastern tips of central China on the morning of 10 June. Later Kai-tak transformed into an extra-tropical cyclone in the northern part of the Yellow Sea at 18UTC 10 July.

TY KAI-TAK (0004)

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
03 Jul - 12 Jul						03 Jul - 12 Jul					
Jul 03/12	15.9	119.1	1000	-	TD	Jul 08/06	20.3	119.6	970	65	TY
03/18	16.4	119.5	996	-	TD	08/12	20.8	120.2	980	55	STS
04/00	17.0	119.8	996	-	TD	08/18	21.5	120.8	980	55	STS
04/06	17.8	120.1	994	-	TD	09/00	22.7	121.2	985	50	STS
04/12	18.6	120.3	996	-	TD	09/03	23.6	121.3	985	50	STS
04/18	18.9	120.3	994	-	TD	09/06	24.4	121.4	985	50	STS
05/00	19.0	120.2	994	-	TD	09/09	25.4	121.3	990	45	TS
05/06	19.1	120.1	994	-	TD	09/12	26.3	121.2	990	45	TS
05/12	19.2	120.0	994	-	TD	09/18	28.0	121.5	990	40	TS
05/18	19.3	120.0	992	40	TS	10/00	30.3	121.6	992	40	TS
06/00	19.4	119.8	985	50	STS	10/06	32.2	122.1	994	35	TS
06/06	19.5	119.6	975	60	STS	10/12	34.3	122.6	994	35	TS
06/12	19.6	119.0	970	65	TY	10/18	36.9	122.9	994	-	L
06/18	19.6	118.6	965	70	TY	11/00	38.4	123.2	994	-	L
07/00	19.6	118.6	960	75	TY	11/06	40.0	123.9	996	-	L
07/06	19.7	118.7	960	75	TY	11/12	41.2	125.4	996	-	L
07/12	19.8	118.8	960	75	TY	11/18	42.0	127.9	996	-	L
07/18	19.9	119.0	960	75	TY	12/00	42.8	130.9	996	-	L
08/00	20.0	119.2	965	70	TY	12/06	-	-	-	-	Dissip





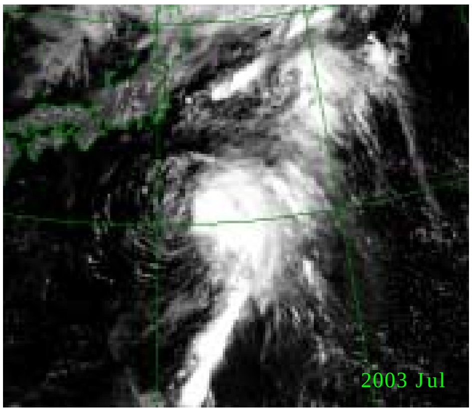
TS TEMBIN (0005)

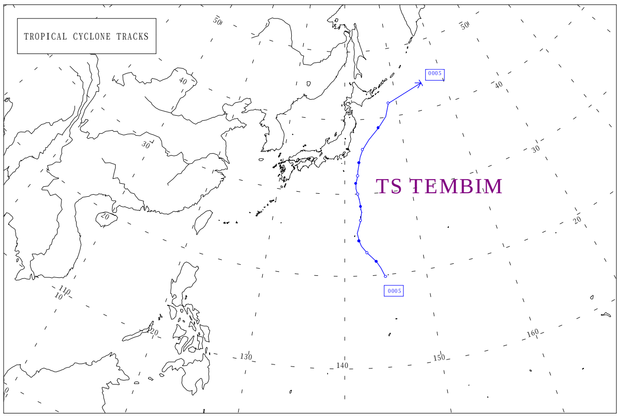
A tropical depression formed at 00UTC 17 July north of the Mariana Islands. Moving northwestward initially, then northward the depression became a tropical storm around Ogasawara-shoto at 00UTC 19 July. Keeping TS intensity, Tembin continued to move northward until it was downgraded into a tropical depression about 200 km southeast of Japan at 18UTC 21 July.

TS TEMBIM (0005)

17 Jul - 23 Jul

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
Jul 17/00	19.8	145.0	1006	-	TD	Jul 20/06	30.7	141.7	992	40	TS
17/06	20.8	144.5	1004	-	TD	20/12	31.4	141.7	992	40	TS
17/12	21.6	144.0	1004	-	TD	20/18	31.9	141.9	992	40	TS
17/18	22.2	143.4	1004	-	TD	21/00	32.4	142.0	994	35	TS
18/00	22.7	142.9	1004	-	TD	21/06	33.1	142.1	994	35	TS
18/06	23.5	142.2	1002	-	TD	21/12	34.1	142.3	994	35	TS
18/12	24.2	141.9	1000	-	TD	21/18	34.9	142.5	994	-	TD
18/18	25.1	141.7	1000	-	TD	22/00	35.9	143.0	996	-	TD
19/00	26.7	142.2	998	35	TS	22/06	37.2	144.2	996	-	TD
19/03	27.3	142.3	998	35	TS	22/12	38.7	146.0	996	-	TD
19/06	27.7	142.4	996	35	TS	22/18	40.2	147.6	998	-	TD
19/09	28.1	142.3	996	35	TS	23/00	42.0	148.4	1000	-	TD
19/12	28.4	142.3	996	35	TS	23/06	43.0	151.9	1000	-	TD
19/18	29.4	142.1	992	40	TS	23/12	-	-	-	-	Dissip

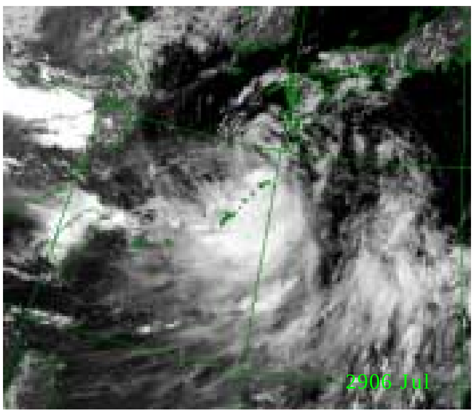


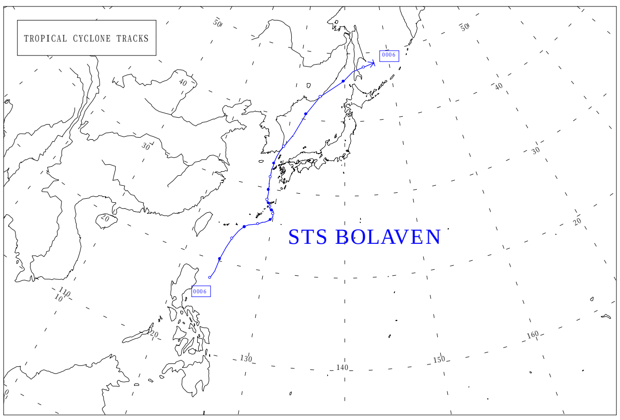


STS BOLAVEN (0006)

Bolaven formed as a tropical depression east of Luzon at 00UTC 24 July and moved north-northeastward. Turning to the east-northeast, it attained TS intensity around Okinawa at 18UTC 25 July. After passing south of Okinawa on the morning of 26 June, the storm made an anti-clockwise turn keeping TS intensity over waters east of Okinawa from 26 to 28 July. Decreasing its translation velocity, it developed into a severe tropical storm at 06UTC 29 July. As Bolaven moved northward further southwest of Japan, it weakened to a tropical depression at the southern tip of the Korean Peninsula at 00UTC 31 July, and transformed into an extra-tropical cyclone shortly.

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
STS BOLAVEN (0006)											
24 Jul - 02 Aug						24 Jul - 02 Aug					
Jul 24/00	17.9	123.9	1000	-	TD	Jul 28/15	28.2	128.9	985	45	TS
24/06	18.8	124.2	1000	-	TD	28/18	28.3	128.8	985	45	TS
24/12	20.3	124.4	1000	-	TD	28/21	28.4	128.7	985	45	TS
24/18	21.8	124.8	998	-	TD	29/00	28.6	128.7	985	45	TS
25/00	23.0	125.2	998	-	TD	29/03	28.8	128.7	985	45	TS
2/506	24.0	125.8	996	-	TD	29/06	29.1	128.7	980	50	STS
25/12	24.7	126.4	994	-	TD	29/09	29.5	128.7	980	50	STS
25/18	25.0	126.9	992	35	TS	29/12	29.9	128.6	985	45	TS
26/00	25.4	128.1	990	40	TS	29/15	30.3	128.6	985	45	TS
26/03	25.7	128.6	990	40	TS	29/18	30.7	128.5	985	45	TS
26/06	25.8	129.0	985	40	TS	29/21	31.1	128.5	985	45	TS
26/09	26.0	129.4	985	40	TS	30/00	31.6	128.5	985	45	TS
26/12	26.2	129.7	985	45	TS	30/03	32.1	128.5	985	40	TS
26/15	26.6	129.9	985	45	TS	30/06	32.6	128.5	985	40	TS
26/18	26.8	129.9	985	45	TS	30/09	33.0	128.6	985	40	TS
26/21	26.9	129.9	985	45	TS	30/12	33.4	128.6	985	40	TS
27/00	27.0	129.9	985	45	TS	30/15	33.8	128.7	990	40	TS
27/03	27.2	129.9	985	45	TS	30/18	34.4	128.9	988	40	TS
27/06	27.3	129.8	985	45	TS	30/21	35.2	129.2	990	35	TS
27/09	27.4	129.7	985	45	TS	31/00	35.9	129.7	992	-	TD
27/12	27.4	129.6	985	45	TS	31/06	37.7	131.0	994	-	L
27/15	27.4	129.5	985	45	TS	31/12	40.8	132.7	996	-	L
27/18	27.5	129.4	985	45	TS	31/18	42.2	133.9	998	-	L
27/21	27.6	129.3	985	45	TS	Aug 01/00	43.5	135.1	1000	-	L
28/00	27.8	129.3	985	45	TS	01/06	44.7	137.3	1004	-	L
28/03	28.0	129.2	985	45	TS	01/12	45.9	139.7	1006	-	L
28/06	28.1	129.1	985	45	TS	01/18	47.3	141.8	1006	-	L
28/09	28.2	129.1	985	45	TS	02/00	47.9	144.2	1010	-	L
28/12	28.2	129.0	985	45	TS	02/06	-	-	-	-	Dissip

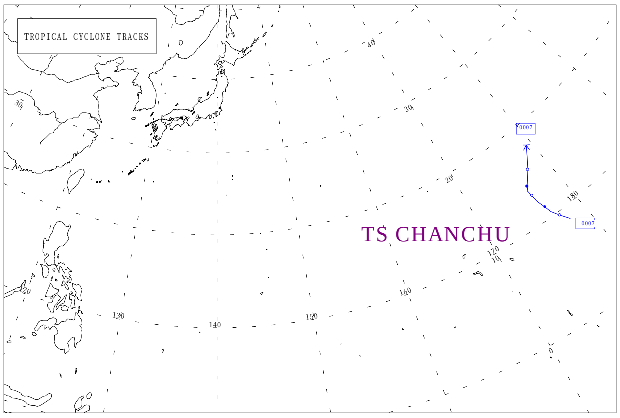




TS CHANCHU (0007)

Chanchu was a short-lived system, which formed as a tropical depression east of the Marshall Islands at 18UTC 27 July. The depression moved to the north-northwest and became a tropical storm east of the Islands at 18UTC 28 July. After moving northward with TS intensity for one day, it weakened to a tropical depression east of Wake Island at 18UTC 29 July.

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 CHANCHU (0007)											
27 Jul - 30 Jul						27 Jul - 30 Jul					
Jul 27/18	8.8	178.1	1004	-	TD	Jul 29/06	13.6	176.3	998	35	TS
28/00	9.7	177.5	1004	-	TD	29/12	14.1	176.6	1000	35	TS
28/06	10.5	177.0	1004	-	TD	29/18	14.7	177.1	1002	-	TD
28/12	11.2	176.8	1004	-	TD	30/00	15.5	177.8	1004	-	TD
28/18	12.1	176.5	998	35	TS	30/06	16.6	178.6	1008	-	TD
29/00	13.0	176.4	996	35	TS	30/12	-	-	-	-	Dissip



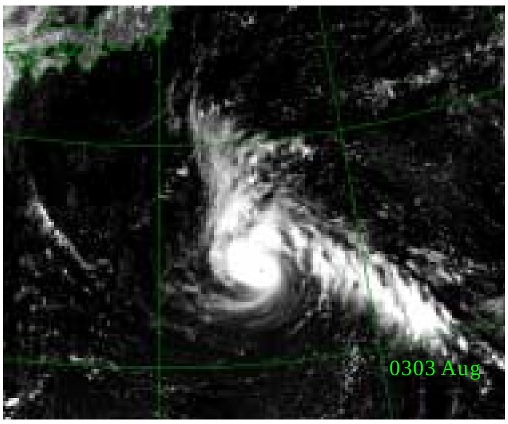
TY JELAWAT (0008)

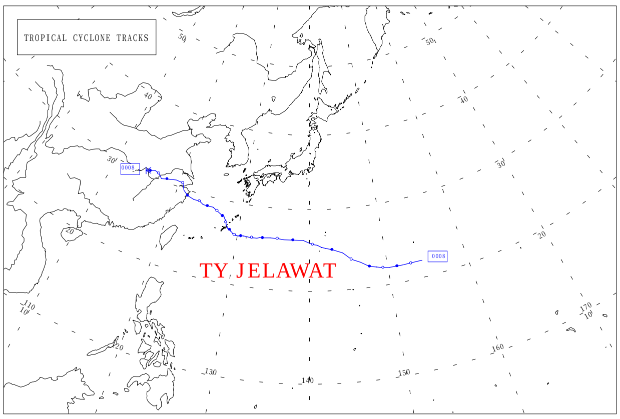
A tropical depression formed south of Marcus Island at 18UTC 31 July. Moving westward, the depression developed rapidly and became a tropical storm at 12UTC 1 August and a typhoon at 00UTC of the following day. On the west-northwestward track Jelawat reached peak intensity with maximum sustained winds of 85 knots north of the Mariana Islands at 00UTC 3 August. It kept TY intensity for several days moving westward and passed near Minamidaito-jima (47945) around 06UTC 6 August. Jerawat then turned to the northwest and passed near Okinawa on the early morning of 8 August. A wind gust of 61.5 m/s was observed at Minamidaito-jima during the passage. As JELAWAT entered the East China Sea, it weakened gradually and was downgraded to a severe tropical storm near the central coast of China at 06UTC 10 August. Shortly from the downgrade it made landfall on the coast and further weakened to a tropical depression at 18UTC of the day.

TY JELAWAT (0008)

31 Jul - 12 Aug

Date/Time (UTC)	Center position Lat. (N)	Center position Lon. (E)	Central pressure (hPa)	Max. wind (kt)	Grade
Jul 31/18	22.0	154.4	1008	-	TD
Aug 01/00	22.0	153.0	1004	-	TD
01/06	22.0	152.0	1000	-	TD
01/12	22.0	151.2	996	35	TS
01/18	22.0	150.2	985	45	TS
02/00	22.1	149.4	970	65	TY
02/06	22.3	148.6	960	75	TY
02/12	22.5	147.7	955	75	TY
02/18	23.1	146.6	945	80	TY
03/00	23.6	145.5	940	85	TY
03/06	24.4	144.4	940	85	TY
03/12	24.9	143.0	940	85	TY
03/15	25.1	142.2	940	85	TY
03/18	25.2	141.6	945	85	TY
03/21	25.5	141.0	945	85	TY
04/00	25.6	140.4	950	80	TY
04/06	26.1	139.1	950	80	TY
04/12	26.1	137.7	950	80	TY
04/18	26.1	136.4	950	80	TY
05/00	26.2	135.5	950	80	TY
05/06	26.2	134.5	950	80	TY
05/12	26.1	133.5	955	80	TY
05/15	26.1	133.1	955	80	TY
05/18	26.0	132.7	955	80	TY
05/21	26.0	132.3	955	80	TY
06/00	26.0	132.0	960	80	TY
06/03	26.0	131.6	960	80	TY
06/06	26.0	131.1	960	80	TY
06/09	26.0	130.8	960	80	TY
06/12	26.0	130.5	960	80	TY
06/15	25.9	130.2	960	80	TY
06/18	25.9	129.9	960	80	TY
Aug 06/21	25.9	129.7	960	80	TY
07/00	26.0	129.6	960	80	TY
07/03	26.0	129.4	960	80	TY
07/06	26.2	129.2	960	80	TY
07/09	26.3	129.0	960	80	TY
07/12	26.5	128.8	965	75	TY
07/15	26.6	128.5	965	75	TY
07/18	26.8	128.4	965	75	TY
07/21	27.0	128.2	965	75	TY
08/00	27.3	128.1	965	75	TY
08/03	27.6	127.9	965	75	TY
08/06	27.8	127.7	965	75	TY
08/09	28.0	127.6	965	75	TY
08/12	28.0	127.4	965	75	TY
08/18	28.2	127.0	965	70	TY
09/00	28.5	126.5	965	70	TY
09/06	28.8	125.8	965	70	TY
09/12	28.8	125.0	970	70	TY
09/18	28.8	124.3	970	70	TY
10/00	29.1	123.7	970	65	TY
10/06	29.1	122.8	980	50	STS
10/12	29.3	121.8	985	40	TS
10/18	29.8	121.0	994	-	TD
11/00	30.7	120.5	998	-	TD
11/06	30.7	119.4	998	-	TD
11/12	30.4	118.1	1000	-	TD
11/18	30.2	117.3	1000	-	TD
12/00	30.7	116.6	1002	-	TD
12/06	30.8	115.9	1002	-	TD
12/12	30.6	115.3	1002	-	TD
12/18	-	-	-	-	Dissip



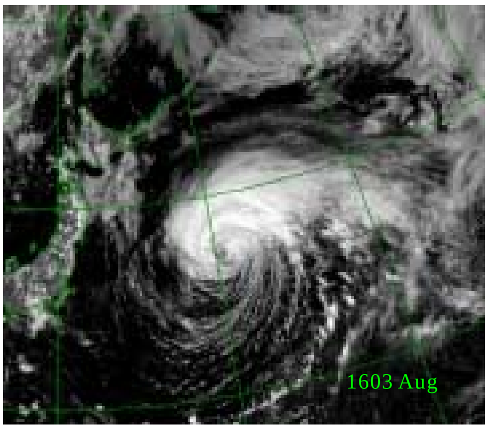


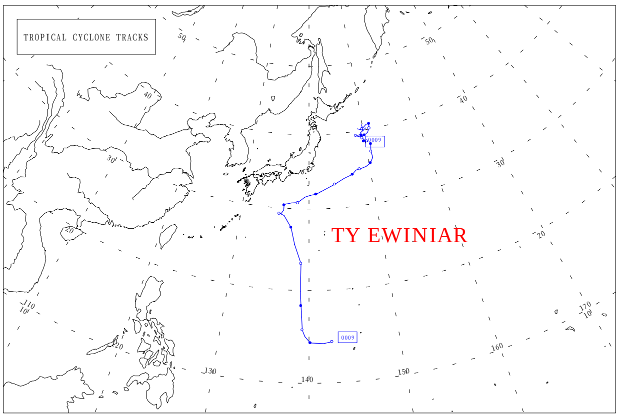
TY EWINIAR (0009)

A tropical depression formed west of Guam Island at 00UTC 9 August. It moved westward initially, then northward and became a tropical storm over the same waters at 18UTC of the day. Accelerating to the north, the storm attained STS intensity southwest of Ogasawara-shoto at 06UTC 11 August. Ewiniar slowed down south of Japan and began moving to the east-northeast around 12UTC 12 August. The storm continued to move east-northeastward over the next three days keeping STS intensity until 18UTC 15 August when it intensified into a typhoon east of Japan. Maximum sustained winds of 65 knots were estimated at the time. As it turned to the north, it lost tropical characteristics gradually and became an extra-tropical cyclone at 12UTC 18 August.

TY EWINIAR (0009)

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
	09 Aug - 21 Aug						09 Aug - 21 Aug				
Aug 09/00	14.3	142.5	1002	-	TD	Aug 14/18	34.7	147.7	980	55	STS
09/06	14.1	141.6	998	-	TD	15/00	34.8	148.3	980	55	STS
09/12	14.2	140.1	996	-	TD	15/06	35.0	149.4	975	60	STS
09/18	14.9	139.5	994	35	TS	15/12	35.4	150.2	975	60	STS
10/00	15.6	139.2	992	40	TS	15/18	36.1	150.8	975	65	TY
10/06	17.0	139.1	992	40	TS	16/00	36.9	150.7	975	65	TY
10/12	18.3	139.0	992	40	TS	16/06	37.3	150.7	975	65	TY
10/18	19.9	138.9	992	40	TS	16/12	38.0	150.9	980	60	STS
11/00	23.2	138.9	990	45	TS	16/18	38.3	150.7	980	55	STS
11/06	25.5	138.0	985	50	STS	17/00	38.4	150.3	985	50	STS
11/12	27.6	137.4	980	55	STS	17/06	38.6	149.9	985	50	STS
11/18	29.1	136.3	980	55	STS	17/12	38.5	149.7	990	45	TS
12/00	29.3	135.6	980	55	STS	17/18	38.5	150.0	992	45	TS
12/06	29.3	135.9	985	50	STS	18/00	39.0	149.6	994	45	TS
12/09	29.8	136.2	985	50	STS	18/06	39.2	149.7	994	45	TS
12/12	30.4	136.2	985	50	STS	18/12	39.4	149.5	994	-	L
12/15	30.6	136.5	985	50	STS	18/18	39.5	149.1	994	-	L
12/18	30.6	136.7	985	50	STS	19/00	39.4	148.5	996	-	L
12/21	30.7	137.3	985	50	STS	19/06	39.2	149.1	996	-	L
13/00	30.8	138.2	985	50	STS	19/12	39.3	150.0	998	-	L
13/03	31.1	138.7	985	50	STS	19/18	39.6	150.7	1000	-	L
13/06	31.5	139.3	985	50	STS	20/00	40.2	151.1	1000	-	L
13/09	31.8	140.2	985	50	STS	20/06	40.6	151.2	1002	-	L
13/12	31.9	141.0	985	50	STS	20/12	40.8	151.2	1004	-	L
13/15	32.2	141.8	985	50	STS	20/18	40.8	150.7	1004	-	L
13/18	32.5	142.5	985	50	STS	21/00	40.2	149.8	1008	-	L
14/00	33.1	144.0	985	50	STS	21/06	40.1	149.9	1008	-	L
14/06	33.8	145.6	985	50	STS	21/12	-	-	-	-	Dissip



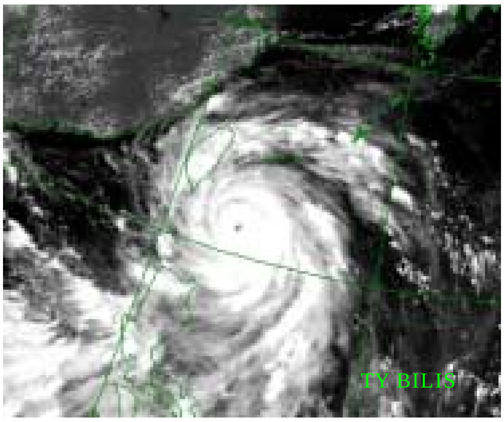


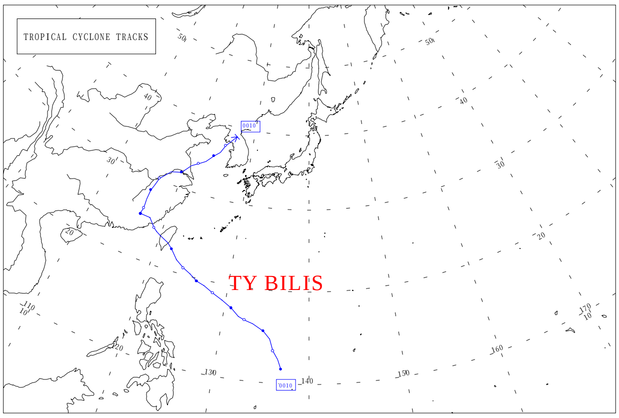
TY BILIS (0010)

Bilis was the most intense tropical cyclone of this season, which was generated as a tropical depression northwest of Yap Island at 12UTC 18 August. It took a northwestward track in its almost whole life until making landfall on southern China. Developing gradually on the northwestward track east of the Philippines, Bilis attained TS intensity at 06UTC 19 August, TY intensity at 12UTC 20 August and reached its peak with maximum sustained winds of 110 knots northeast of Luzon at 18UTC 21 August. With TY intensity Bilis made landfall on Taiwan around midnight of 23 August. After the landfall it weakened rapidly and landed on the southeast coast of China before the noon of the day. As it moved to inland of China, it further weakened to a tropical storm at 06UTC 23 August and to a tropical depression shortly.

TY BILIS (0010)

Date/Time (UTC)	Center position Lat. (N)	Center position Lon. (E)	Central pressure (hPa)	Max. wind (kt)	Grade	Date/Time (UTC)	Center position Lat. (N)	Center position Lon. (E)	Central pressure (hPa)	Max. wind (kt)	Grade
18 Aug - 27 Aug						18 Aug - 27 Aug					
Aug 18/12	11.5	137.0	1004	-	TD	Aug 23/00	24.2	118.9	970	65	TY
18/18	12.5	136.6	1002	-	TD	23/06	25.2	117.9	985	45	TS
19/00	13.4	136.0	1000	-	TD	23/12	25.2	116.5	994	-	TD
19/06	14.6	135.6	996	35	TS	23/18	25.4	116.5	996	-	TD
19/12	15.4	134.8	992	45	TS	24/00	26.0	116.6	998	-	TD
19/18	16.1	133.5	985	50	STS	24/06	27.2	116.5	998	-	TD
20/00	16.4	132.5	980	50	STS	24/12	28.4	116.5	998	-	TD
20/06	16.7	131.8	975	55	STS	24/18	29.1	116.7	1000	-	TD
20/12	17.5	130.8	960	70	TY	25/00	30.2	117.0	1000	-	TD
20/18	18.2	129.6	945	80	TY	25/06	31.6	118.3	1000	-	TD
21/00	18.8	128.3	935	90	TY	25/12	32.0	119.8	1000	-	TD
21/06	19.4	127.1	930	90	TY	25/18	33.3	120.9	1000	-	L
21/12	19.7	126.1	920	100	TY	26/00	33.8	121.9	1000	-	L
21/18	20.3	125.1	920	110	TY	26/06	34.4	122.9	1002	-	L
22/00	20.8	124.1	920	110	TY	26/12	35.4	123.9	1004	-	L
22/06	21.5	123.0	920	110	TY	26/18	36.1	124.8	1004	-	L
22/12	22.5	122.0	920	110	TY	27/00	37.2	125.4	1004	-	L
22/15	23.1	121.3	930	100	TY	27/06	38.0	126.2	1006	-	L
22/18	23.6	120.0	950	90	TY	27/12	-	-	-	-	Dissip

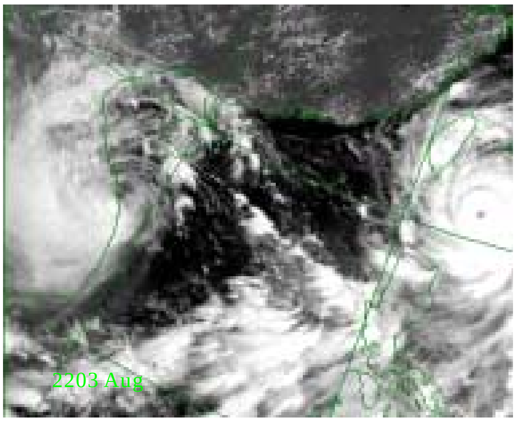


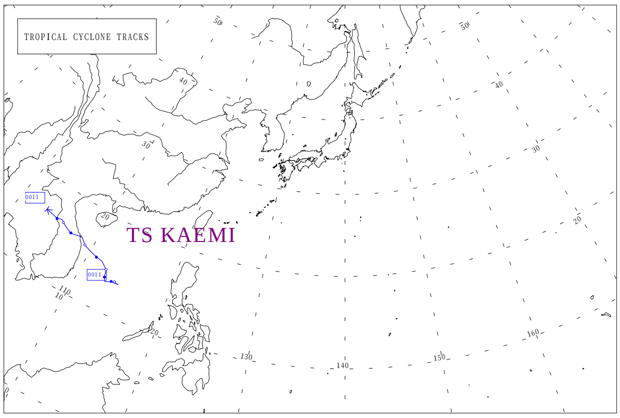


TS KAEMI (0011)

Kaemi was a very short-lived system, formed as a tropical depression in the South China Sea at 12UTC 19 August. Moving westward initially, then northwestward the depression reached TS intensity about 200 km east of Viet Nam at 12UTC 21 August. On the northwestward track, Kaemi made landfall on the central coast of Viet Nam around 06UTC 22 August. After the landfall, it weakened to a tropical depression at 12UTC 22 August.

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 KAEMI (0011)											
19 Aug - 23 Aug						19 Aug - 23 Aug					
Aug 19/12	13.4	113.7	1000	-	TD	Aug 22/00	15.5	109.2	985	40	TS
19/18	13.4	114.5	998	-	TD	22/06	16.1	108.4	985	35	TS
20/00	13.5	114.0	996	-	TD	22/12	15.8	107.1	992	-	TD
20/06	13.1	113.0	996	-	TD	22/18	16.0	106.4	994	-	TD
20/12	13.5	112.8	996	-	TD	23/00	16.3	105.8	996	-	TD
20/18	13.6	112.7	996	-	TD	23/06	16.5	105.4	998	-	TD
21/00	14.3	112.6	994	-	TD	23/12	16.3	104.9	998	-	TD
21/06	14.9	111.7	992	-	TD	23/18	16.4	104.1	1000	-	TD
21/12	15.0	111.0	985	40	TS	24/00	-	-	-	-	Dissip
21/18	15.2	110.1	985	40	TS						





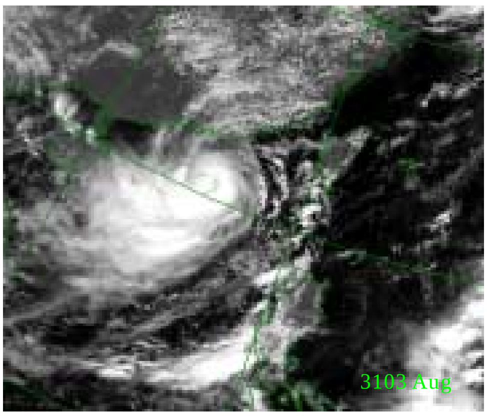
TY PRAPIROON (0012)

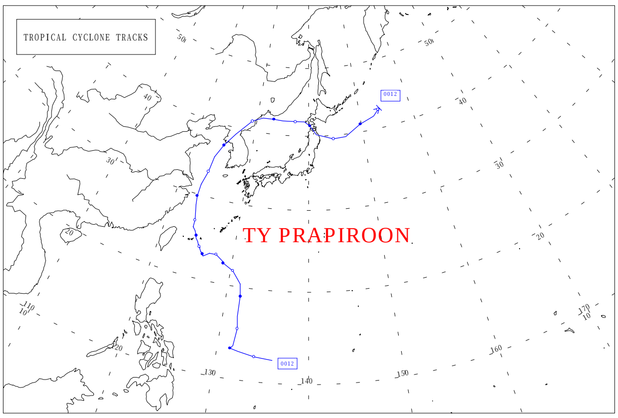
A tropical depression, which formed northwest of Yap Island at 18UTC 24 August, moved westward initially and turned to the north. It became a tropical storm west of Okinotorishima at 18UTC 26 August turning to the northwest. After Prapiroon attained STS intensity at 18UTC 27 August on the northwestward track, it drifted to the west until 12UTC 28 August when it began to move northward. On the accelerating northward track, the storm passed around Okinawa on the evening of 29 August. A wind gust of 36.6 m/s was observed at Miyako-jima (47927). In the East China Sea the cyclone developed to a typhoon at 06UTC 30 August, reached peak intensity at 12UTC of the day and maximum sustained winds of 70 knots were estimated. After crossing the Yellow Sea, Prapiroon hit the northern part of the Korean Peninsula with STS intensity on the night of 31 August. It then weakened gradually and transformed into an extra-tropical cyclone at 12UTC 1 September.

TY PRAPIROON (0012)

24 Aug - 04 Sep

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
Aug 24/18	12.4	136.0	1002	-	TD	Aug 29/15	25.5	124.3	975	55	STS
25/00	12.6	134.1	1002	-	TD	29/18	25.9	123.9	975	55	STS
25/06	13.0	132.3	1002	-	TD	30/00	26.8	123.9	970	60	STS
25/12	13.2	131.4	1002	-	TD	30/06	28.7	123.4	970	65	TY
25/18	13.5	131.7	1000	-	TD	30/12	29.8	123.2	965	70	TY
26/00	15.4	131.9	998	-	TD	30/18	31.4	123.3	965	70	TY
26/06	16.7	131.7	996	-	TD	31/00	33.3	123.8	965	70	TY
26/12	19.0	131.7	996	-	TD	31/06	35.4	124.1	965	70	TY
26/18	20.4	131.5	992	35	TS	31/12	37.3	125.1	975	60	STS
27/00	21.8	130.3	992	40	TS	31/18	39.2	126.7	980	55	STS
27/06	22.5	128.9	990	40	TS	Sep 01/00	41.5	129.2	985	50	STS
27/12	22.5	128.9	990	40	TS	01/06	42.2	131.1	990	45	TS
27/18	22.6	128.9	985	50	STS	01/12	42.2	133.2	990	-	L
28/00	23.3	127.8	985	50	STS	01/18	42.1	135.0	992	-	L
28/03	23.3	126.9	985	50	STS	02/00	42.1	137.4	992	-	L
28/06	22.8	126.2	985	50	STS	02/06	42.1	139.2	990	-	L
28/09	22.8	126.1	980	55	STS	02/12	41.5	140.2	992	-	L
28/12	23.0	126.0	980	55	STS	02/18	40.3	141.4	994	-	L
28/15	23.2	125.8	980	55	STS	03/00	39.6	144.5	996	-	L
28/18	23.6	125.5	980	55	STS	03/06	39.7	146.8	996	-	L
28/21	23.7	125.5	975	60	STS	03/12	41.2	149.8	996	-	L
29/00	23.8	125.4	975	60	STS	03/18	41.9	152.6	996	-	L
29/03	24.0	125.2	975	60	STS	04/00	42.7	153.7	1000	-	L
29/06	24.3	125.0	975	55	STS	04/06	42.8	153.9	1000	-	L
2/909	24.7	124.7	975	55	STS	04/12	-	-	-	-	Dissip
29/12	25.0	124.6	975	55	STS						



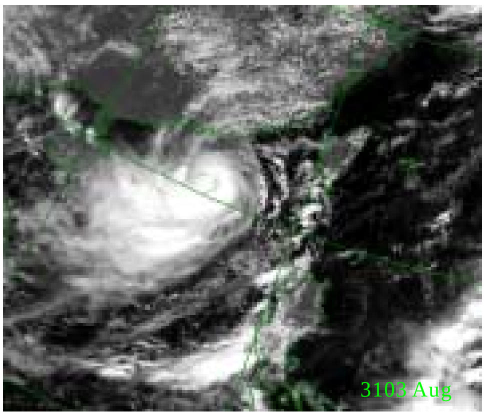


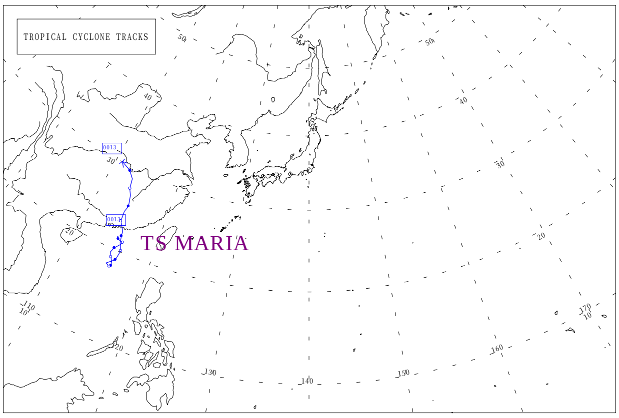
TS MARIA (0013)

A tropical depression formed southeast of Hong Kong at 06UTC 27 August. It took a southward track and became a tropical storm at 12UTC of the following day. Keeping TS intensity, Maria continued to move southward in the northern South China Sea for about two days. It then stopped southward movement about 500 km west of Luzon and remained almost stationary until 00UTC 30 August, when it began to make a clockwise turn. After the turn Maria moved northward and made landfall on the southern coast of China on the early morning of 1 September. Shortly after the landfall it weakened to a tropical depression.

TS MARIA (0013)

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
27 Aug - 02 Sep						27 Aug - 02 Sep					
Aug 27/06	21.6	115.0	1000	-	TD	30/18	19.4	116.0	990	35	TS
27/12	21.3	115.2	1000	-	TD	31/00	20.2	116.1	985	40	TS
27/18	21.2	115.5	1000	-	TD	31/06	21.0	115.6	985	40	TS
28/00	21.2	115.9	1000	-	TD	31/12	21.8	115.4	985	40	TS
28/06	20.8	115.7	998	-	TD	31/18	22.4	115.3	985	40	TS
28/12	20.2	115.2	996	35	TS	Sep 01/00	23.4	114.5	990	35	TS
28/18	19.6	115.0	992	35	TS	01/06	24.6	114.4	990	-	TD
29/00	19.1	115.3	992	35	TS	01/12	25.4	114.6	996	-	TD
29/06	18.6	115.6	992	35	TS	01/18	26.7	114.2	998	-	TD
29/12	18.2	115.7	990	35	TS	02/00	27.5	113.7	1000	-	TD
29/18	18.1	115.8	990	35	TS	02/06	28.7	113.4	1002	-	TD
30/00	18.0	115.6	990	35	TS	02/12	29.5	112.5	1002	-	TD
30/06	18.2	115.1	990	35	TS	02/18	29.8	111.7	1004	-	TD
30/12	19.0	115.9	990	35	TS	03/00	-	-	-	-	Dissip





TY SAOMAI (0014)

SAOMAI was a long-lived tropical cyclone, which maintained TS intensity or higher almost two weeks. A tropical depression formed far east of the Mariana Islands at 18UTC 31 August and moved northward initially, then turned to the west. On the westward track, it developed into a tropical storm at 12UTC 2 September and a typhoon east of Saipan Island at 06UTC 4 September. It turned to the south and weakened into STS grade at 06UTC 5 September. At 06UTC 6 September it changed the track to the west and then to the northwest. On its steady northwestward track through the following several days, it kept STS intensity until 00UTC 9 September, when it re-developed to attain TY intensity. Saomai further developed and reached peak intensity with maximum sustained winds of 95 knots southeast of Minamidaito-jima at 12UTC 10 September. It then passed the central portion of Okinawa Island just after 10UTC 12 September. A wind gust of 42.0 m/s was observed during the passage. In the East China Sea it changed the track northeastward, and then north-northeastward increasing its translation velocity. After weakening into STS intensity, Saomai made landfall on the southern coast of the Korean Peninsula around 20UTC 15 September. Moving north-northeastward, SAOMAI transformed into an extratropical cyclone at 06UTC 16 September northeast off the Korean Peninsula.

TY SAOMAI (0014)

31 Aug - 19 Sep

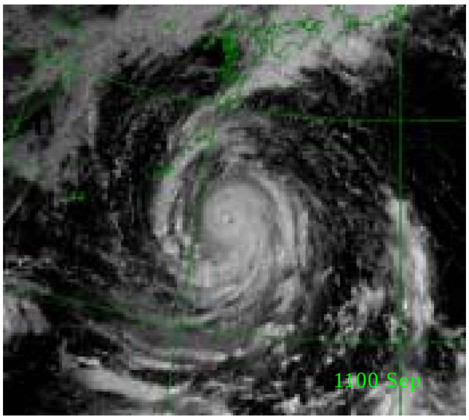
Date/Time (UTC)	Center position Lat. (N)	Lon. (E)	Central pressure (hPa)	Max. wind (kt)	Grade
Aug 31/18	13.5	156.9	1008	-	TD
Sep 01/00	14.2	157.0	1008	-	TD
01/06	14.8	157.0	1006	-	TD
01/12	15.5	157.1	1008	-	TD
01/18	15.9	157.2	1004	-	TD
02/00	16.1	157.4	1004	-	TD
02/06	16.3	157.1	1004	-	TD
02/12	16.1	156.3	1000	35	TS
02/18	16.0	155.5	996	40	TS
03/00	15.9	154.9	992	40	TS
03/06	15.9	154.2	990	45	TS
03/12	15.9	153.4	985	50	STS
03/18	15.9	152.6	980	55	STS
04/00	16.0	151.7	980	60	STS
04/06	16.1	150.7	975	65	TY
04/12	16.2	149.9	975	65	TY
04/18	16.1	149.0	975	65	TY
05/00	16.0	148.0	975	65	TY
05/06	15.9	148.0	980	55	STS
05/12	15.0	148.0	985	50	STS
05/18	14.2	148.0	985	50	STS
06/00	13.6	148.0	985	50	STS
06/06	13.6	147.4	985	50	STS
06/12	13.9	147.1	985	50	STS
06/18	14.2	146.9	985	50	STS
07/00	15.8	145.7	985	50	STS
07/06	16.4	144.7	985	50	STS
07/12	16.9	143.5	985	50	STS
07/18	17.5	142.0	985	50	STS
08/00	18.3	140.9	980	55	STS
08/06	19.1	140.4	980	55	STS
08/12	19.7	139.7	980	55	STS
08/18	20.4	138.4	975	60	STS

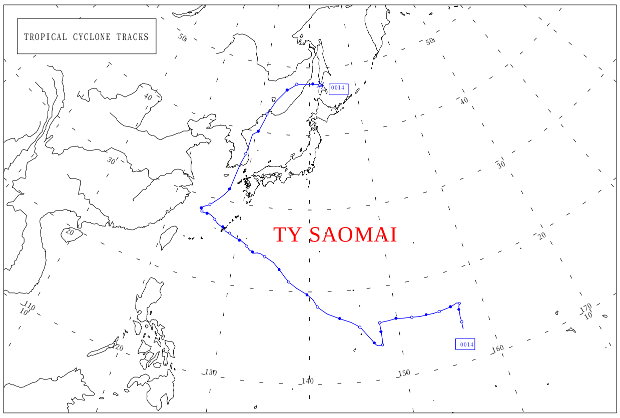
31 Aug - 19 Sep

Date/Time (UTC)	Center position Lat. (N)	Lon. (E)	Central pressure (hPa)	Max. wind (kt)	Grade
Sep 11/06	25.4	130.8	930	90	TY
11/09	25.5	130.5	930	90	TY
11/12	25.5	130.4	935	90	TY
11/15	25.7	129.8	935	90	TY
11/18	25.8	129.5	940	85	TY
11/21	25.9	129.2	940	85	TY
12/00	26.1	128.9	940	85	TY
12/03	26.2	128.5	945	80	TY
12/06	26.3	128.2	945	75	TY
12/09	26.5	128.1	945	75	TY
12/10	26.5	128.0	945	75	TY
12/12	26.7	127.8	945	75	TY
12/15	26.8	127.4	950	75	TY
12/18	27.0	127.0	950	75	TY
12/21	27.2	126.7	950	75	TY
13/00	27.4	126.5	950	75	TY
13/03	27.6	126.2	955	70	TY
13/06	27.8	125.9	960	70	TY
13/09	27.9	125.5	960	70	TY
13/12	27.9	125.2	955	70	TY
13/18	27.9	124.6	955	70	TY
14/00	28.0	124.4	955	70	TY
14/06	28.2	124.2	955	70	TY
14/12	28.4	124.2	960	70	TY
14/18	28.6	124.4	960	70	TY
15/00	29.1	125.3	965	65	TY
15/03	29.6	125.8	965	65	TY
15/06	30.1	126.3	965	65	TY
15/09	30.8	127.0	965	65	TY
15/12	31.6	127.6	970	60	STS
15/15	32.8	127.9	970	60	STS
15/18	34.0	128.1	970	60	STS
15/21	35.2	128.4	970	55	STS

09/00	21.1	137.4	965	70	TY
09/06	21.7	136.8	955	75	TY
09/12	22.5	136.1	945	80	TY
09/18	23.3	135.2	935	90	TY
10/00	23.9	134.1	930	90	TY
10/03	24.2	133.5	930	90	TY
10/06	24.3	133.0	930	90	TY
10/09	24.2	132.5	930	90	TY
10/12	24.3	132.4	925	95	TY
10/15	24.4	132.2	925	95	TY
10/18	24.4	132.0	925	95	TY
10/21	24.6	131.8	925	95	TY
11/00	24.9	131.5	925	95	TY
11/03	25.2	131.1	930	90	TY

16/00	36.7	129.0	980	50	STS
16/06	39.5	129.5	982	-	L
16/12	40.1	130.5	986	-	L
16/18	42.0	131.4	988	-	L
17/00	42.7	131.6	990	-	L
17/06	44.7	133.0	990	-	L
17/12	46.5	135.1	992	-	L
17/18	47.0	136.2	994	-	L
18/00	47.5	137.2	996	-	L
18/06	47.5	138.7	998	-	L
18/12	47.6	140.7	1004	-	L
18/18	47.5	141.6	1008	-	L
19/00	47.4	142.2	1012	-	L
19/06	-	-	-	-	Dissip



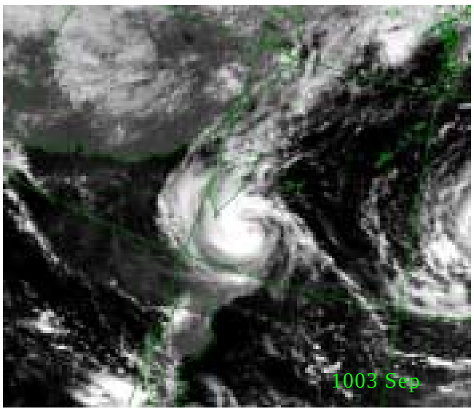


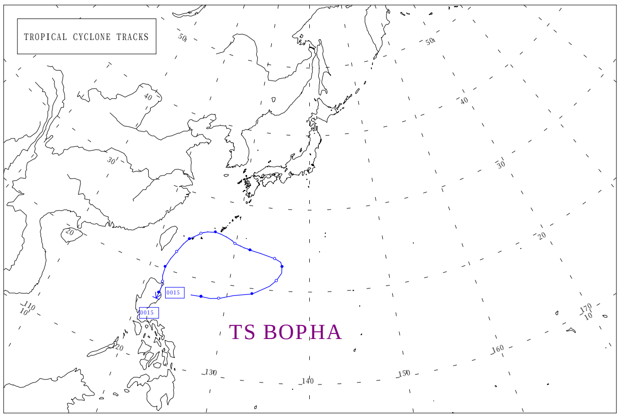
TS BOPHA (0015)

A tropical depression, which formed east of Luzon at 06UTC 4 September, moved east initially, then made a gradual anti-clockwise turn to the west-northwest on 6 September. It intensified into a tropical storm southeast of Minamidaito-jima at 18UTC 6 September. After passing just south of Okinawa Island on 08 September, Bopha made another anti-clockwise turn to the south on 9 September. Keeping TS intensity, it passed east off Taiwan from the night of 9 to the morning of 10 September and made landfall on Luzon around 23UTC 10 September. The storm weakened into a tropical depression on the northern coast of Luzon at 00UTC 11 September.

TS BOPHA (0015)

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
4 Sep - 10 Sep						4 Sep - 10 Sep					
Sep 04/06	18.0	125.8	1000	-	TD	Sep 08/09	25.8	127.7	990	45	TS
04/12	18.1	127.0	1000	-	TD	08/12	25.9	127.0	994	40	TS
04/18	18.1	128.1	1000	-	TD	08/15	25.8	126.5	994	40	TS
05/00	18.3	129.1	1000	-	TD	08/18	25.7	125.9	994	40	TS
05/06	18.9	130.8	998	-	TD	08/21	25.5	125.4	994	40	TS
05/12	19.4	133.0	998	-	TD	09/00	25.3	125.1	994	40	TS
05/18	20.5	135.0	998	-	TD	09/03	25.0	124.7	994	40	TS
06/00	21.2	135.8	998	-	TD	09/06	24.8	124.4	992	40	TS
06/06	22.1	136.4	996	-	TD	09/09	24.6	124.1	990	45	TS
06/12	22.9	136.4	996	-	TD	09/12	24.3	123.8	988	45	TS
06/18	23.4	136.2	994	35	TS	09/15	23.9	123.5	992	45	TS
07/00	23.8	135.4	994	40	TS	09/18	23.5	123.2	988	45	TS
07/06	24.3	133.4	992	40	TS	10/00	22.4	122.7	990	45	TS
07/12	24.5	132.0	990	45	TS	10/06	21.4	122.2	990	45	TS
07/15	24.6	131.6	990	45	TS	10/12	20.3	121.9	990	45	TS
07/18	24.7	131.2	990	45	TS	10/18	19.2	121.9	990	45	TS
07/21	24.8	130.6	990	45	TS	11/00	18.6	122.1	994	-	TD
08/00	25.0	129.9	990	45	TS	11/06	18.0	122.2	994	-	TD
08/03	25.3	129.4	990	45	TS	11/12	17.3	122.1	998	-	TD
08/06	25.6	128.6	990	45	TS	11/18	-	-	-	-	Dissip





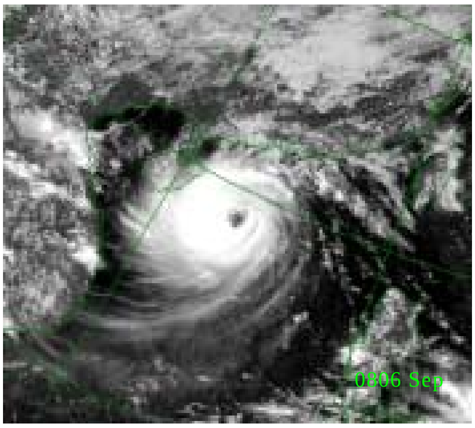
TY WUKONG (0016)

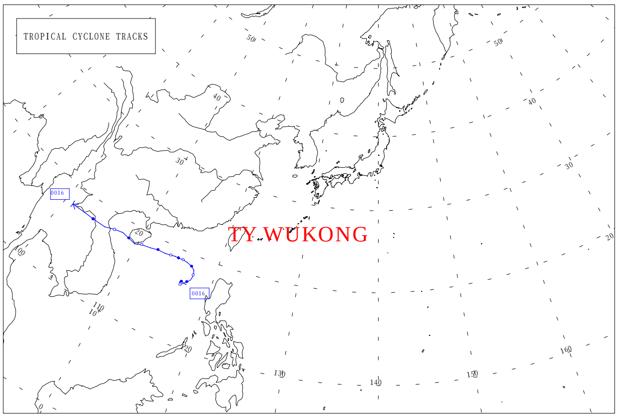
Wukong formed as a tropical depression west of Luzon at 06UTC 4 September. It remained almost stationary until 12UTC 5 September and then made an anti-clockwise turn to the west in the South China Sea. During the turn the depression developed into a tropical storm at 00UTC 6 September. It further intensified to attain TY intensity at 18UTC 7 September and reached its peak with maximum sustained winds of 75 knots at 06UTC 8 September. Weakening gradually, Wukong skirted around the southern coasts of Hainan Island on 9 September and made landfall on the northern part of Vietnam around 04UTC 10 September. After the landfall it weakened into a tropical depression in the northeastern part of Thailand at 12UTC of the day.

TY WUKONG (0016)

4 Sep - 11 Sep

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
Sep 04/06	16.6	117.2	1000	-	TD	Sep 07/18	19.0	114.7	970	65	TY
04/12	16.7	116.6	1000	-	TD	08/00	18.9	114.2	960	70	TY
04/18	16.6	116.4	1000	-	TD	08/06	18.8	113.4	955	75	TY
05/00	16.4	116.6	1000	-	TD	08/12	18.8	112.5	955	75	TY
05/06	16.5	116.8	998	-	TD	08/18	18.6	111.6	960	70	TY
05/12	16.9	117.2	996	-	TD	09/00	18.4	110.5	960	70	TY
05/18	17.3	117.5	994	-	TD	09/06	18.1	109.7	970	60	STS
06/00	17.9	117.6	992	35	TS	09/12	18.3	108.8	975	55	STS
06/06	18.4	117.4	990	40	TS	09/18	18.5	107.8	980	50	STS
06/12	18.7	117.0	985	50	STS	10/00	18.3	106.8	985	50	STS
06/18	18.9	116.3	985	50	STS	10/06	17.9	105.6	990	45	TS
07/00	19.0	115.8	980	55	STS	10/12	17.9	104.0	996	-	TD
07/06	19.0	115.5	980	55	STS	10/18	17.9	102.5	1000	-	TD
07/12	19.0	115.2	975	60	STS	11/00	-	-	-	-	Dissip



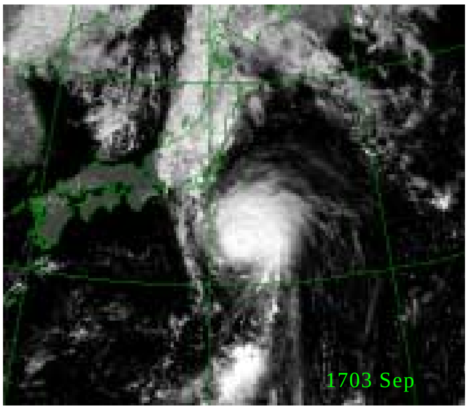


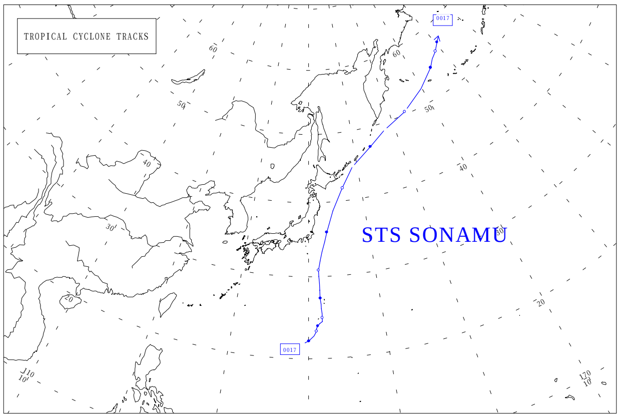
STS SONAMU (0017)

A tropical depression, which formed southwest of Iwo-jima at 06UTC 14 September, moved northward and developed into a tropical storm south of the island at 03UTC 15 September. It turned to the north and passed just west of Ogasawara-shoto around 12UTC 16 September. A half day later Sonamu attained STS intensity southeast of Japan and then made a slight turn to the north-northeast on 17 September. The storm transformed into an extratropical cyclone near the Chishima Islands at 06UTC 18 September

STS SONAMU (0017)

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
14 Sep - 20 Sep						14 Sep - 20 Sep					
Sep 14/06	21.9	139.5	998	-	TD	Sep 17/00	30.9	141.5	985	50	STS
14/12	22.1	140.0	1000	-	TD	17/03	32.1	141.8	980	55	STS
14/18	22.7	140.7	1000	-	TD	17/06	33.3	142.1	980	55	STS
15/00	23.3	141.0	1000	-	TD	17/09	34.6	142.6	980	55	STS
15/03	23.4	141.0	996	35	TS	17/12	35.9	143.0	980	55	STS
15/06	23.6	141.0	994	40	TS	17/18	38.8	144.3	980	55	STS
15/12	23.9	141.2	992	45	TS	18/00	41.9	146.5	985	50	STS
15/15	24.0	141.3	992	45	TS	18/06	44.7	149.0	988	-	L
15/18	24.2	141.5	990	45	TS	18/12	47.1	153.6	990	-	L
15/21	24.4	141.8	990	45	TS	18/18	48.9	157.5	996	-	L
16/00	24.9	141.8	990	45	TS	19/00	50.5	163.6	994	-	L
16/03	25.5	141.8	990	45	TS	19/06	52.5	169.7	992	-	L
16/06	26.0	141.7	990	45	TS	19/12	54.5	174.8	988	-	L
16/09	26.6	141.7	990	45	TS	19/18	55.4	176.5	986	-	L
16/12	27.3	141.6	990	45	TS	20/00	56.1	178.5	984	-	L
16/15	28.3	141.6	990	45	TS	20/06	56.4	179.0	984	-	L
16/18	29.2	141.6	990	45	TS	20/12	57.0	180.5	986	-	Out
16/21	30.1	141.5	990	45	TS						



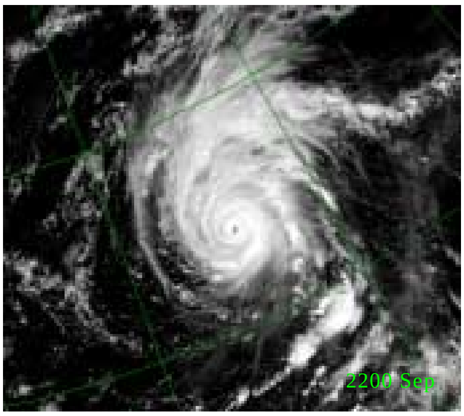


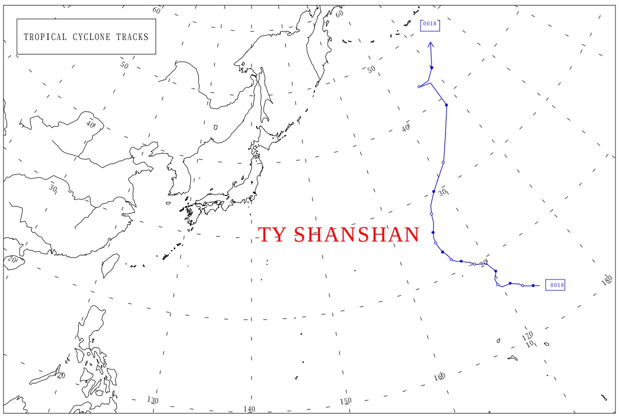
TY SHANSHAN (0018)

A tropical depression formed northeast of the Marshall Islands at 06UTC 17 September. Moving northwest, it developed into a tropical storm at 12UTC 18 September and one day later attained TY intensity over the same waters. Shanshan further intensified passing northeast of Wake Island and reached its peak with maximum sustained winds of 95 knots north of the island at 12UTC 21 September. Turning to the northeast, Shanshan accelerated its translation velocity with gradual weakening on 22 and 23 September. The storm transformed into an extra-tropical cyclone northwest of Midway Island at 18UTC 24 September.

TY SHANSHAN (0018)

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
17 Sep - 25 Sep						17 Sep - 25 Sep					
Sep 17/06	14.2	173.6	1004	-	TD	Sep 21/18	23.6	165.4	925	95	TY
17/12	14.5	173.1	1004	-	TD	22/00	24.2	165.3	925	95	TY
17/18	14.8	172.6	1004	-	TD	22/06	24.9	165.3	925	95	TY
18/00	15.1	172.1	1004	-	TD	22/12	25.5	165.6	935	90	TY
18/06	15.5	171.8	1002	-	TD	22/18	26.6	166.2	940	85	TY
18/12	16.0	171.0	998	35	TS	23/00	27.7	166.5	945	85	TY
18/18	16.2	170.0	990	45	TS	23/06	28.7	167.0	950	80	TY
19/00	16.6	169.7	985	50	STS	2/312	30.1	168.3	955	75	TY
19/06	17.3	169.7	980	55	STS	23/18	31.1	169.6	960	70	TY
19/12	18.0	170.3	970	65	TY	24/00	32.7	171.8	960	70	TY
19/18	19.3	169.8	960	75	TY	24/06	35.8	174.6	960	70	TY
20/00	19.9	168.5	950	80	TY	24/12	38.9	177.8	955	70	TY
20/06	20.3	168.1	945	85	TY	24/18	42.8	177.9	956	-	L
20/12	20.9	167.2	940	85	TY	25/00	43.3	175.6	956	-	L
20/18	21.2	166.6	935	90	TY	25/06	43.3	177.8	960	-	L
21/00	21.6	166.2	935	90	TY	25/12	44.4	180.0	964	-	L
21/06	22.3	166.0	930	95	TY	25/18	45.9	181.7	964	-	Out
21/12	22.9	165.6	925	95	TY						

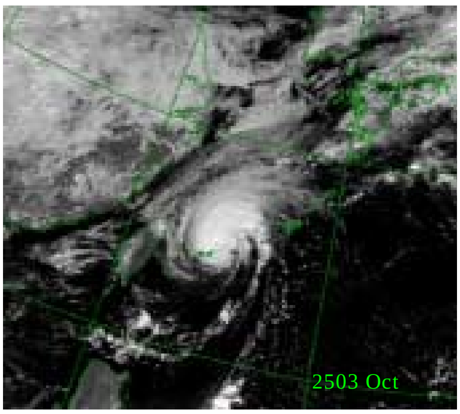


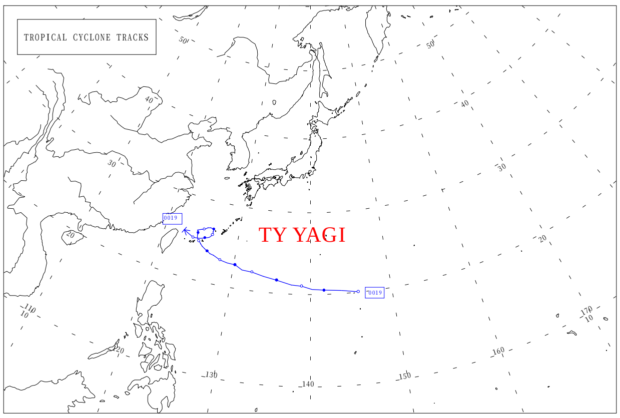


TY YAGI (0019)

Almost one month later after Shanshan dissipated in late September, YAGI formed as a tropical depression north of the Mariana Islands at 00UTC 21 October. Moving west-northwest, it developed into a tropical storm east-northeast of Okino-torishima at 00UTC 22 October. The storm kept moving west-northwestward with gradual development and attained TY intensity south of Okinawa at 12UTC 24 October. After YAGI reached its peak with maximum sustained winds of 70 knots, it changed the track to the northwest, then turned to the north and made a full turn over the waters around Okinawa from 26 to 28 October. YAGI weakened gradually during the turn and downgraded into a tropical depression over the same waters at 00UTC 27 October.

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 YAGI (0019) 21 Oct -28 Oct						21 Oct -28 Oct					
Oct 21/00	20.1	145.9	1008	-	TD	Oct 25/06	25.2	124.5	970	65	TY
21/06	20.4	143.8	1006	-	TD	25/09	25.4	124.5	970	65	TY
21/12	20.5	141.7	1004	-	TD	25/12	25.6	124.5	975	60	STS
21/18	20.6	140.2	1002	-	TD	25/15	25.8	124.4	975	60	STS
22/00	21.0	138.9	1000	35	TS	25/18	25.9	124.3	980	55	STS
22/06	21.1	137.6	998	35	TS	25/21	26.1	124.8	980	55	STS
22/12	21.6	135.7	996	40	TS	26/00	26.2	125.2	985	50	STS
22/18	21.9	134.0	992	40	TS	26/03	26.5	125.6	985	50	STS
23/00	22.2	132.5	990	45	TS	26/06	26.6	126.0	985	50	STS
23/06	22.3	131.2	990	45	TS	26/09	26.5	126.5	985	50	STS
23/12	22.8	130.2	985	50	STS	26/12	26.5	126.5	990	45	TS
23/18	22.8	129.2	985	50	STS	26/15	26.4	126.5	992	45	TS
24/00	23.0	128.2	980	55	STS	26/18	26.2	126.4	998	40	TS
24/06	23.4	127.2	975	60	STS	26/21	26.0	126.5	1000	35	TS
24/09	23.5	126.7	975	60	STS	27/00	25.8	126.5	1004	-	TD
24/12	23.7	126.3	970	65	TY	27/06	25.4	126.1	1008	-	TD
24/15	23.9	125.9	970	65	TY	27/12	25.2	125.6	1012	-	TD
24/18	24.1	125.5	965	70	TY	27/18	25.0	124.9	1012	-	TD
24/21	24.4	125.2	965	70	TY	28/00	24.9	124.0	1012	-	TD
25/00	24.7	124.9	965	70	TY	28/06	25.2	123.3	1010	-	TD
25/03	24.9	124.6	965	70	TY	28/12	-	-	-	-	Dissip



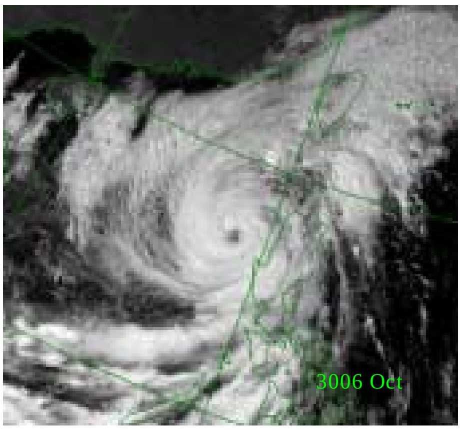


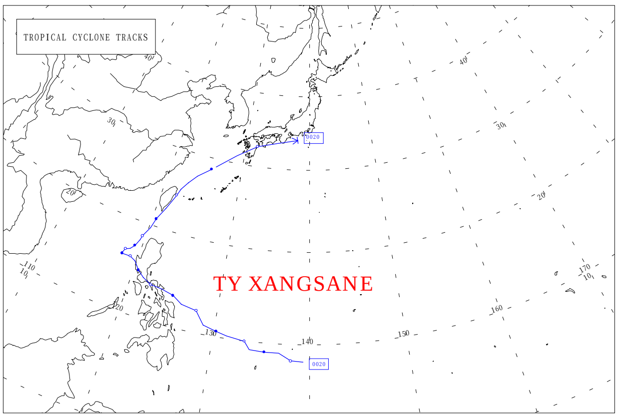
TY XANGSANE (0020)

A tropical depression formed southeast of Yap Island at 18UTC 24 October 2000. It gradually developed moving west-northwestward and became a tropical storm east of the Philippines at 06UTC 26 October. On the west-northwestward track, the storm attained STS intensity at 00UTC 27 October and made landfall on the east coast of the Philippines around 21UTC 27 October. It slightly weakened passing Luzon and entered the South China Sea on the early morning of 29 October. Xangsane then decelerated westward movement and almost remained stationary until 18UTC 29 October, when it started moving to the north-northeast. Shortly the storm re-intensified to attain TY intensity at 00UTC 30 October and reached its peak with maximum sustained winds of 75 knots west of Luzon. Xangsane continued to move north-northeastward for the following two days keeping TY intensity and passed just east of Taiwan on the morning of 1 November. Entering the East China Sea, it turned to the northeast and transformed into an extratropical cyclone at 12UTC 1 November.

TY XANGSANE (0020)

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
24 Oct - 2 Nov						24 Oct - 2 Nov					
Oct 24/18	8.3	139.3	1008	-	TD	Oct 29/12	15.9	118.1	980	55	STS
25/00	8.4	138.1	1008	-	TD	29/18	16.0	118.1	975	60	STS
25/06	9.1	136.9	1004	-	TD	30/00	16.5	118.3	965	70	TY
25/12	9.1	135.4	1004	-	TD	30/06	16.7	118.8	960	75	TY
25/18	9.2	133.9	1004	-	TD	30/12	17.2	119.2	960	75	TY
26/00	10.0	133.3	1004	-	TD	30/18	18.0	119.5	960	75	TY
26/06	10.3	131.4	998	35	TS	31/00	18.5	119.6	960	75	TY
26/12	10.6	130.3	996	40	TS	31/06	19.7	120.2	960	75	TY
26/18	11.0	128.8	992	45	TS	31/12	20.9	120.5	960	75	TY
27/00	12.3	127.8	985	50	STS	31/18	22.4	121.2	965	70	TY
27/06	12.6	126.1	980	55	STS	Nov 01/00	24.3	122.0	975	60	STS
27/12	13.3	125.0	975	60	STS	01/03	25.2	122.3	985	50	STS
27/18	13.6	123.6	975	60	STS	01/06	26.2	123.0	985	50	STS
28/00	13.7	122.3	980	55	STS	01/09	27.3	124.0	985	50	STS
28/06	14.2	121.3	985	50	STS	01/12	28.6	125.7	992	-	L
28/12	14.8	120.5	990	45	TS	01/18	31.1	128.9	1000	-	L
28/18	15.6	119.8	990	45	TS	02/00	32.7	131.8	1006	-	L
29/00	15.9	119.1	990	45	TS	02/06	33.4	134.9	1006	-	L
29/06	15.9	118.2	985	50	STS	02/12	-	-	-	-	Dissip



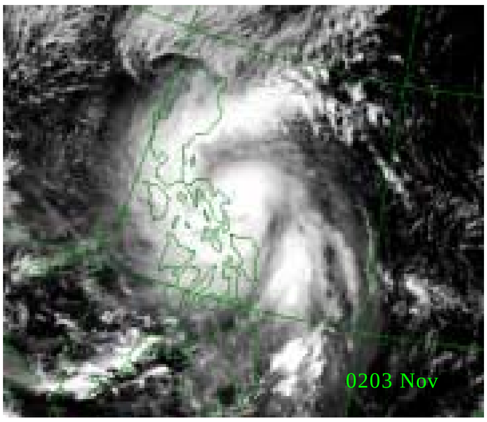


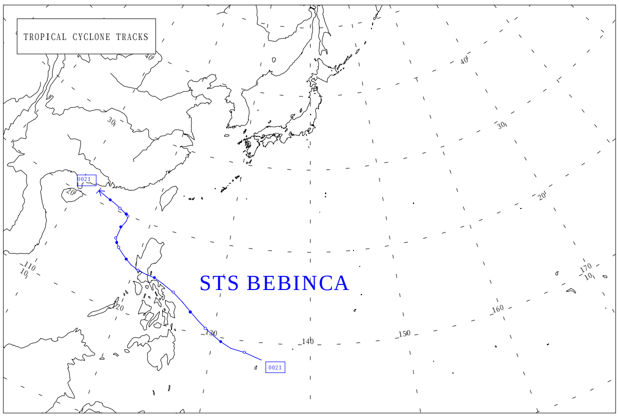
STS BEBINCA (0021)

While Xangsane was located west of Luzon, Bebinca formed as a tropical depression north of Palau Island at 18UTC 30 October. It followed almost the same course that Xangsane took about six days before and developed into a tropical storm northeast of Mindanao Island at 00UTC 1 November. The storm further intensified into a severe tropical storm southeast of Luzon at 18UTC 1 November. It then started weakening around 18UTC 2 November, when it made landfall on the southern part of Luzon, and was downgraded into a tropical storm on the west coast of the Island at 00UTC 3 November. As Bebinca entered the South China Sea, it re-intensified to attain STS intensity again at 00UTC 4 November. It made a northward turn on 5 November and then a westward turn on 6 November with gradual weakening. The system weakened to a tropical depression southeast of Hong Kong at 00UTC 7 November.

STS BEBINCA (0021) — 30 Oct - 7 Nov

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
Oct 30/18	8.3	135.1	1004	-	TD	Nov 04/00	16.3	117.5	990	50	STS
31/00	8.9	133.4	1004	-	TD	04/06	16.6	117.2	985	55	STS
31/06	9.1	132.0	1002	-	TD	04/12	16.7	117.1	985	55	STS
31/12	9.6	130.9	1002	-	TD	04/18	16.9	116.9	985	55	STS
31/18	10.1	130.0	1000	-	TD	05/00	17.1	116.8	985	55	STS
Nov 01/00	10.7	129.1	998	35	TS	05/06	17.7	116.8	985	55	STS
01/06	11.3	128.2	996	35	TS	05/12	18.5	116.8	980	60	STS
01/12	12.0	127.2	994	45	TS	05/18	19.3	117.1	980	60	STS
01/18	12.8	126.2	990	50	STS	06/00	19.9	117.1	985	55	STS
02/00	13.6	124.9	985	55	STS	06/06	20.1	116.9	990	50	STS
02/06	14.2	123.5	985	55	STS	06/12	20.1	116.8	996	40	TS
02/12	14.5	122.5	985	55	STS	06/18	20.2	116.5	1000	35	TS
02/18	14.6	121.5	990	50	STS	07/00	20.4	115.8	1006	-	TD
03/00	14.7	120.5	998	35	TS	07/06	20.7	114.8	1006	-	TD
03/06	15.0	119.5	996	40	TS	07/12	20.8	114.3	1006	-	TD
03/12	15.4	118.8	994	45	TS	07/18	21.0	113.4	1008	-	TD
03/18	15.8	118.2	992	45	TS	08/00	-	-	-	-	Dissip



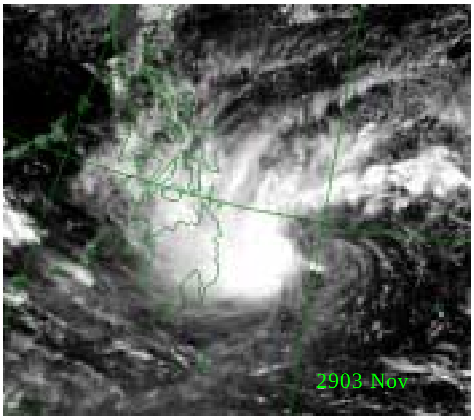


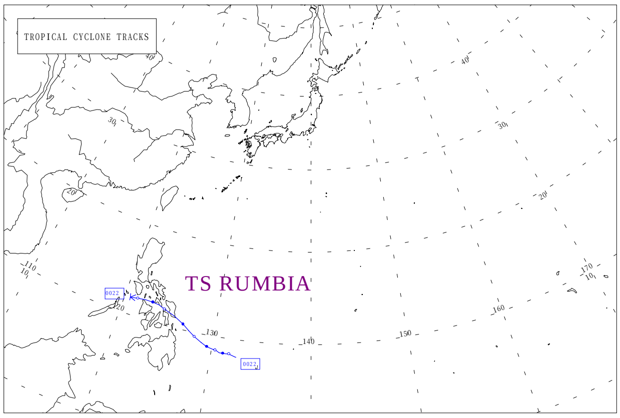
TS RUMBIA (0022)

A tropical depression formed west of Palau Island at 18UTC 27 November 2000. Moving west, it developed into a tropical storm over the same waters at 12UTC 28 November. Slightly turning to the west-northwest, Rumbia kept TS intensity until 18UTC 30 November, when it weakened into a tropical depression on southeastern Samar Island of the Philippines.

TS RUMBIA (0022)

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
27 Nov - 2 Dec						27 Nov - 2 Dec					
Nov 27/18	8.3	132.5	1000	-	TD	Nov 30/06	10.1	127.4	990	40	TS
28/00	8.5	131.8	1000	-	TD	30/12	10.6	126.7	994	40	TS
28/06	8.5	131.4	998	-	TD	30/18	11.2	125.6	998	-	TD
28/12	8.5	131.2	996	35	TS	01/00	11.6	124.4	1000	-	TD
28/18	8.5	130.8	990	40	TS	01/06	11.9	123.7	1000	-	TD
29/00	8.7	130.4	992	40	TS	01/12	12.0	123.0	1002	-	TD
29/06	8.7	130.2	992	40	TS	01/18	12.0	122.2	1002	-	TD
29/12	8.9	129.5	992	40	TS	02/00	11.9	121.4	1004	-	TD
29/18	9.2	128.9	992	40	TS	02/06	-	-	-	-	Dissip



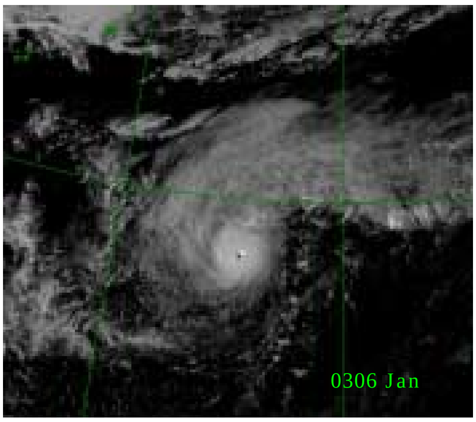


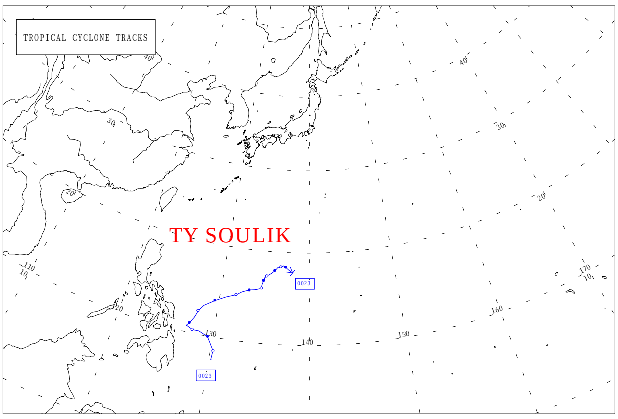
TY SOULIK (0023)

Soulik was generated in late December and lived beyond the year-end for the first time in the last 15 years. A tropical depression formed east of Mindanao Island at 18UTC 28 December. It moved northward initially and then made westward turn toward the Philippines on the following day. On the westward track Soulik became a tropical storm about 200km east of Layte Island at 00UTC 30 December. The storm changed its track to the northeast and attained STS intensity at 18UTC 31 December. Soulik moved east-northeastward keeping STS intensity until 00UTC 2 January 2001, when it turned to the north-northeast south of Okinotorishima. After slightly weakening on the day, it moved northeastward and began to develop rapidly on 3 January. The storm became a typhoon at 06UTC 3 January and reached its peak with maximum sustained winds of 80 knots at 12UTC of the day. It however weakened quickly to a tropical depression over the same waters at 12UTC of the following day.

TY SOULIK (0023)

Date/Time (UTC)	Center position Lat. (N)	Center position Lon. (E)	Central pressure (hPa)	Max. wind (kt)	Grade	Date/Time (UTC)	Center position Lat. (N)	Center position Lon. (E)	Central pressure (hPa)	Max. wind (kt)	Grade
28 Dec - 04 Jan						28 Dec - 04 Jan					
Dec 28/18	7.8	130.2	1002	-	TD	Jan 01/12	15.5	133.2	985	50	STS
29/00	8.7	130.3	1002	-	TD	01/18	15.6	133.9	985	50	STS
29/06	9.3	129.9	1000	-	TD	02/00	15.8	134.5	985	50	STS
29/12	10.0	129.5	1000	-	TD	02/06	16.3	134.6	990	45	TS
29/18	10.4	128.5	998	-	TD	02/12	16.7	134.7	990	45	TS
3/000	10.4	127.8	994	35	TS	02/18	17.0	134.8	985	50	STS
30/06	10.7	127.1	992	40	TS	03/00	17.2	135.0	980	55	STS
30/12	11.0	127.4	990	45	TS	03/06	17.5	135.5	965	70	TY
30/18	11.7	127.8	990	45	TS	03/12	17.9	135.9	955	80	TY
31/00	12.4	128.0	990	45	TS	03/18	18.2	136.2	955	80	TY
31/06	13.1	128.5	990	45	TS	04/00	18.3	136.6	960	70	TY
31/12	13.8	129.6	990	45	TS	04/06	18.5	136.9	975	60	STS
31/18	14.4	130.7	985	50	STS	04/12	18.3	137.2	990	45	TS
Jan 01/00	14.8	131.8	985	50	STS	04/18	18.0	137.6	1000	-	TD
01/06	15.2	132.4	985	50	STS	05/00	-	-	-	-	Dissip





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 (in 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 : 00,248,72,96,120 * ; 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 attached 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.

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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 2000. 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)
|------Contents.pdf (contents of Annual Report 2000 in PDF)
|------TopMenu.exe (Start menu setup program)
|------Users_Manual.htm (user’s manual of a satellite image viewer)
|------Annual_Report
           |---Text
                  |--Text2000.pdf (text of Annual Report 2000 in PDF)
                  |--Text2000.doc (text of Annual Report 2000 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
           |---2000_1 (3-hourly GMS image data)
           |---2000_2 (   to 2000_23)
|------Users_Manual
                  |--Gmanual.doc (User’s Manual for MS Word)
|------Andata
                  |--Best2000.txt (Best track data for the year 2000)
```

How to use this CD-ROM

When you set the CD-ROOM, start menu will be presented automatically with a panel which has "Annual Report 2000", "GMS Satellite Images", "About CD-ROM" and "Close" buttons and a file list box for some introductory documents. Select 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 2000 >

Annual Report 2000 is prepared in the following two formats: "PDF files" and "MS Word/Excel/PowerPoint files".

- PDF files:

Click the "Annual Report 2000" button to open the annual report 2000 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 holder 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 2000 is displayed in the 'Selection window' of satellite images for tropical cyclones.

- Displaying satellite images:

Select 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. Select 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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