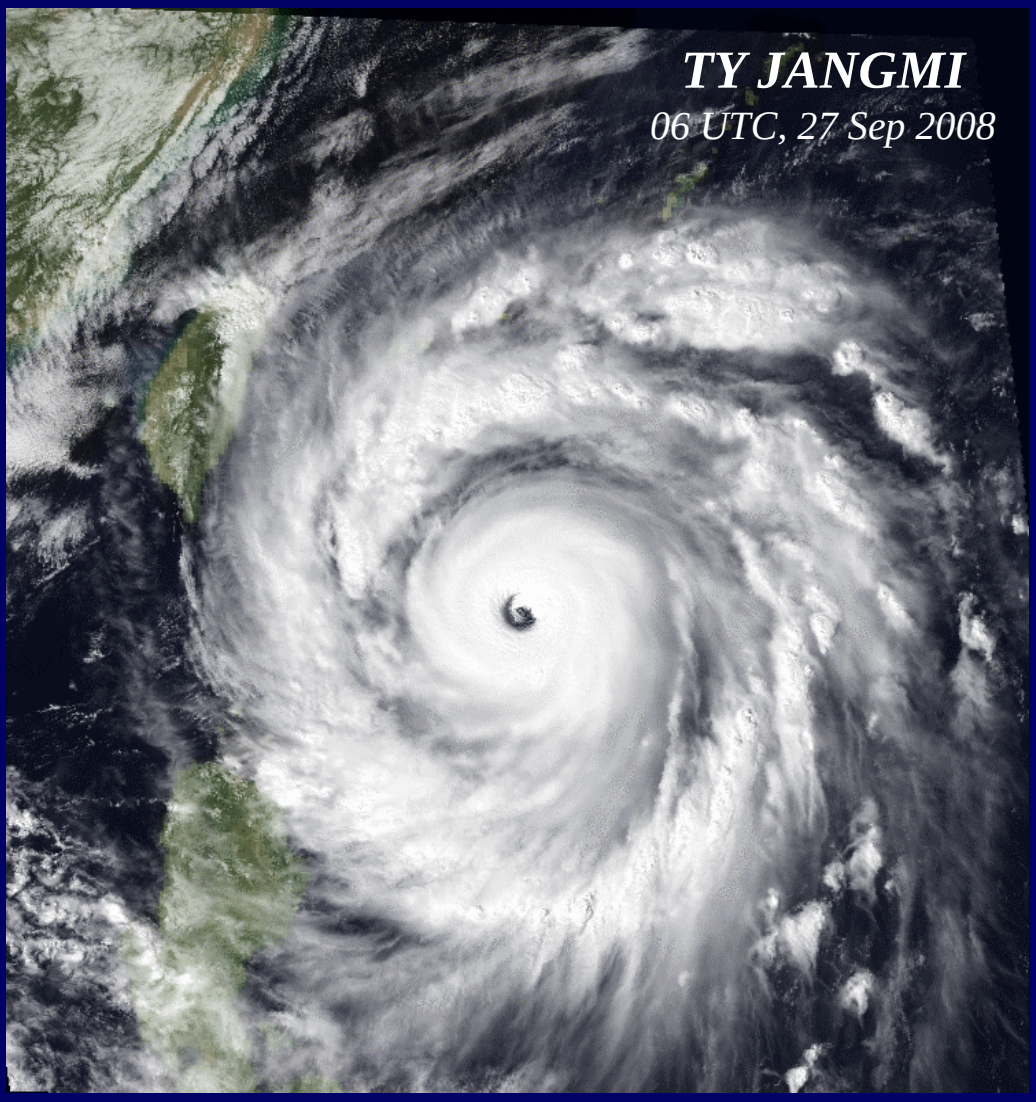
Annual Report on the Activities of the RSMC Tokyo - Typhoon Center 2008



Japan Meteorological Agency

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Introduction

The RSMC Tokyo - Typhoon Center (referred to below as *the Center*) is a Regional Specialized Meteorological Centre (RSMC) that carries out specialized activities in analysis, tracking and forecasting of western North Pacific tropical cyclones (TCs) 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 a designation by the WMO Executive Council at its 40th session (Geneva, June 1988).

The Center conducts the following operations on a routine basis:

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

In addition to the routine services outlined above, the Center distributes a series of reports entitled *Annual Report on the Activities of the RSMC Tokyo - Typhoon Center* to serve as operational references for the NMSs concerned. The report is aimed at summarizing the activities of the Center and reviewing the TCs of the preceding year.

In this issue covering 2008, an outline of routine operations at the Center and its operational products are presented in Chapter 1, while Chapter 2 reports on the major activities of the Center in 2008. Chapter 3 describes atmospheric and oceanic conditions in the tropics and notes the highlights of TC activities in 2008. In Chapter 4, verification statistics of operational forecasts and predictions of the numerical weather prediction (NWP) models of the Center are presented. The best track data for TCs in 2008 are shown in table and chart forms in the appendices. All the relevant texts, tables, charts and appendices are included on the DVD attached to this report.

The DVD contains hourly cloud images of all the TCs in 2008 of TS intensity or higher within the Center's area of responsibility. Also included is the necessary viewer software, which features various functions for analyzing satellite imagery such as image animation and is expected to facilitate efficient post-analysis of TCs and their environments. A setup program and a user manual for the software are also included on the DVD. Appendix 8 shows an outline of the DVD and how to use the software.

Chapter 1

Operations at the RSMC Tokyo - Typhoon Center in 2008

The Center's area of responsibility covers the western North Pacific and the South China Sea (0°-60°N, 100°-180°E) including the marginal seas and adjacent land areas (Figure 1.1). The Center carries out analyses and forecasts of tropical cyclones (TCs) when they are in or expected to move into the area. The Center provides the relevant National Meteorological Services (NMSs) with the RSMC products through such means as the GTS, the AFTN and the Internet.

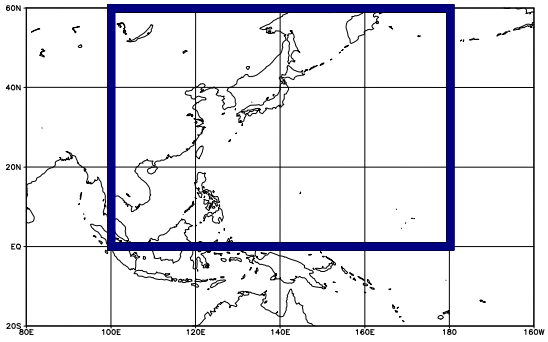


Figure 1.1
Area of responsibility of the RSMC Tokyo - Typhoon Center

1.1 Analysis

TC analyses are performed eight times a day at 00, 03, 06, 09, 12, 15, 18 and 21 UTC, and each analysis begins with the determination of the center position of the TC. Cloud images from the Multi-functional Transport Satellite (MTSAT) are the principal source for determining this, especially for TCs migrating over data-sparse ocean areas. The TC's direction and speed of movement are determined primarily from the six-hourly displacement vectors of the center position.

The central pressure of a TC is determined mainly from the CI number, which is derived from satellite imagery using the Dvorak method. The CI number also gives the maximum sustained wind speed in the vicinity of the center. The radii of circles of winds more than 30 and 50 knots are determined mainly from surface observations, QuikSCAT and ASCAT observations, and low-level cloud motion winds (LCW) derived from cloud motion vectors of satellite images in the vicinity of the TC.

1.2 Forecasts

As a primary basis for TC track forecasts, JMA uses numerical weather prediction (NWP); the Global Spectral Model (GSM) and the Typhoon Ensemble Prediction System (TEPS). GSM (TL959L60), upgraded on 21 November 2007, has approx. 20 km horizontal resolution and 60 vertical layers while TEPS (TL319L60), became operational in February 2008, has 11 members with approx. 60 km horizontal resolution and 60 vertical layers. This upgrade of GMS together with TEPS replaced the previously used Typhoon Model (TYM). Further details and recent improvements on the models are shown in Appendix 6. As for the TC intensity, central pressure and the maximum sustained wind speeds are forecasted based on the results from NWP and the Dvorak method.

A probability circle shows the range into which the center of a TC is expected to move with 70%

probability at each validation time. The radius of the circle is statistically determined according to the speed of TC movement based on the verification results of recent TC track forecasts.

1.3 Provision of RSMC Products

The Center prepares and disseminates the RSMC bulletins listed below via the GTS and the AFTN when:

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

The RSMC products are continually issued as long as a TC keeps TS intensity or higher within the area of responsibility. Appendix 5 denotes the code forms of the bulletins.

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

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

Analysis	Center position Accuracy of determination of the center position Direction and speed of movement Central pressure Maximum sustained wind speed (10-minute average) Maximum gust wind speed Radii of wind areas over 50 and 30 knots
24-, 48- and 72-hour forecasts	Center position and radius of the probability circle Direction and speed of movement Central pressure Maximum sustained wind speed (10-minute average) Maximum gust wind speed

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

The RSMC Guidance for Forecast reports the results of GSM predictions; GSM is run four times a day with initial analyses at 00, 06, 12 and 18 UTC. The Guidance presents GSM's six-hourly predictions of a TC up to 84 hours ahead. It includes following elements:

NWP prediction (T=06 to 84)
- Center position
- Central pressure*
- Maximum sustained wind speed*

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

(3) SAREP (TCNA20/21 RJTD: via GTS)

The SAREP reports TC analysis including intensity information (i.e. the CI number) based on the Dvorak method. It is issued a half to one hour after observations at 00, 03, 06, 09, 12, 15, 18 and 21 UTC, and contains following elements:

MTSAT imagery analysis	Center position
	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

** *These parameters are reported only at 00, 06, 12 and 18 UTC.*

In accordance with the WMO migration plan to table-driven code forms, the Center has been disseminating SAREP reports in BUFR format (IUCC10 RJTD) since November 2005 while also continuing dissemination in the existing format. BUFR/CREX templates for translation into table-driven code forms are provided on the WMO website at http://www.wmo.int/pages/prog/www/WMOCodes.html

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

The RSMC Prognostic Reasoning provides a brief reasoning for a TC 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, the synoptic situation of the subtropical ridge, the movement and intensity of the TC as well as relevant remarks are given in plain language.

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

The RSMC Tropical Cyclone Best Track provides post-analysis data on TCs of TS intensity or higher. It contains the center position, the central pressure and the maximum sustained wind speed. The best track for a TC is usually finalized one and a half months after the termination of issuance of the above RSMC bulletins for the TC.

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

The Center, as one of the Tropical Cyclone Advisory Centres within the framework of the International Civil Aviation Organization (ICAO), provides Tropical Cyclone Advisory for SIGMET to Meteorological Watch Offices (MWOs) to support their preparations of SIGMET information on TCs. It includes the following elements in the analysis and the 12- and 24-hour forecasts:

Analysis	Center position
	Direction and speed of movement
	Central pressure
	Maximum sustained wind speed (10-minute average)
12- and 24-hour forecasts***	Center position
	Maximum sustained wind speed (10-minute average)

**** 6- and 18-hour forecasts are added from 22 May 2008.*

1.4 RSMC Data Serving System

Since 1995, JMA has been operating the RSMC Data Serving System which allows the NMSs concerned to retrieve NWP products such as predicted fields in grid-point-value (GPV) form and observational data. The products and data provided through the system are listed in Appendix 7.

1.5 RSMC Tokyo - Typhoon Center Website

The RSMC Tokyo - Typhoon Center Website provides TC advisories on a real-time basis, as well as a wide variety of products including TC analysis archives, technical reviews and annual reports on the activities of the Center. The website address is:

http://www.jma.go.jp/jma/jma-eng/jma-center/rsmc-hp-pub-eg/RSMC_HP.htm.

1.6 Numerical Typhoon Prediction Website

JMA has been operating the Numerical Typhoon Prediction (NTP) website since 1 October 2004. The site provides predictions of TC tracks performed by models of eight major NWP centers i.e. BoM (Australia), CMC (Canada), DWD (Germany), ECMWF, KMA (Republic of Korea), NCEP (USA), UKMO (UK) and JMA to assist the NMSs of the Typhoon Committee Members in improving TC forecasting and warning services. The site includes:

- TC track predictions, in table and chart format, of the participating NWP centers with several useful functions such as deriving an ensemble mean from any combination of predictions by the centers
- Weather charts of the NWP models of the participating NWP centers

Chapter 2

Major Activities of the RSMC Tokyo - Typhoon Center in 2008

2.1 Dissemination of RSMC Products

The Center provides operational products for tropical cyclone (TC) forecasting to NMSs via such networks as the GTS and the AFTN. Its monthly and annual totals of issuance of the products in 2008 are listed in Table 2.1.

Product	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TCNA20	0	0	0	18	65	36	39	43	106	17	19	25	368
TCNA21	0	0	0	20	77	39	51	56	114	21	22	25	425
IUCC10	0	0	0	38	142	75	90	99	220	38	41	50	793
WTPQ20-25	0	0	0	39	164	78	105	115	224	41	47	53	866
WTPQ30-35	0	0	0	10	38	19	26	28	57	10	12	14	214
FXPQ20-25	0	0	0	19	77	38	51	56	115	19	22	26	423
FKPQ30-35	0	0	0	19	80	38	51	56	118	19	22	26	429
AXPQ20	0	0	0	0	1	3	1	3	3	3	4	3	21

Notes:

TCNA20/21 RJTD	SAREP (TACs)
IUCC10 RJTD	SAREP (BUFR format)
WTPQ20-25 RJTD	RSMC Tropical Cyclone Advisory
WTPQ30-35 RJTD	RSMC Prognostic Reasoning
FXPQ20-25 RJTD	RSMC Guidance for Forecast
FKPQ30-35 RJTD	Tropical Cyclone Advisory for SIGMET
AXPQ20 RJTD	RSMC Tropical Cyclone Best Track

Table 2.1 Monthly and annual total numbers of products issued by the RSMC Tokyo - Typhoon Center in 2008

2.2 Publication

In March 2008, *the tenth issue of the RSMC Technical Review* was issued with the following three topics.

1. Revision of JMA's Early Stage Dvorak Analysis and Its Use to Analyze Tropical Cyclones in the Early Developing Stage
2. The Possibility of Determining Whether Organized Cloud Clusters Will Develop into Tropical Storms by Detecting Warm Core Structures from Advanced Microwave Sounding Unit Observations
3. Analysis of Tropical Cyclones Using Microwave Satellite Imagery

In November 2008, the Center published the *Annual Report on the Activities of the RSMC Tokyo - Typhoon Center in 2007*. Both of the publications are available on the website.

2.3 Monitoring of Observational Data Availability

The Center carried out regular monitoring of information exchange for enhanced TC observations in accordance with the standard procedures stipulated in Section 6.2, Chapter 6 of *The Typhoon Committee Operational Manual (TOM) - Meteorological Component (WMO/TD-No.196)*. Monitoring for the period from 1st November 2007 to 31st October 2008 was conducted for the following two typhoons:

1. TY Fengshen (0806), from 00 UTC 20 June to 23 UTC 24 June 2008
2. TY Hagupit (0814), from 00 UTC 21 September to 23 UTC 25 September 2008

The results were distributed to all the Typhoon Committee Members in March 2009, and are also available on the WMO Distributed Database server at ftp://ddb.kishou.go.jp/pub/monitoring/.

Chapter 3

Summary of the 2008 Typhoon Season

In 2008, 22 TCs of tropical storm (TS) intensity or higher formed in the western North Pacific and the South China Sea. This total is less than the 30-year average* frequency of 26.7. Out of these 22 TCs, 11 reached typhoon (TY) intensity, 6 reached severe tropical storm (STS) intensity, and 5 reached TS intensity (Table 3.1).

Tropical Cyclone			Duration (UTC) (TS of higher)		Minimum Central Pressure (UTC)	lat (N)	long (E)	(hPa)	Max Wind (kt)
TY	NEOGURI	(0801)	150600 Apr	- 191800 Apr	170600	15.9	112.0	960	80
TY	RAMMASUN	(0802)	071800 May	- 130000 May	101200	16.8	132.0	915	105
STS	MATMO	(0803)	151200 May	- 170000 May	160600	25.3	132.8	992	50
STS	HALONG	(0804)	160600 May	- 201200 May	170600	15.9	119.2	975	60
TY	NAKRI	(0805)	270600 May	- 030600 Jun	291200	16.2	135.5	930	100
TY	FENGSHEN	(0806)	190000 Jun	- 250600 Jun	210000	11.9	122.7	945	90
TY	KALMAEGI	(0807)	150600 Jul	- 181800 Jul	170600	23.2	122.3	970	65
TY	FUNG-WONG	(0808)	250600 Jul	- 291200 Jul	271200	22.7	123.1	960	75
STS	KAMMURI	(0809)	050000 Aug	- 071800 Aug	060000	20.9	113.9	975	50
STS	PHANFONE	(0810)	100600 Aug	- 110600 Aug	101800	35.0	160.3	996	50
STS	VONGFONG	(0811)	150600 Aug	- 180000 Aug	160600	33.7	143.0	990	50
TY	NURI	(0812)	171800 Aug	- 230000 Aug	190600	17.6	125.5	955	75
TY	SINLAKU	(0813)	081800 Sep	- 210000 Sep	101200	20.6	124.3	935	100
TY	HAGUPIT	(0814)	191200 Sep	- 250000 Sep	231800	21.1	112.5	935	90
TY	JANGMI	(0815)	241200 Sep	- 010000 Oct	271200	21.3	124.4	905	115
TS	MEKKHALA	(0816)	290000 Sep	- 301200 Sep	291800	17.2	108.0	990	45
TS	HIGOS	(0817)	020000 Oct	- 030600 Oct	020000	15.3	116.3	996	35
TS	BAVI	(0818)	190600 Oct	- 201200 Oct	220600	49.8	178.9	948	45
STS	MAYSAK	(0819)	070600 Nov	- 091200 Nov	081200	17.0	115.1	985	50
TS	HAISHEN	(0820)	151800 Nov	- 171200 Nov	190000	43.4	180.5	998	40
TS	NOUL	(0821)	161200 Nov	- 171200 Nov	170000	11.3	111.0	994	40
TY	DOLPHIN	(0822)	121800 Dec	- 181200 Dec	151800	15.3	130.5	970	65

Table 3.1 List of the tropical cyclones reaching TS intensity or higher in 2008

3.1 Atmospheric and Oceanographic Conditions in the Tropics

In terms of the sea surface temperature (SST), large negative anomalies more than 2.0°C associated with La Niña events were prevailed over the tropics of the central Pacific in the beginning of 2008 and gradually disappeared toward the middle of the year. No specific trend was observed over the South China Sea throughout the year.

Regarding atmospheric conditions, anticyclonic high pressure system over the tropics of western North Pacific in summer was stronger than normal and prevented convective activities. Consequently, the total of 12 named TCs that formed during July to October fell well below the 30-year average* of 18.5. To the contrary, convergence in the lower troposphere seen around the Philippines resulted in as many as four TCs generated in May which was the largest number along with the years 1971 and 1980 since 1951, the start of statistics. The monthly and annual frequencies of named TCs since 1951 are presented in Appendix 4.

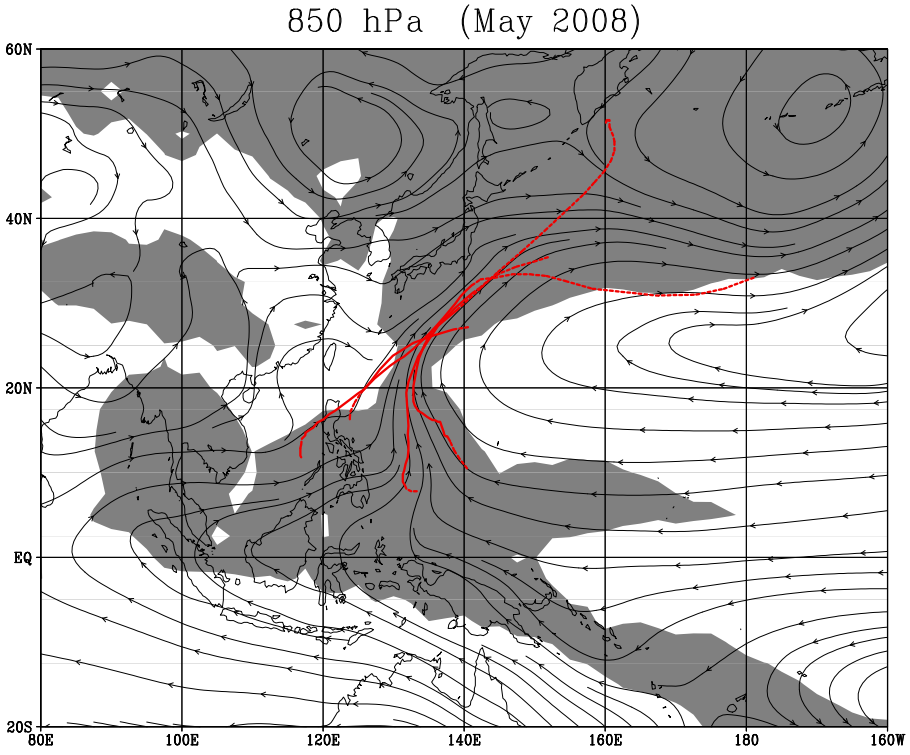


Figure 3.1 Monthly mean streamline at 850 hPa (lines with arrows) and areas of less than 230 w/m^2 of OLR (shaded) in May 2008. The tracks of the four named TCs formed in May are superimposed onto the figure.

The following charts are included on the attached DVD: monthly mean SST anomalies for the western North Pacific and the South China Sea, monthly mean streamlines at 850 hPa and 200 hPa, and OLR for the months from January to December (SST anomalies 2008.ppt and Streamline 2008.ppt).

3.2 Tropical Cyclones in 2008

Over the western North Pacific and the South China Sea, 22 named TCs formed in 2008. The TC season this year began in April with the formation of NEOGURI (0801), which moved northward over the South China Sea and made landfall in China (see a blue line in Fig. 3.2). In May, convective activities in the tropics were enhanced from the South China Sea to the area east of the Philippines, especially in the latter. Four (the 30-year average* of 1.0) named TCs formed over the sea around or east of the Philippines. All these TCs moved northeastward over the sea south of Japan (see green lines in Fig. 3.2).

On the other hand, TC activities in the western North Pacific were very quiet from June to October. In this period, only 13 (the 30-year average* of 20.2) named TCs formed: ten moved northwestward toward southern China or Indochina, while the other three moved northeastward over the sea east of Japan (see red lines in Fig. 1). Of the ten TCs that moved toward southern China or Indochina, four hit Taiwan Island including KALMAEGI (0807) and SINLAKU (0813), bringing damage to the area. FENGSHEN (0806), KAMMURI (0809), HAGUPIT (0814) and MEKKHALA (0816) hit southern China or Indochina, causing damage to Cambodia, China, the Philippines, Laos, Thailand and Viet Nam. No named TCs made landfall in Japan, which is the first time since 2000. In November and December, four named TCs formed (see grey lines in Fig. 3.2). The detailed descriptions of each TC in 2008 are found in the attached DVD.

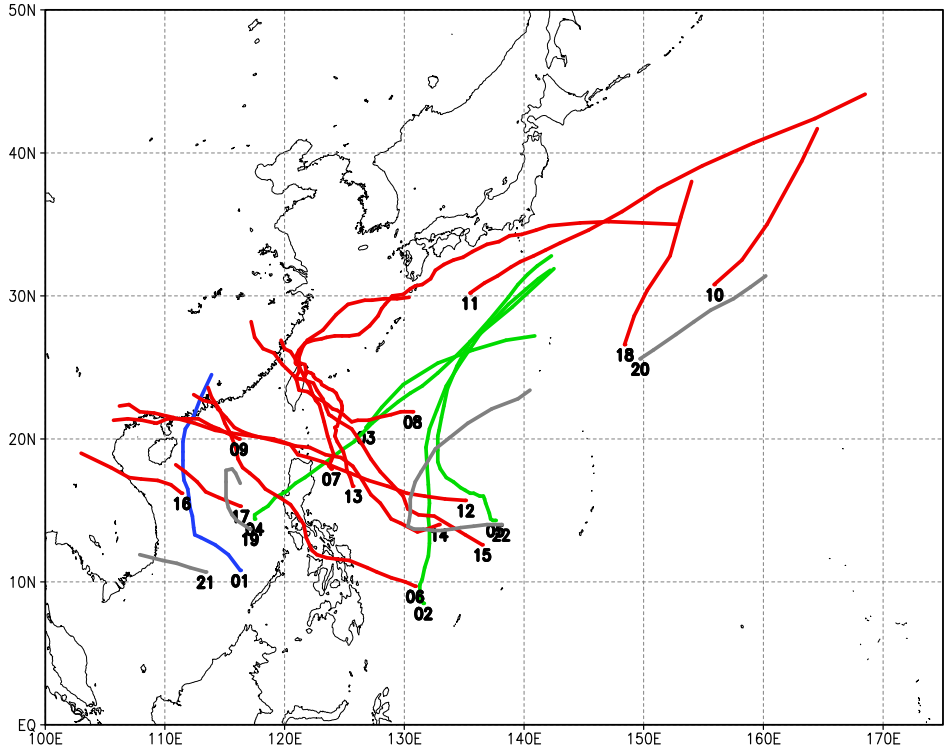


Figure 3.2 Tracks of the 22 named TCs in 2008

Figure 3.3 shows genesis points of the 22 TCs generated in 2008 superimposed on the average frequency distribution (1951 – 2007). No TCs generated in the area of 140°E - 180°, EQ. - 20°N (average years: 8.3).

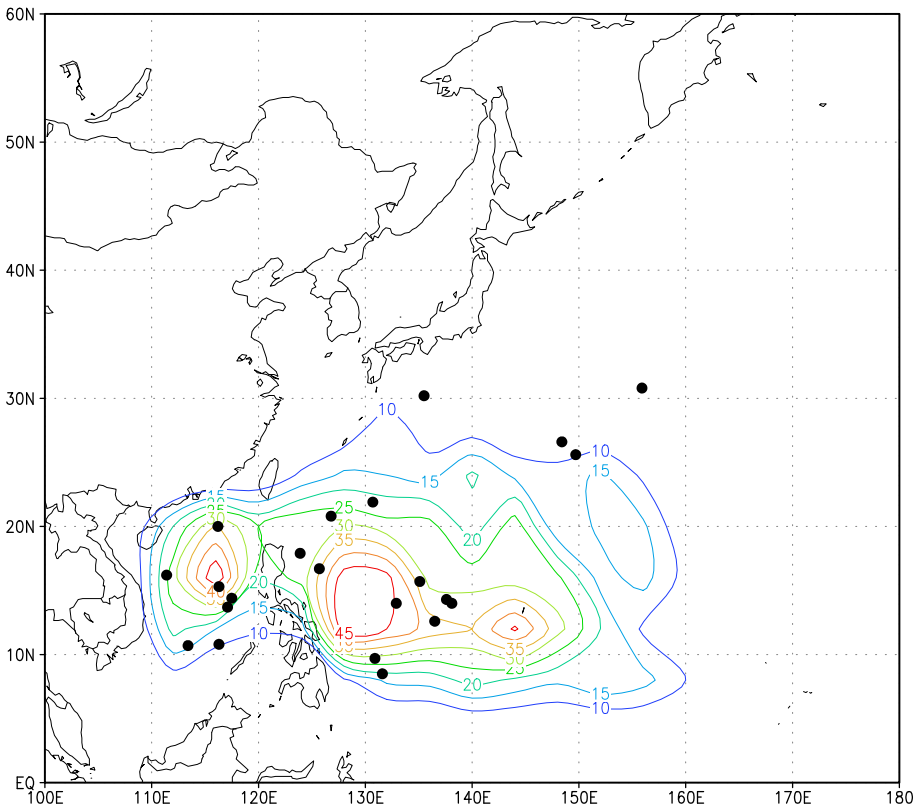


Figure 3.3 Genesis points of the 22 TCs generated in 2008 (dots) and frequency distribution of genesis points for 1951 - 2007 (lines)

* *The 30-year average is from 1971 to 2000.*

***Mean formation latitude (longitude) here is defined as the arithmetic average of the latitudes (longitudes) of genesis points of all TCs of TS intensity or higher.*

Chapter 4

Verification of Forecasts in 2008

4.1 Verification of Operational Forecasts

Operational forecasts of the 22 TCs of TS intensity or higher in 2008 were verified with the RSMC TC best track data. The verified elements are the 24-, 48- and 72-hour forecasts of the center position, central pressure and maximum sustained wind. The position and intensity errors of operational forecasts for each TC in 2008 are indicated in Appendix 3.

4.1.1 Center Position

Figure 4.1 shows annual mean errors of 24-hour (since 1982), 48-hour (since 1988) and 72-hour (since 1997) forecasts of center position. The errors in 2008 were 114 km, 209 km and 345 km for 24-hour, 48-hour and 72-hour forecasts respectively. The errors of 24-hour and 48-hour forecast were nearly the same as the recent years however that of 72-hour was the worst since 2005.

The details of the errors for each TC in 2008 are summarized in Table 4.1. The forecasts for FUNG-WONG (0808) which moved westwards passing over Taiwan Island had small errors. FENGSHEN (0806) which moved northwestwards passing over the Philippines and DOLPHIN (0822) which recurved very sharply had larger errors.

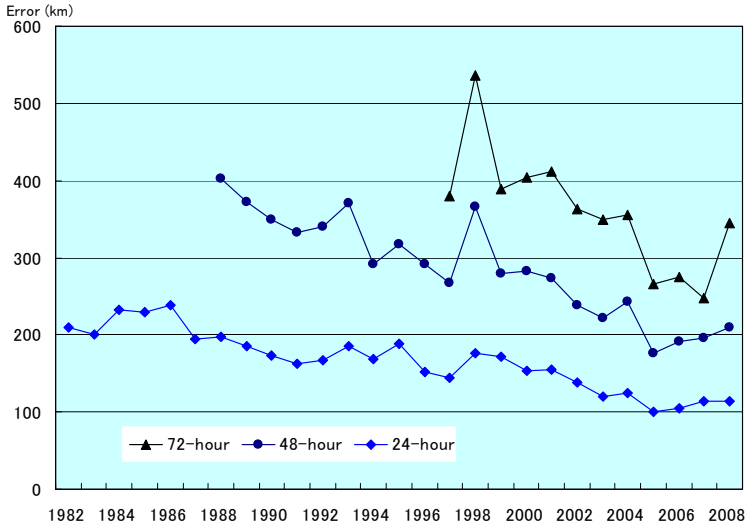


Figure 4.1 Annual means of position errors in 24-, 48- and 72-hour operational track forecasts

The position errors were also compared with those of the persistency (PER) method*. The ratios of EO (i.e. the position errors of operational forecasts) to EP (the position errors of PER method forecasts) as percentages are also shown in Table 4.1. An EO/EP of smaller/greater than 100% indicates that the operational forecast is better/worse than the PER method forecast. The annual mean EO/EPs for the 24-, 48- and 72-hour forecasts in 2008 were 54% (44% in 2007), 45% (32%) and 45% (24%) respectively. Figure 4.2 shows a histogram of 24-hour forecast position errors. About 75% (77% in 2007) of 24-hour forecasts, 80% (84%) of 48-hour forecasts, and 72% (86%) of 72-hour forecasts had errors of less than 150km, 300km, and 450 km respectively.

** The PER method is based on the assumption that a TC holds the same movement throughout the forecast period, and the linear extrapolation of the latest 12-hour track of the TC is applied to obtain the TC track forecasts. Position errors of the PER method are used to evaluate the relative performance of operational forecasts and model predictions.*

Tropical Cyclone			24-hour Forecast				48-hour Forecast				72-hour 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	NEOGURI	(0801)	136	73	14	72	264	96	10	63	434	165	6	38
TY	RAMMASUN	(0802)	134	62	17	56	206	114	13	37	242	97	9	26
STS	MATMO	(0803)	350	41	2	-	-	-	0	-	-	-	0	-
STS	HALONG	(0804)	131	52	13	57	234	69	9	37	419	165	5	39
TY	NAKRI	(0805)	71	46	24	39	141	68	20	33	259	101	16	36
TY	FENGSHEN	(0806)	164	104	21	72	350	197	17	73	544	228	13	79
TY	KALMAEGI	(0807)	113	40	10	52	213	97	6	43	195	7	2	-
TY	FUNG-WONG	(0808)	62	37	13	37	78	32	9	22	211	69	5	39
STS	KAMMURI	(0809)	97	27	7	38	157	29	3	42	-	-	0	-
STS	PHANFONE	(0810)	-	-	0	-	-	-	0	-	-	-	0	-
STS	VONGFONG	(0811)	100	54	5	25	334	0	1	-	-	-	0	-
TY	NURI	(0812)	76	49	17	41	164	65	12	46	329	118	8	44
TY	SINLAKU	(0813)	84	52	45	52	165	102	41	45	235	181	37	40
TY	HAGUPIT	(0814)	103	45	18	64	242	50	14	54	433	176	10	44
TY	JANGMI	(0815)	93	69	22	35	159	84	18	29	360	116	14	50
TS	MEKKHALA	(0816)	273	77	2	-	-	-	0	-	-	-	0	-
TS	HIGOS	(0817)	286	0	1	-	-	-	0	-	-	-	0	-
TS	BAVI	(0818)	261	0	1	-	-	-	0	-	-	-	0	-
STS	MAYSAK	(0819)	172	65	5	84	359	0	1	-	-	-	0	-
TS	HAISHEN	(0820)	298	3	2	-	-	-	0	-	-	-	0	-
TS	NOUL	(0821)	-	-	0	-	-	-	0	-	-	-	0	-
TY	DOLPHIN	(0822)	163	115	19	77	346	205	15	61	608	410	11	52
Annual Mean (Total)			114	80	258	54	209	136	189	45	345	229	136	45

Table 4.1 Mean position errors of 24-, 48- and 72-hour operational forecasts for each TC in 2008. S.D., EO, EP, and EO/EP represent the standard deviation of operational forecast position error, the operational forecast position error, the position error with the PER method, and the ratio of EO to EP respectively.

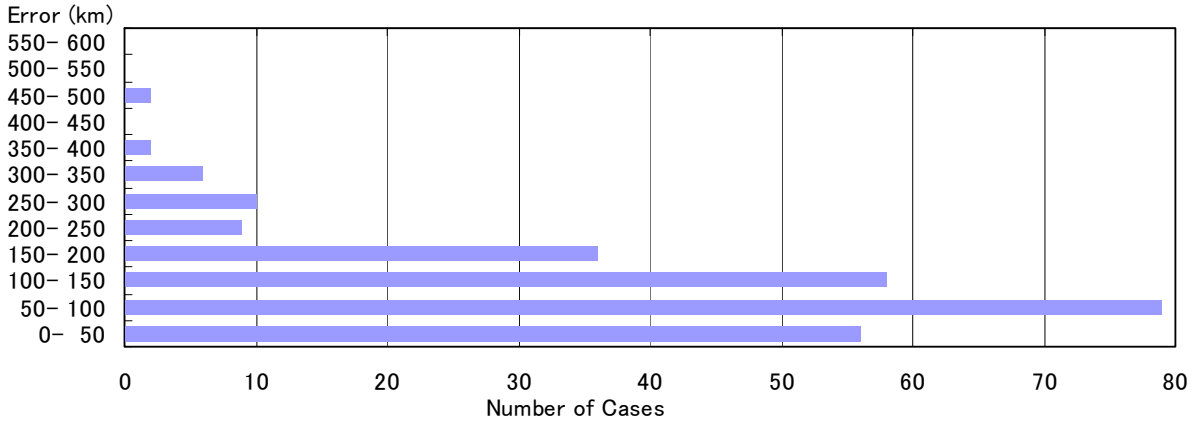


Figure 4.2 Histogram of 24-hour forecast position errors in 2008
(Those for 48- and 72-hour forecasts are included on the attached DVD).

As from 21 May 2008, the Center improves forecasts, reducing radii of 70% probability circles* in its TC track forecasts. The radius of the circle is determined statistically based on the performance in the past several years, depending on the direction and speed of TC movement. The verification of JMA's operational forecasts from 2004 to 2007 indicates the feasibility of reduction in the radii of the circles about 15% on average; 20% in case of a TC moving northwestward and 10% in the other directions.

Table 4.2 presents the mean hitting ratios and radii of the 70% probability circles of operational forecasts for each TC in 2008. The term *hitting ratio* here is used to describe the ratio of forecasts of 70% probability circles within which the actual TC center fell. The annual mean radius of the circles issued for 24-hour position forecasts was 147 km (167 km in 2007), and their hitting ratio was 77% (82%). The corresponding ones for 48-hour forecasts were 254 km (288 km in 2007) and 69% (83%), while those for 72-hour forecasts were 372 km (448 km in 2007) and 63% (91%).

Tropical Cyclone			24-hour Forecast			48-hour Forecast			72-hour Forecast		
			Ratio (%)	Num.	Radius (km)	Ratio (%)	Num.	Radius (km)	Ratio (%)	Num.	Radius (km)
TY	NEOGURI	(0801)	64	14	160	40	10	278	33	6	408
TY	RAMMASUN	(0802)	71	17	175	77	13	292	100	9	478
STS	MATMO	(0803)	0	2	185	-	0	-	-	0	-
STS	HALONG	(0804)	85	13	192	89	9	307	80	5	548
TY	NAKRI	(0805)	92	24	140	85	20	260	88	16	369
TY	FENGSHEN	(0806)	48	21	131	24	17	237	15	13	348
TY	KALMAEGI	(0807)	70	10	131	83	6	266	100	2	408
TY	FUNG-WONG	(0808)	92	13	130	100	9	204	80	5	296
STS	KAMMURI	(0809)	86	7	131	100	3	259	-	0	-
STS	PHANFONE	(0810)	-	0	-	-	0	-	-	0	-
STS	VONGFONG	(0811)	80	5	158	0	1	334	-	0	-
TY	NURI	(0812)	94	17	139	83	12	204	50	8	296
TY	SINLAKU	(0813)	91	45	149	85	41	275	86	37	399
TY	HAGUPIT	(0814)	78	18	136	50	14	238	50	10	347
TY	JANGMI	(0815)	91	22	142	72	18	239	36	14	320
TS	MEKKHALA	(0816)	0	2	130	-	0	-	-	0	-
TS	HIGOS	(0817)	0	1	139	-	0	-	-	0	-
TS	BAVI	(0818)	0	1	222	-	0	-	-	0	-
STS	MAYSAK	(0819)	40	5	135	0	1	296	-	0	-
TS	HAISHEN	(0820)	0	2	158	-	0	-	-	0	-
TS	NOUL	(0821)	-	0	-	-	0	-	-	0	-
TY	DOLPHIN	(0822)	63	19	142	33	15	222	27	11	296
Annual Mean (Total)			77	258	147	69	189	254	63	136	372

Table 4.2 Mean hitting ratios (%) and radii (km) of 70% probability circles for 24-, 48- and 72-hour operational forecasts for each TC in 2008

* probability circle: a circular range in which a TC is expected to be located with a probability of 70% at each forecast time to indicate uncertainty of the forecasts

4.1.2 Central Pressure and Maximum Wind Speed

Table 4.3 gives the root mean square errors (RMSEs) of 24-, 48- and 72-hour operational central pressure forecasts for each TC in 2008. The RMSEs for maximum wind speed forecasts are included on the attached DVD. The annual mean RMSEs of the central pressure and the maximum wind speed for 24-hour forecasts were 13.9 hPa (13.0 hPa in 2007) and 7.3 m/s (6.7 m/s). For 48-hour forecasts, the corresponding ones were 20.2 hPa (17.0 hPa in 2007) and 10.1 m/s (8.5 m/s), while those for 72-hour forecasts were 20.5 hPa (19.9 hPa) and 9.4 m/s (9.5 m/s) respectively.

Tropical Cyclone			24-hour Forecast			48-hour Forecast			72-hour Forecast		
			Error (hPa)	RMSE (hPa)	Num.	Error (hPa)	RMSE (hPa)	Num.	Error (hPa)	RMSE (hPa)	Num.
TY	NEOGURI	(0801)	2.9	9.3	14	11.1	16.3	10	6.0	15.7	6
TY	RAMMASUN	(0802)	8.2	19.6	17	16.9	29.5	13	10.6	20.5	9
STS	MATMO	(0803)	1.0	1.4	2	-	-	0	-	-	0
STS	HALONG	(0804)	1.4	5.1	13	-3.1	7.7	9	-7.6	8.0	5
TY	NAKRI	(0805)	2.8	24.7	24	-2.3	32.4	20	-11.6	24.3	16
TY	FENGSHEN	(0806)	-2.9	13.4	21	-12.6	22.1	17	-24.5	29.5	13
TY	KALMAEGI	(0807)	-9.8	20.3	10	-10.8	24.7	6	-14.0	14.0	2
TY	FUNG-WONG	(0808)	-5.2	8.3	13	-11.7	14.6	9	-17.0	17.2	5
STS	KAMMURI	(0809)	1.4	7.1	7	7.3	7.7	3	-	-	0
STS	PHANFONE	(0810)	-	-	0	-	-	0	-	-	0
STS	VONGFONG	(0811)	3.2	3.3	5	8.0	8.0	1	-	-	0
TY	NURI	(0812)	-1.8	15.9	17	-7.0	14.5	12	-19.5	23.0	8
TY	SINLAKU	(0813)	-3.7	13.1	45	-6.8	16.1	41	-10.6	17.6	37
TY	HAGUPIT	(0814)	-2.1	6.1	18	-0.1	10.1	14	1.3	11.8	10
TY	JANGMI	(0815)	3.7	13.6	22	9.5	25.2	18	1.9	27.4	14
TS	MEKKHALA	(0816)	-11.5	13.2	2	-	-	0	-	-	0
TS	HIGOS	(0817)	-4.0	4.0	1	-	-	0	-	-	0
TS	BAVI	(0818)	0.0	0.0	1	-	-	0	-	-	0
STS	MAYSAK	(0819)	4.2	7.1	5	6.0	6.0	1	-	-	0
TS	HAISHEN	(0820)	0.0	0.0	2	-	-	0	-	-	0
TS	NOUL	(0821)	-	-	0	-	-	0	-	-	0
TY	DOLPHIN	(0822)	-3.3	5.9	19	-5.3	9.0	15	-9.0	11.0	11
Annual Mean (Total)			-0.6	13.9	258	-1.9	20.2	189	-8.3	20.5	136

Table 4.3 Mean intensity errors of 24-, 48- and 72-hour operational central pressure forecasts for each TC in 2008

Figure 4.3 shows a histogram of maximum wind speed errors for 24-hour forecasts. About 45% (44% in 2007) of 24-hour forecasts had errors of less than ±3.75 m/s, with figures of ±6.25 m/s for 45% (55%) of 48-hour forecasts and ±6.25 m/s for 46% (47%) of 72-hour forecasts.

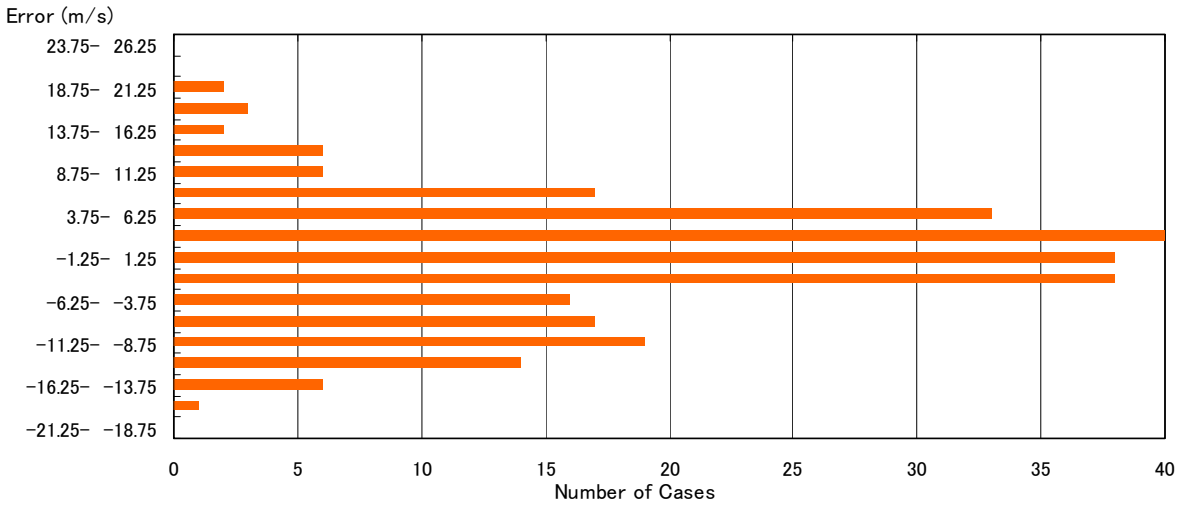


Figure 4.3 Histogram of 24-hour forecast maximum wind speed errors in 2008
(Those for 48- and 72-hour forecasts are shown on the attached DVD)

4.2 Verification of Numerical Models (GSM, TEPS)

The Global Spectral Model (GSM) and the Typhoon Ensemble Prediction System (TEPS) provide primary information for JMA forecasters to make operational TC track and intensity forecasts. The details and recent improvements on GSM and TEPS are given in Appendix 6. GSM and TEPS predictions were verified with RSMC TC best track data and predictions using the persistency (PER) method. All TC forecast verifications were conducted for the both systems.

4.2.1 GSM Predictions

1) Center Position

The GSM annual mean position errors since 1996 are presented in Figure 4.4. In 2008, the annual mean errors for 30-, 54- and 78-hour* predictions were 136 km (143 km in 2007), 220 km (201 km) and 346 km (252 km) respectively. 30- and 54-hour forecast errors were almost same with 2007, while 78-hour forecast error became worse than previous 3-years. The mean position errors of 18-, 30-, 42-, 54-, 66- and 78-hour predictions for each TC are given in Table 4.4.

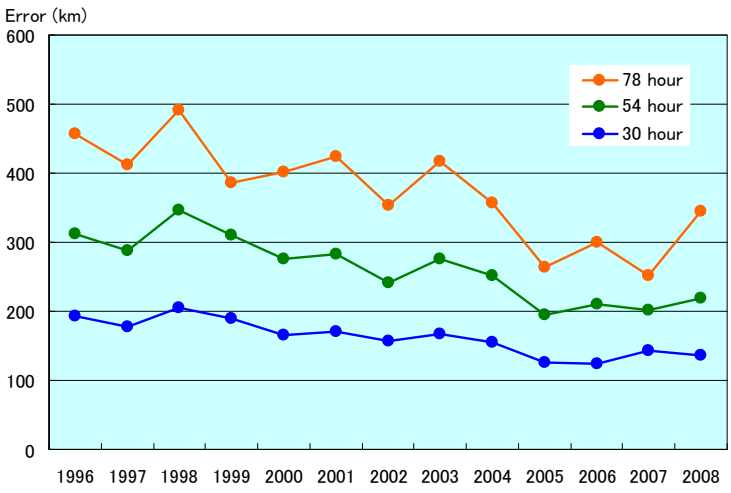


Figure 4.4 GSM annual mean position errors since 1996

** 30-, 54- 78-hour predictions using GSM are the primary information for forecasters preparing 24-, 48- and 72-hour operational forecasts respectively.*

Table 4.4 Mean position errors (km) of GSM for each TC in 2008.
The number of samples is given in parentheses.

Tropical Cyclone			T=18		T=30		T=42		T=54		T=66		T=78	
TY	0801	NEOGURI	109.1	(20)	136.5	(18)	195.8	(16)	256.0	(14)	340.6	(12)	447.0	(10)
TY	0802	RAMMASUN	82.8	(22)	108.9	(20)	118.6	(18)	139.0	(16)	150.7	(14)	176.1	(12)
STS	0803	MATMO	284.7	(8)	402.7	(6)	523.9	(4)	661.0	(2)	-	(-)	-	(-)
STS	0804	HALONG	104.5	(20)	127.7	(18)	156.7	(16)	191.8	(14)	268.6	(12)	348.2	(10)
TY	0805	NAKRI	75.5	(25)	91.0	(23)	110.6	(21)	155.7	(19)	225.3	(17)	272.1	(15)
TY	0806	FENGSHEN	108.0	(24)	194.0	(21)	299.3	(19)	435.5	(15)	606.0	(12)	748.7	(9)
TY	0807	KALMAEGI	122.5	(25)	161.8	(22)	206.4	(19)	271.7	(17)	358.1	(15)	443.1	(13)
TY	0808	FUNG-WONG	83.4	(19)	95.1	(17)	93.3	(15)	101.2	(13)	127.6	(11)	157.8	(9)
STS	0809	KAMMURI	74.3	(13)	96.3	(11)	145.5	(9)	300.6	(6)	451.3	(3)	709.6	(1)
STS	0810	PHANFONE	223.5	(3)	522.2	(1)	-	(-)	-	(-)	-	(-)	-	(-)
STS	0811	VONGFONG	95.9	(7)	98.0	(3)	11.1	(1)	-	(-)	-	(-)	-	(-)
TY	0812	NURI	80.4	(20)	94.9	(18)	130.6	(16)	190.6	(14)	282.8	(12)	375.6	(9)
TY	0813	SINLAKU	71.0	(48)	96.6	(46)	133.4	(44)	167.9	(42)	198.4	(40)	238.2	(38)
TY	0814	HAGUPIT	79.3	(21)	86.9	(19)	129.5	(17)	202.7	(15)	295.0	(13)	455.0	(11)
TY	0815	JANGMI	88.5	(25)	126.7	(23)	138.8	(21)	181.3	(19)	258.7	(17)	320.6	(13)
TS	0816	MEKKHALA	275.5	(7)	398.8	(5)	593.3	(3)	885.2	(1)	-	(-)	-	(-)
TS	0817	HIGOS	193.9	(12)	218.5	(8)	194.2	(6)	206.5	(4)	161.1	(2)	-	(-)
TS	0818	BAVI	166.1	(5)	235.5	(3)	304.4	(1)	-	(-)	-	(-)	-	(-)
STS	0819	MAYSAK	94.3	(8)	100.4	(6)	175.1	(4)	162.5	(1)	-	(-)	-	(-)
TS	0820	HAISHEN	225.6	(3)	-	(-)	-	(-)	-	(-)	-	(-)	-	(-)
TS	0821	NOUL	174.5	(4)	299.8	(2)	-	(-)	-	(-)	-	(-)	-	(-)
TY	0822	DOLPHIN	113.0	(26)	155.9	(24)	210.8	(22)	291.6	(20)	389.8	(18)	437.0	(16)
Annual Mean			106.5	(365)	135.9	(314)	169.8	(272)	219.6	(232)	280.6	(198)	345.6	(166)

Table 4.5 gives GSM's relative performance compared with the PER method. In this comparison, life stages of TCs were classified into the three stages of before, during and after recurvature. Each stage is defined with the direction of movement of each TC at each prediction time. The table indicates that GSM outperformed the PER method throughout the forecast period beyond 18 hours from the initial time, and that the rates of error reduction for GSM compared to the PER method were about 36% (41% in 2007), 53% (57%), 59% (69%) and 59% (76%) for 18-, 30-, 54- and 78-hour predictions respectively. These rates were relatively higher for the *after* stage, in which the position errors of the PER methods were larger than those for the other two stages.

About 70% (65% in 2007) of 30-hour predictions had errors of less than 150 km, while 74% (83%) of 54-hour predictions had errors of less than 300 km, and 73% (90%) of 78-hour predictions had errors of less than 450 km respectively. Histograms of the position errors of 30-, 54- and 78-hour predictions are included on the attached DVD.

TIME	MODEL	Before	During	After	All
T=18	GSM	111.1 (148)	87.6 (93)	115.1 (124)	106.5 (365)
	PER	144.7 (148)	144.9 (93)	206.0 (124)	165.6 (365)
	IMPROV	23.3 %	39.6 %	44.1 %	35.7 %
T=30	GSM	142.6 (121)	111.1 (83)	147.3 (110)	135.9 (314)
	PER	234.9 (121)	248.8 (83)	372.4 (110)	286.7 (314)
	IMPROV	39.3 %	55.3 %	60.4 %	52.6 %
T=42	GSM	171.0 (98)	163.6 (74)	173.2 (100)	169.8 (272)
	PER	335.9 (98)	386.4 (74)	518.3 (100)	416.7 (272)
	IMPROV	49.1 %	57.7 %	66.6 %	59.3 %
T=54	GSM	214.4 (76)	220.3 (65)	223.5 (91)	219.6 (232)
	PER	471.3 (76)	513.7 (65)	619.6 (91)	541.3 (232)
	IMPROV	54.5 %	57.1 %	63.9 %	59.4 %
T=66	GSM	269.2 (59)	288.5 (55)	283.3 (84)	280.6 (198)
	PER	586.8 (59)	666.9 (55)	736.9 (84)	672.7 (198)
	IMPROV	54.1 %	56.7 %	61.6 %	58.3 %
T=78	GSM	369.5 (46)	315.9 (43)	348.0 (77)	345.6 (166)
	PER	758.0 (46)	749.0 (43)	944.4 (77)	842.2 (166)
	IMPROV	51.3 %	57.8 %	63.2 %	59.0 %

Table 4.5 Mean position errors (km) of GSM and PER method predictions for the 22 TCs in 2008 in the stages before, during and after recurvature. The number of samples is given in parentheses. IMPROV is error reduction rate of GSM to the PER method.

2) Central Pressure and Maximum Wind Speed

Due to the upgrade of the GSM in November 2007 with finer horizontal resolution of approx. 20 km compared to the previous 60 km, remarkable improvement is found in TC intensity forecast between 2007 and 2008.

The mean errors of 30-, 54-, 78-hour central pressure predictions by GSM in 2008 were +10.4 hPa (+15.7 hPa in 2007), +12.5 hPa (+17.1 hPa) and +10.3 hPa (+15.0 hPa) respectively. Their root mean square errors (RMSEs) were 18.9 hPa (25.7 hPa in 2007) for 30-hour predictions, 23.3 hPa (28.5 hPa) for 54-hour predictions and 24.7 hPa (28.2 hPa) for 78-hour predictions. The bias for 30-, 54-, and 78-hour maximum wind speed predictions were -6.0 m/s (-11.4 m/s in 2007) with RMSE of 10.5 m/s (16.1 m/s), -6.7 m/s (-12.0 m/s) with RMSE of 12.9 m/s (17.6 m/s) and -5.9 m/s (-10.6 m/s) with RMSE of 13.2 m/s (17.2 m/s) respectively.

Figure 4.5 shows histograms of the central pressure errors and the maximum wind speed errors of 30-hour GSM predictions. The figures show that GSM tends to underestimate the wind speed of TCs (right) and have a positive bias for the central pressure prediction (left). However, those errors were significantly reduced in 2008 compared with 2007. The reason should be the resolution improvement of the GSM. GSM was upgraded from TL319L40 (approx horizontal resolution: 60 km) to TL959L60 (approx horizontal resolution: 20 km) on November 2007. It makes GSM possible to predict the steeper pressure gradient around the center of the typhoon.

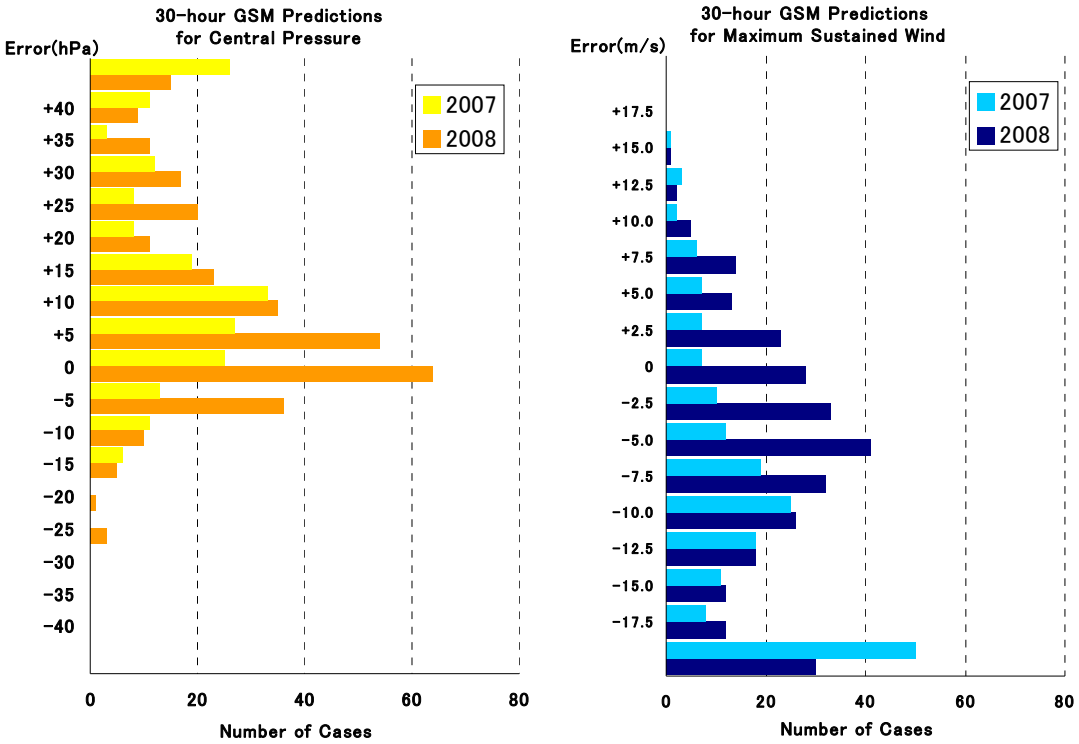


Figure 4.5 Error distributions of GSM 30-hour intensity predictions in 2008 and 2007. The figure on the left shows error distributions for central pressure, while the one on the right shows those for maximum wind speed (the error distributions of 54- and 78-hour predictions are included on the attached DVD).

4.2.2 TEPS Predictions

1) Ensemble mean center position

The mean position error of TEPS ensemble mean forecasts at 30-, 54-, 78-, 102- and 126-hour predictions for each TC are given in Table 4.6. Annual mean of ensemble mean position error at 30-, 54- and 78-hour predictions are 167 km (136 km in GSM), 272 km (220 km) and 417 km (346 km) respectively.

Table 4.6 Mean position errors (km) of TEPS ensemble mean forecasts for each TC in 2008. The number of samples is given in parentheses.

Tropical Cyclone			T=30		T=54		T=78		T=102		T=126	
TY	0801	NEOGURI	160.9	(13)	286.3	(8)	313.2	(3)	-	(-)	-	(-)
TY	0802	RAMMASUN	142.4	(19)	169.7	(15)	192.5	(11)	392.1	(7)	780.1	(3)
STS	0803	MATMO	479.6	(5)	803.3	(1)	-	(-)	-	(-)	-	(-)
STS	0804	HALONG	149.6	(18)	241.1	(14)	323.3	(10)	331.0	(6)	284.4	(2)
TY	0805	NAKRI	117.9	(23)	232.4	(19)	393.5	(15)	525.3	(11)	420.6	(7)
TY	0806	FENGSHEN	266.0	(24)	597.9	(15)	1002.0	(10)	1344.0	(7)	1781.3	(7)
TY	0807	KALMAEGI	198.5	(22)	318.3	(17)	518.1	(11)	661.1	(6)	631.0	(2)
TY	0808	FUNG-WONG	82.5	(16)	103.7	(12)	193.7	(8)	303.8	(4)	-	(-)
STS	0809	KAMMURI	83.7	(9)	126.8	(3)	-	(-)	-	(-)	-	(-)
STS	0810	PHANFONE	551.8	(1)	-	(-)	-	(-)	-	(-)	-	(-)
STS	0811	VONGFONG	149.3	(3)	-	(-)	-	(-)	-	(-)	-	(-)
TY	0812	NURI	160.5	(18)	361.8	(12)	659.4	(6)	-	(-)	-	(-)
TY	0813	SINLAKU	125.6	(46)	198.3	(42)	240.8	(38)	282.6	(34)	331.5	(30)
TY	0814	HAGUPIT	105.8	(19)	229.1	(15)	500.6	(11)	960.8	(7)	1410.7	(3)
TY	0815	JANGMI	131.9	(22)	197.3	(18)	419.5	(13)	765.7	(9)	1076.7	(6)
TS	0816	MEKKHALA	395.2	(4)	-	(-)	-	(-)	-	(-)	-	(-)
TS	0817	HIGOS	249.1	(8)	241.0	(4)	-	(-)	-	(-)	-	(-)
TS	0818	BAVI	244.2	(1)	-	(-)	-	(-)	-	(-)	-	(-)
STS	0819	MAYSAK	133.3	(6)	252.2	(2)	-	(-)	-	(-)	-	(-)
TS	0820	HAISHEN	-	(-)	-	(-)	-	(-)	-	(-)	-	(-)
TS	0821	NOUL	301.8	(2)	-	(-)	-	(-)	-	(-)	-	(-)
TY	0822	DOLPHIN	225.9	(21)	445.0	(17)	659.7	(13)	680.7	(9)	634.6	(5)
All	Annual	Mean	166.6	(300)	271.6	(214)	416.8	(149)	544.5	(100)	667.6	(65)

2) Spread-skill relationship

While position error of TEPS ensemble mean forecast was larger than GSM in short range forecast, TEPS gives the useful information on the reliability of the TC track forecast with its ensemble spread. Figure 4.6 shows relationship between 6-hourly accumulated ensemble spread on the TC position forecast and ensemble mean forecast position error at 126-hour prediction. The large position error was found when the ensemble spread was large, generally.

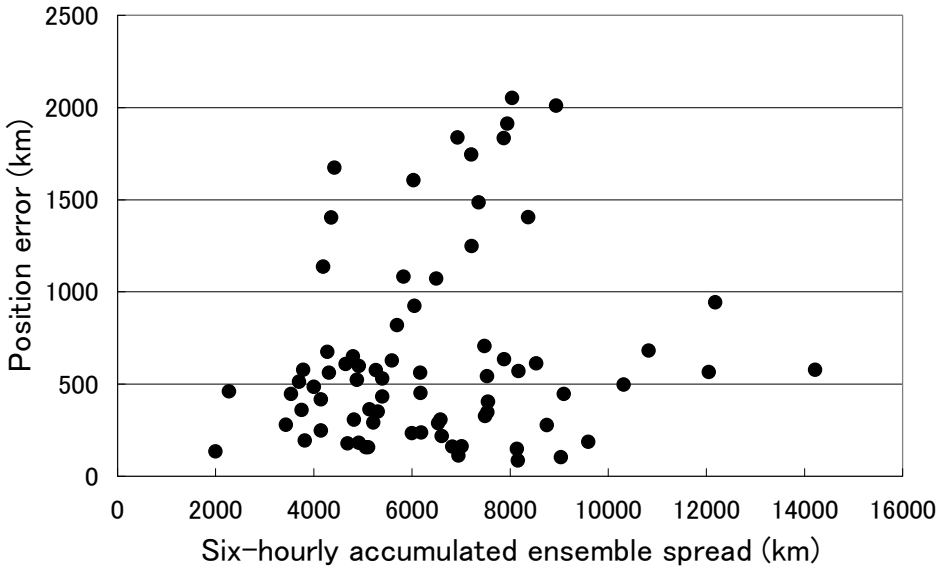


Figure 4.6 Relation between 6-hourly accumulated ensemble spread on the TC position forecast (km) and ensemble mean forecast position error (km) at 126-hour prediction.

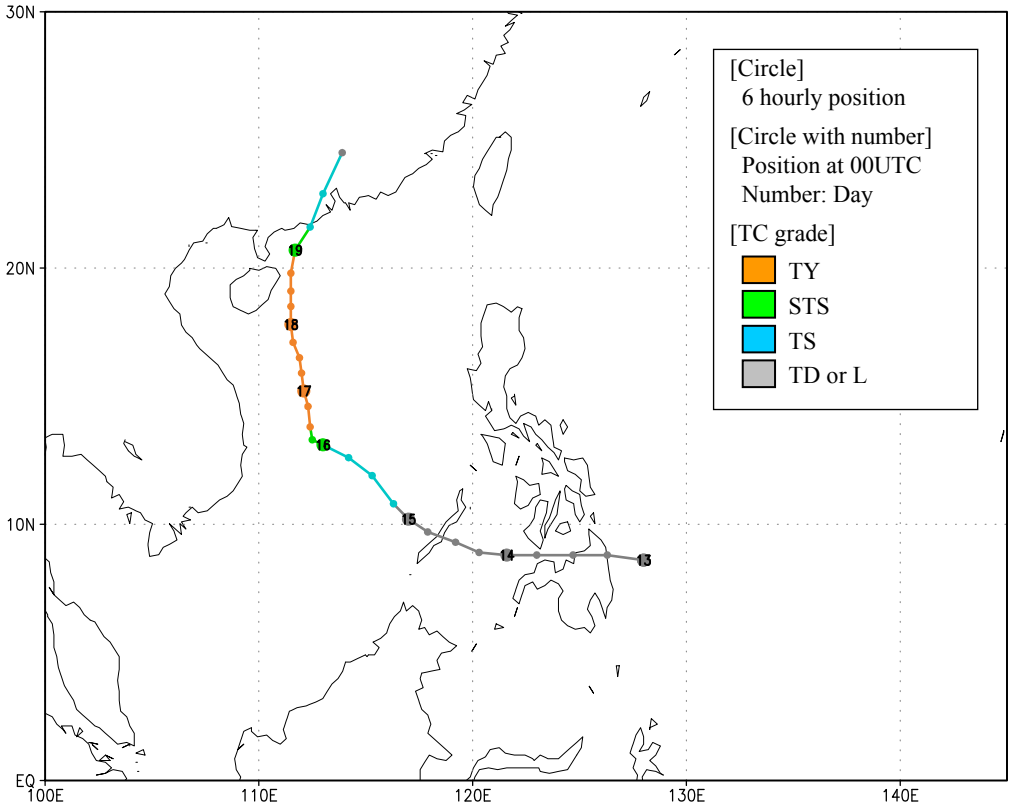
Table 4.7 shows ensemble mean forecast errors classified with 6-hourly accumulated ensemble spread at each forecast time. A reliability index (A, B or C, representing the categories of the highest, middle-level or lowest reliability, respectively) is allocated, and the frequency of each category is set to be 40%, 40% and 20% respectively. Mean position errors of reliability C are larger than those of reliability B through out all forecast times. But the reliability A shows the larger position error compared with the reliability B up to 102-hour forecast. Although the accuracy remains to be improved, TEPS can give the reliability information on the typhoon track forecast.

Table 4.7 Ensemble mean forecast position errors (km) in 2008 classified with 6-hourly accumulated ensemble spread at each forecast time. The number of samples is given in parentheses.

	Reliability Index		
Time	A	B	C
T=30	164.9 (79)	162.4 (189)	176.4 (51)
T=54	323.4 (46)	246.5 (150)	274.2 (46)
T=78	475.1 (19)	358.4 (110)	447.1 (39)
T=102	487.9 (10)	439.4 (68)	672.6 (34)
T=126	366.4 (05)	626.3 (46)	744.6 (24)

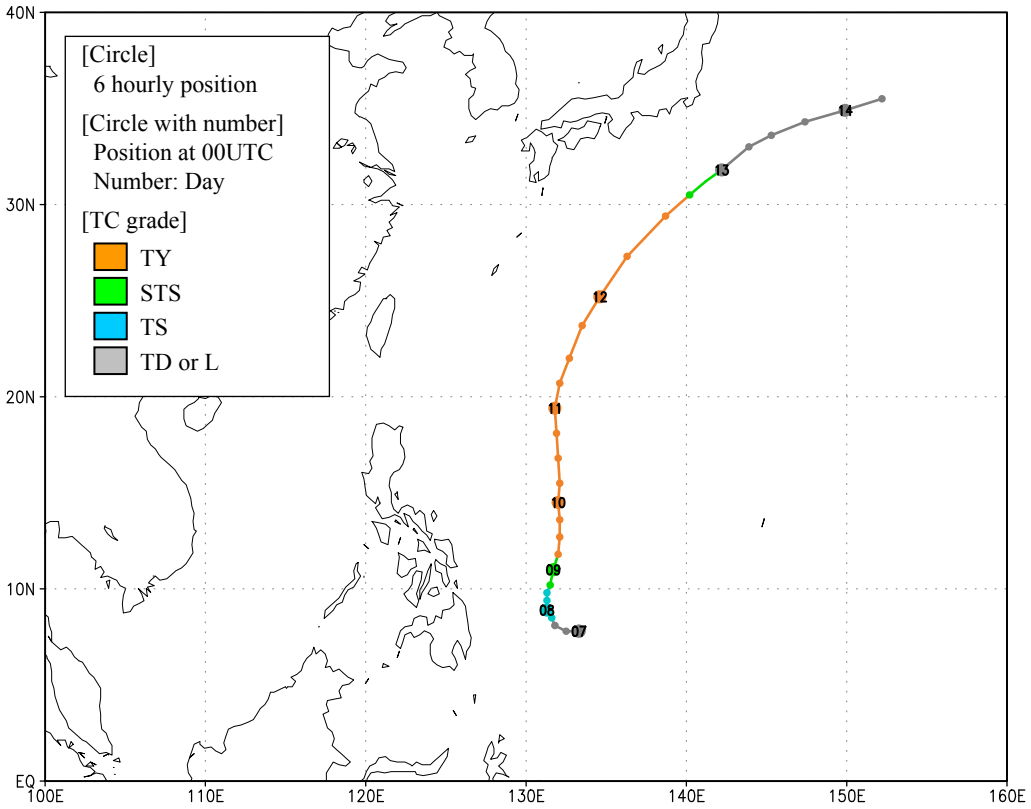
NEOGURI (0801)

NEOGURI formed as a tropical depression (TD) off the east coast of Mindanao Island at 00 UTC on 13 April 2008. Moving westward and passing over Mindanao Island and the Sulu Sea before turning gradually to the northwest, it was upgraded to tropical storm (TS) intensity over the sea northwest of Palawan Island at 06 UTC on 15 April. Early on 16 April, it turned sharply to the north, and was upgraded to typhoon (TY) intensity over the middle of the South China Sea at 12 UTC on that day. Moving northward over the South China Sea, NEOGURI reached peak intensity with maximum sustained winds of 80 kt and a central pressure of 960 hPa at 06 UTC on 17 April. After passing by east of Hainan Island, it gradually weakened and was downgraded to TS intensity at 06 UTC on 19 April, reaching the coast west of Macao, China around that time. It weakened to TD intensity at 18 UTC on 19 April and dissipated at 00 UTC 20 April.



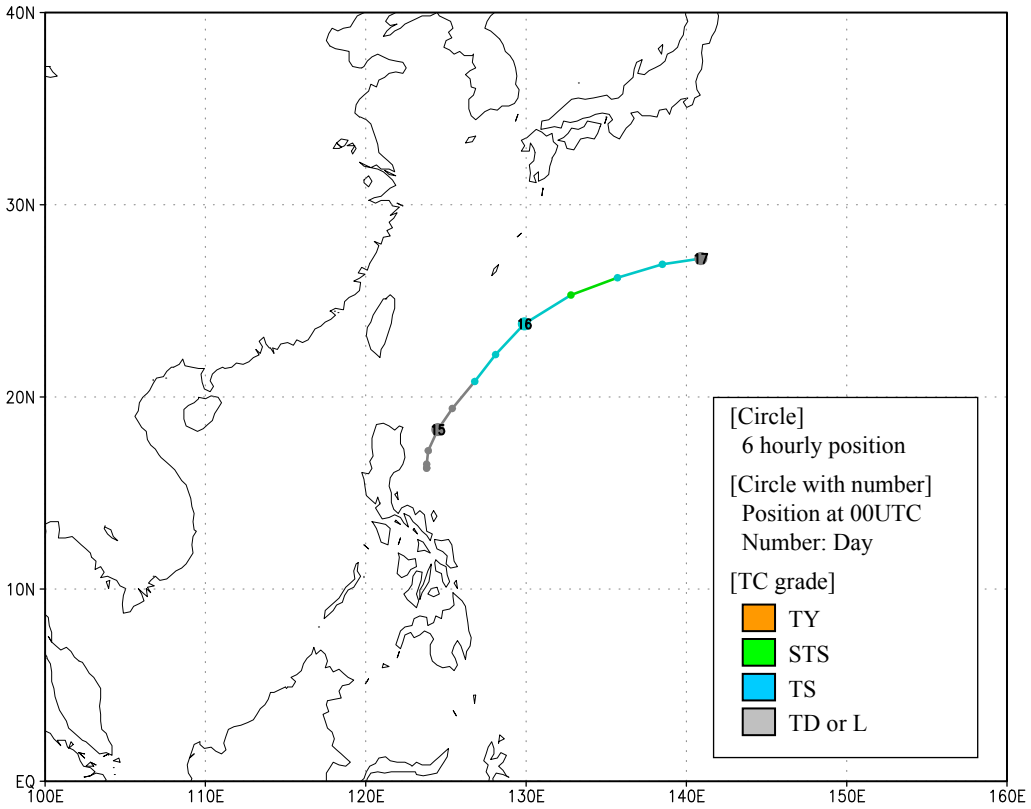
RAMMASUN (0802)

RAMMASUN formed as a tropical depression (TD) over the sea east of the Philippines at 00 UTC on 7 May 2008. Moving westward, it was upgraded to tropical storm (TS) intensity over the same waters at 18 UTC that day. After turning to the north, it was upgraded to typhoon (TY) intensity over the same sea at 06 UTC on 9 May and reached peak intensity with maximum sustained winds of 105 kt and a central pressure of 915 hPa at 12 UTC the next day. Then turning to the east-northeast, it was downgraded to severe tropical storm (STS) intensity south of Hachijojima Island at 18 UTC on 12 May, and transformed into an extratropical cyclone southeast of Hachijojima Island at 00 UTC the next day. Moving east-northeastward, it dissipated over the sea east of Japan at 12 UTC on 14 May.



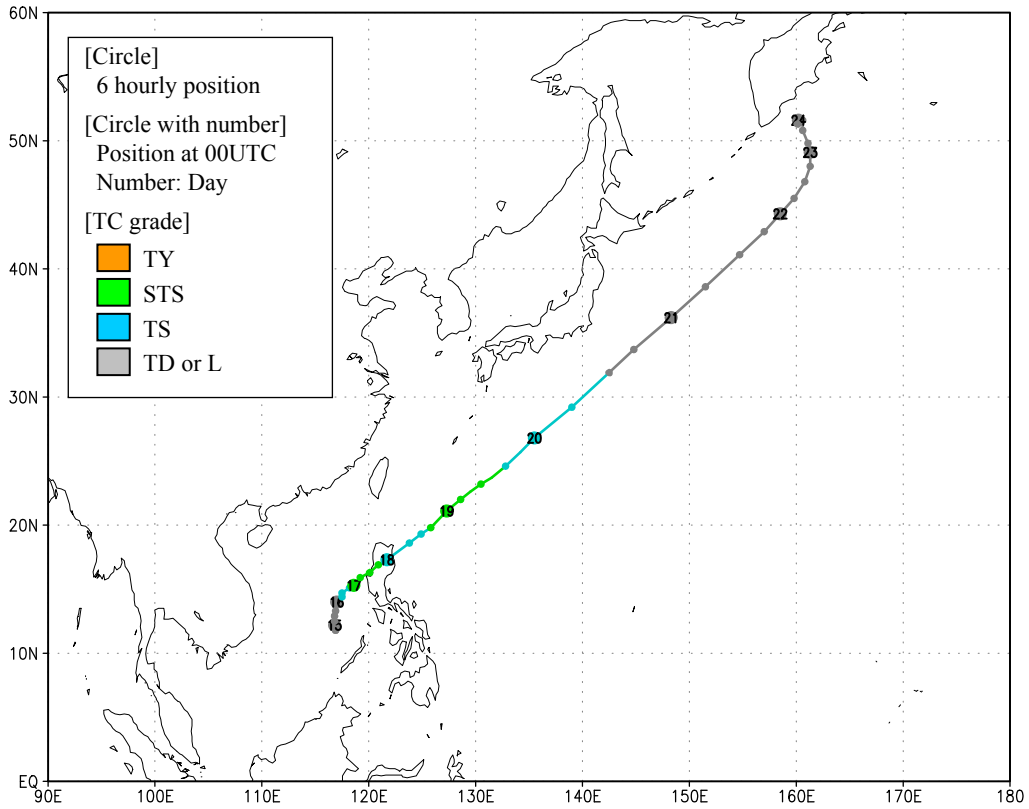
MATMO (0803)

MATMO formed as a tropical depression (TD) over the sea east of Luzon Island at 06 UTC on 14 May 2008. Moving to the northeast, it was upgraded to tropical storm (TS) intensity over the sea south of Okinawa Island at 12 UTC the next day. Keeping its northeastward track, MATMO was upgraded to severe tropical storm (STS) intensity and reached peak intensity with maximum sustained winds of 50 kt and a central pressure of 992 hPa over the sea south of Japan at 06 UTC on 16 May. Weakening and turning to the east, it was downgraded to TD intensity over the sea north of Iwojima Island at 00 UTC the next day before dissipating over the same waters six hours later.



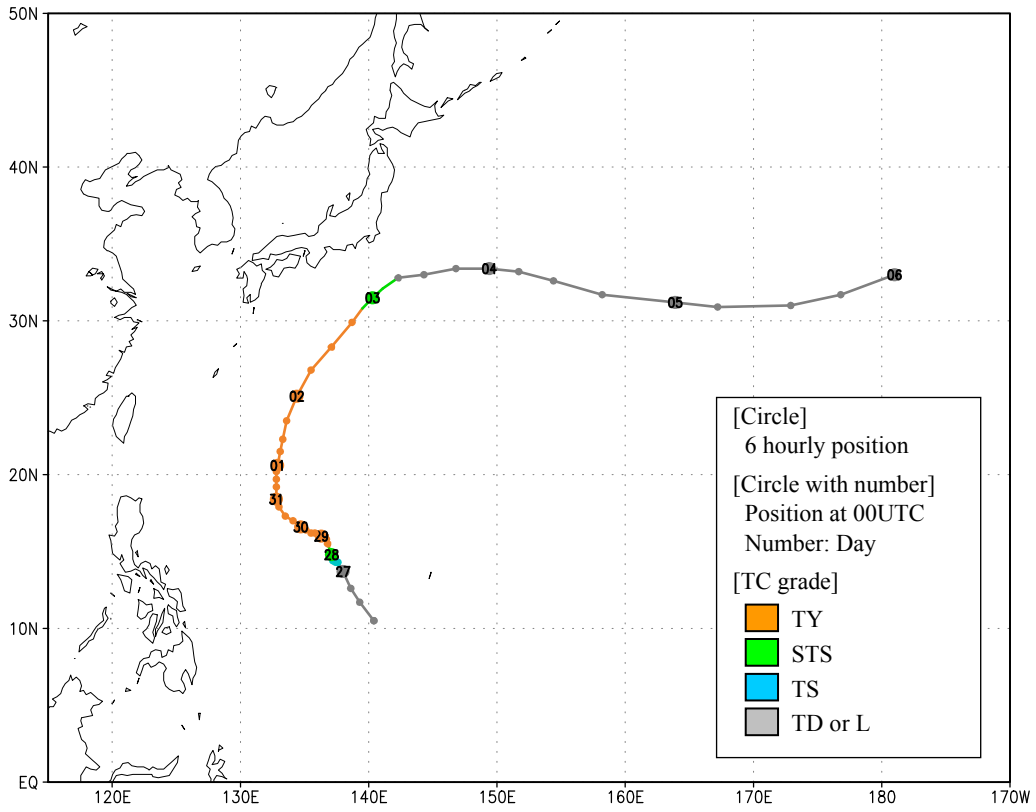
HALONG (0804)

HALONG formed as tropical depression (TD) over the South China Sea at 12 UTC on 14 May 2008. Moving northward and then turning gradually to the northeast, it was upgraded to tropical storm (TS) intensity over the same waters at 06 UTC on 16 May. It developed further to severe tropical storm (STS) intensity at 00 UTC on 17 May and reached peak intensity with maximum sustained winds of 60 kt and a central pressure of 975 hPa off the west coast of Luzon Island at 06 UTC on 17 May. Subsequently, it hit the northern part of Luzon Island and weakened to TS intensity at 00 UTC on 18 May. After passing over the island, it redeveloped slowly and was upgraded to STS intensity at 18 UTC on 18 May, reaching peak intensity with maximum sustained winds of 55 kt and a central pressure of 980 hPa over the sea south of Okinawa Island. Keeping its northeastward track, HALONG gradually weakened and transformed into an extratropical cyclone over the sea southeast of Hachijojima Island at 12 UTC on 20 May. After moving northeastward over the sea east of Japan, it dissipated over the sea southeast of the Kamchatka Peninsula at 12 UTC on 24 May.



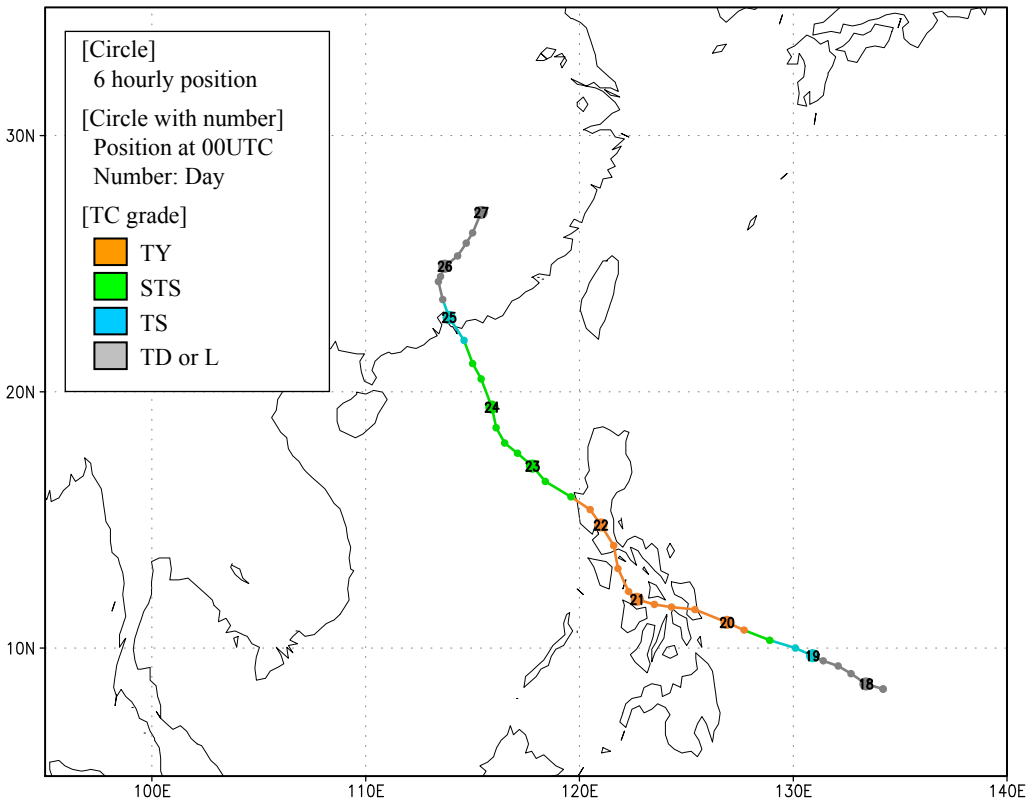
NAKRI (0805)

NAKRI formed as a tropical depression (TD) over the sea east of Yap Island at 06 UTC on 26 May 2008. It moved northwestwards and became a tropical storm (TS) north of Yap Island at 06 UTC on 27 May. Continuing slowly northwestwards, it was quickly upgraded to typhoon (TY) intensity at 06 UTC on 28 May and reached peak intensity with maximum sustained winds of 100 kt and a central pressure of 930 hPa at 12 UTC on 29 May. Weakening from 30 May to 1 June, NAKRI turned to the north and passed west of Okinotorishima Island. From the afternoon of 1 June, it redeveloped slightly again and moved northeastward over the sea south of Japan. At 06 UTC on 3 June, NAKRI transformed into an extratropical cyclone east of Hachijojima Island and continued to move eastward until it crossed 180°E before 00 UTC on 6 June.



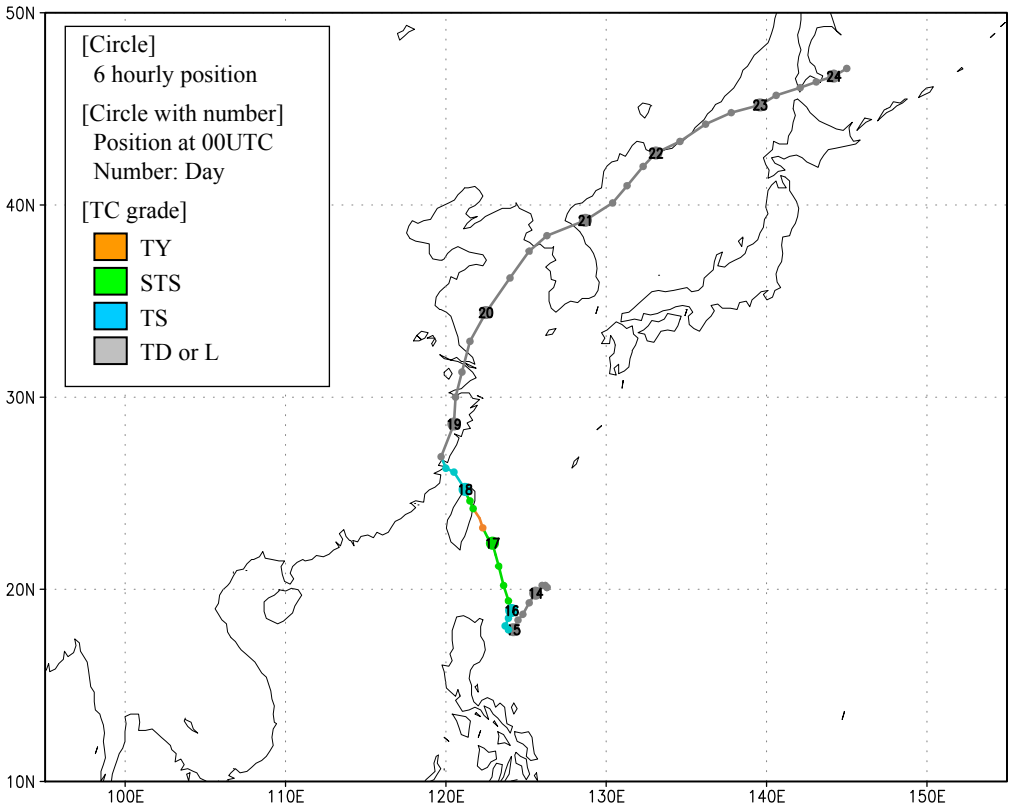
FENGSHEN (0806)

FENGSHEN formed as a tropical depression (TD) over the sea northwest of the Palau Islands at 18 UTC on 17 June 2008. Moving west-northwestward, it was upgraded to tropical storm (TS) intensity east of Mindanao Island at 00 UTC on 19 June. Keeping its west-northwestward track, it was rapidly upgraded to typhoon (TY) intensity east of Samar Island at 18 UTC the same day before hitting Samar Island early the next day. Turning from the west-northwest to the northwest, it reached peak intensity with maximum sustained winds of 90 kt and a central pressure of 945 hPa south of Sibuyan Island at 00 UTC on 21 June. After hitting Luzon Island late on 21 June, it moved over the South China Sea before 12 UTC the next day. FENGSHEN turned to the north-northwest on 23 June and hit Hong Kong before 00 UTC on 25 June. After being downgraded to TD intensity at 06 UTC on 25 June, it turned to the northeast and dissipated over southern China at 06 UTC on 27 June.



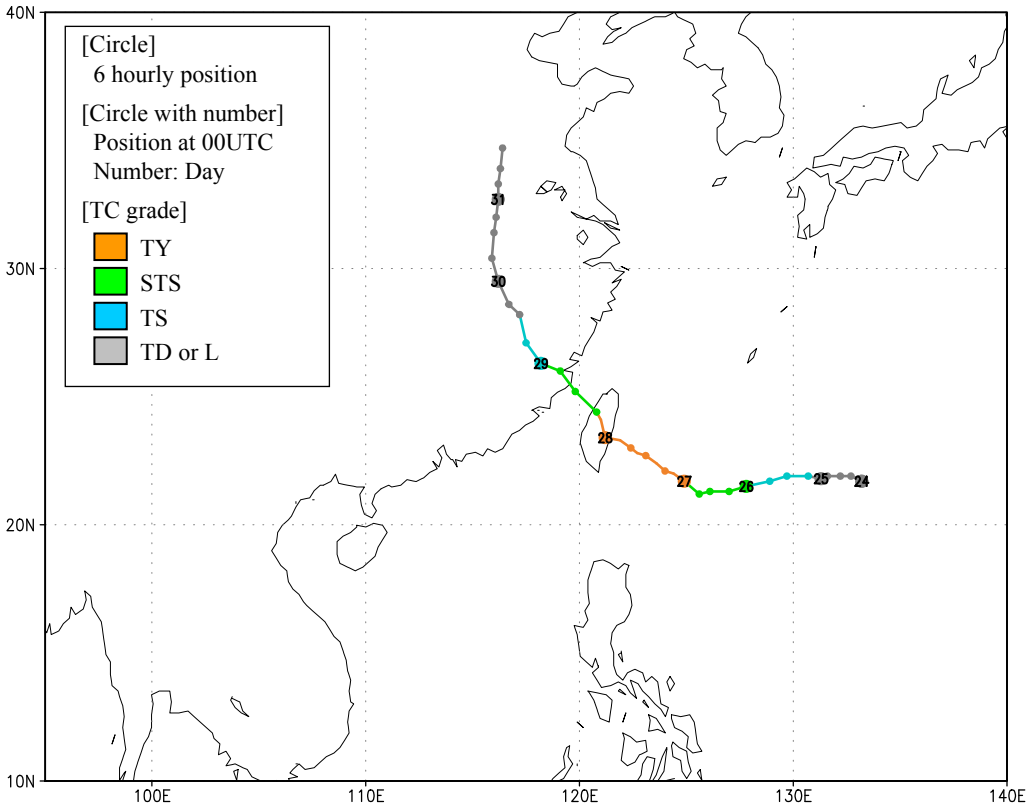
KALMAEGI (0807)

KALMAEGI formed as a tropical depression (TD) over the sea northeast of the Philippines at 06 UTC on 13 July 2008. Moving southwestward, it was upgraded to tropical storm (TS) intensity over the same waters at 06 UTC on 15 July. After turning northward, it was upgraded to typhoon (TY) intensity over the sea east of Taiwan at 06 UTC on 17 July and reached peak intensity with maximum sustained winds of 65 kt and a central pressure of 970 hPa. Then turning northwestward, it crossed Taiwan Island with TS intensity and transformed into a tropical depression over southeastern China at 18 UTC on 18 July. It turned northeastward, crossed the Yellow Sea and transformed into an extratropical cyclone at 12 UTC on 20 July before crossing the Korean peninsula. KALMAEGI dissipated over the Sea of Okhotsk at 12 UTC on 24 July.



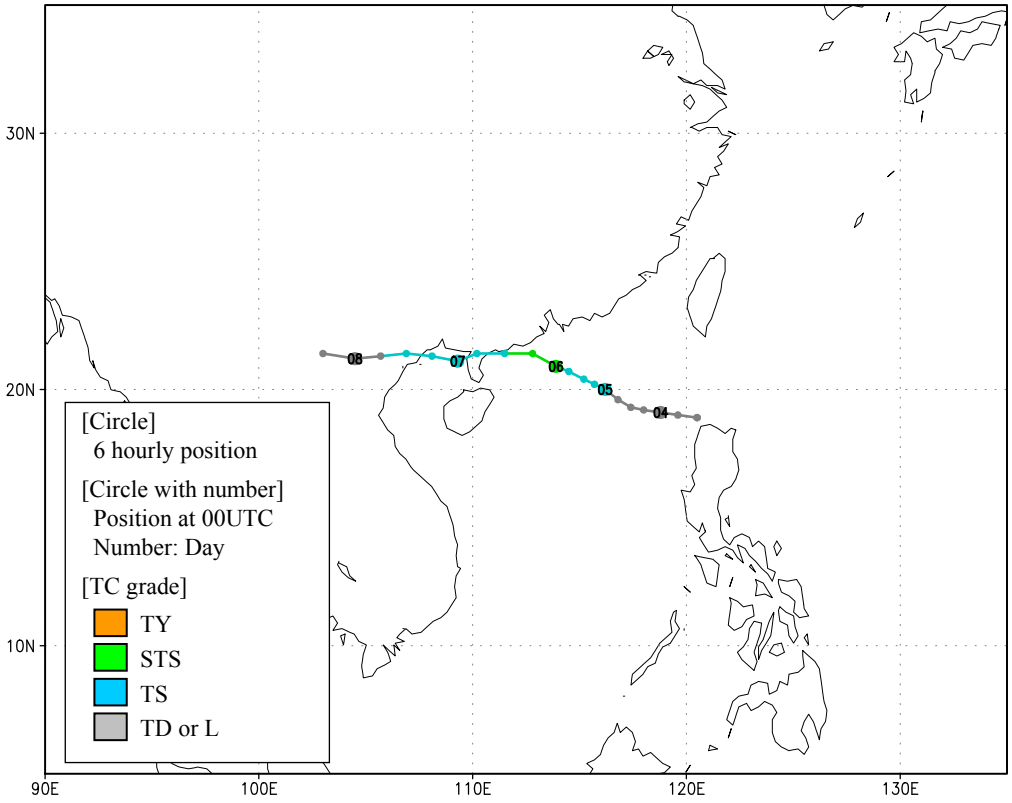
FUNG-WONG (0808)

FUNG-WONG formed as a tropical depression (TD) over the sea south of Minamidaitojima Island at 00 UTC on 24 July 2008. Moving westward, it was upgraded to tropical storm (TS) intensity over the same waters at 06 UTC on 25 July. Late on 26 July, it turned sharply to the northwest before being upgraded to typhoon (TY) intensity south of Ishigakijima Island at 00 UTC on 27 July. It reached peak intensity with maximum sustained winds of 75 kt and a central pressure of 960 hPa east of Taiwan at 12 UTC that day. Then, it hit the central part of Taiwan before 00 UTC on 28 July and weakened to STS intensity at 06 UTC that day. After passing over Taiwan, FUNG-WONG hit southern China and was downgraded to TS intensity at 00 UTC on 29 July. Moving northward over China, it weakened to TD intensity at 12 UTC that day and dissipated at 00 UTC on 01 August.



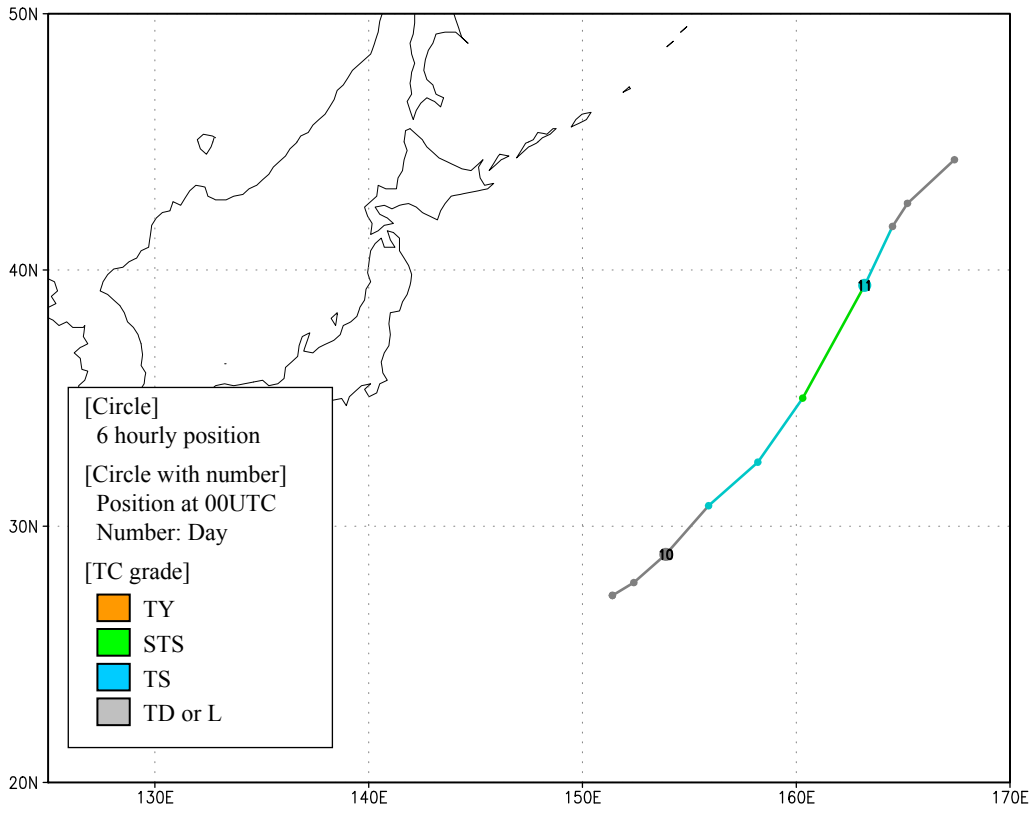
KAMMURI (0809)

KAMMURI formed as a tropical depression (TD) off the northern coast of Luzon Island at 12 UTC on 3 August 2008. Moving to the west-northwest, it was upgraded to tropical storm (TS) intensity over the South China Sea at 00 UTC on 5 August. Keeping its west-northwestward track, KAMMURI was upgraded to severe tropical storm (STS) intensity and reached peak intensity with maximum sustained winds of 50 kt and a central pressure of 975 hPa over the sea south of Hong Kong at 00 UTC on 6 August. Weakening its intensity and turning to the west, it crossed the Leizhou Peninsula of China late that day. Keeping its westward track, KAMMURI was downgraded to TD intensity over northern Vietnam at 18 UTC on 7 August before dissipating over northern Laos 18 hours later.



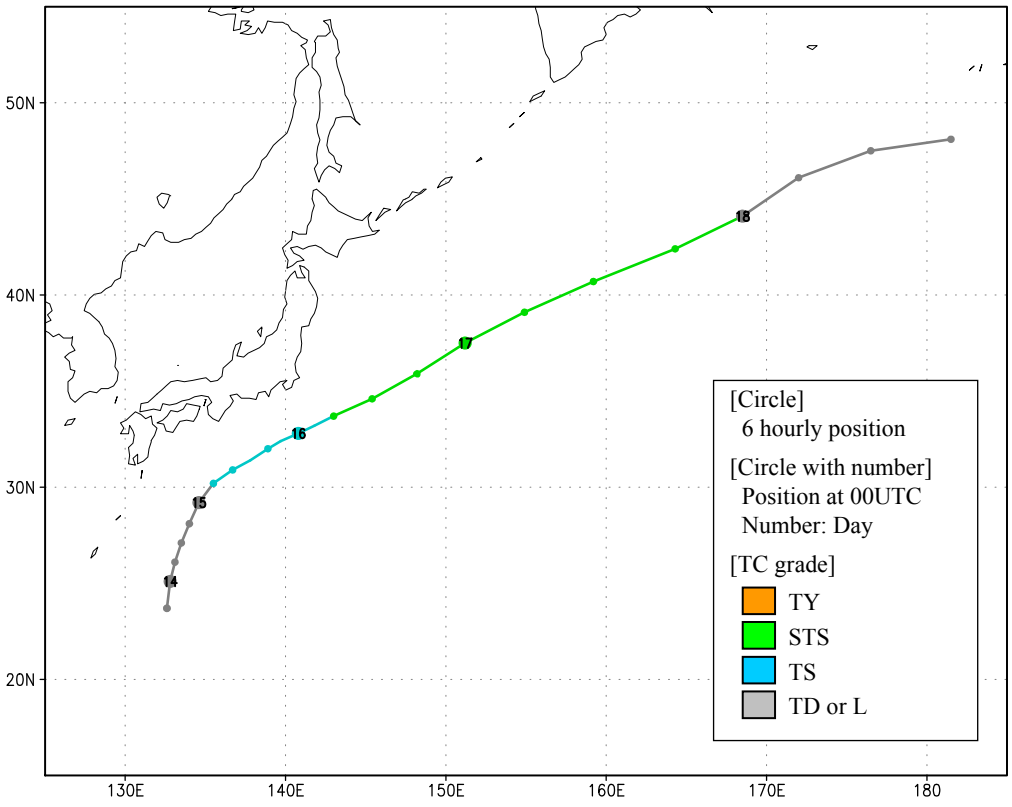
PHANFONE (0810)

PHANFONE formed as a tropical depression (TD) over the sea northwest of Minamitorishima Island at 12 UTC on 9 August 2008. Moving northeastward, it was upgraded to tropical storm (TS) intensity over the sea far east of Japan at 06 UTC on 10 August. Keeping its northeastward track, PHANFONE reached peak intensity with maximum sustained winds of 50 kt and a central pressure of 996 hPa when it was upgraded to severe tropical storm (STS) intensity over the same waters at 18 UTC on 10 August. Turning gradually to the north-northeast, PHANFONE was downgraded to TS intensity at 00 UTC and transformed into an extratropical cyclone at 06 UTC on 11 August. It dissipated over the sea east of the Kuril Islands at 00 UTC on 12 August.



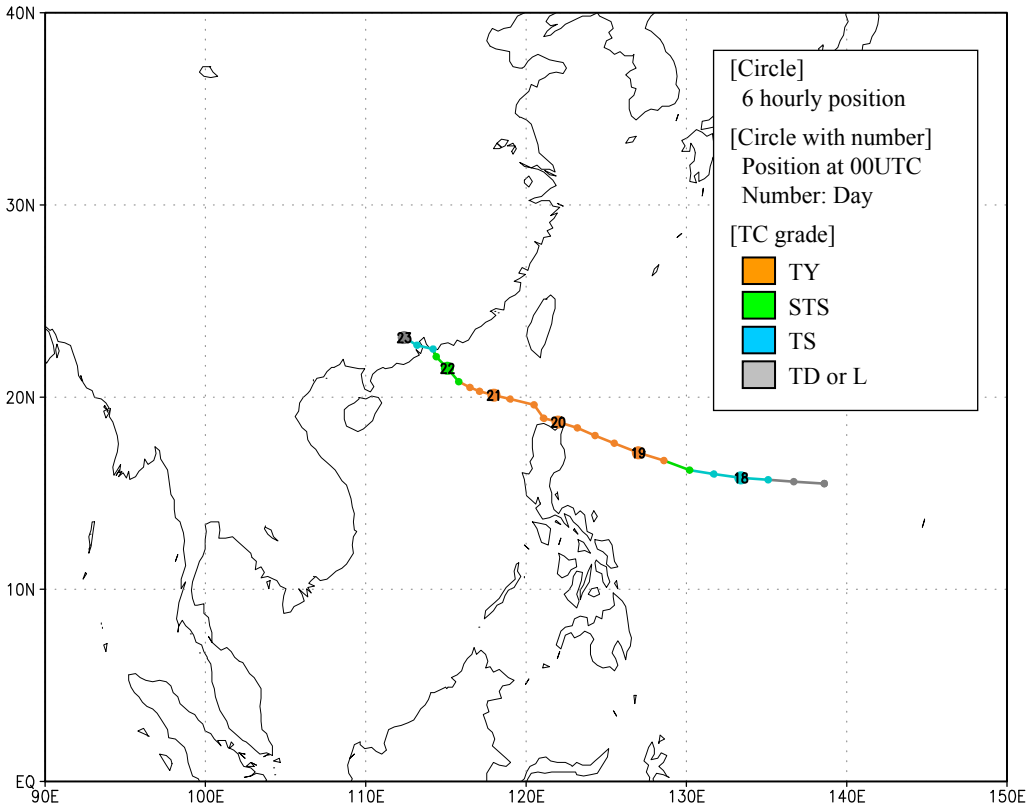
VONGFONG (0811)

VONGFONG formed as a tropical depression (TD) over the sea southeast of Minamidaitojima Island at 18 UTC on 13 August 2008. Moving north-northeastward, it was upgraded to tropical storm (TS) intensity south of Japan at 06 UTC on 15 August. After turning to the east-northeastward, it reached peak intensity with maximum sustained winds of 50 kt and a central pressure of 990 hPa over the sea east of Japan when it was upgraded to severe tropical storm (STS) intensity at 06 UTC on 16 August. Keeping its east-northeastward track and STS intensity, VONGFONG transformed into an extratropical cyclone east of the Kuril Islands at 00 UTC on 18 August and crossed 180°E before 18 UTC that day.



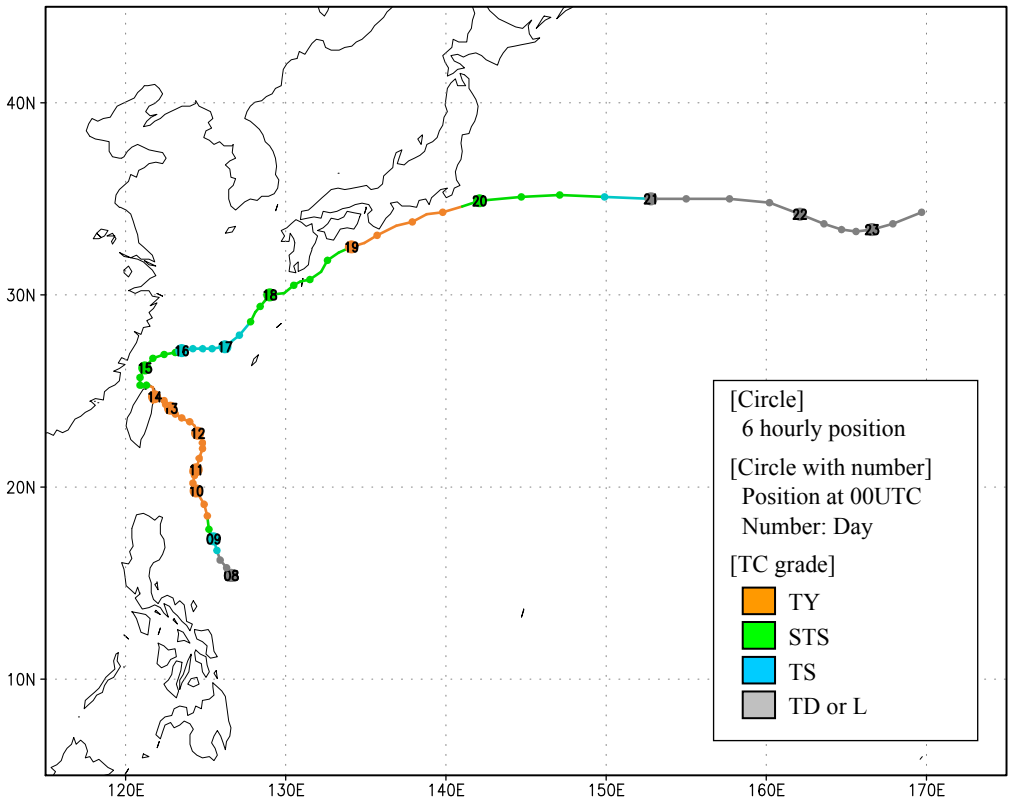
NURI (00812)

NURI formed as a tropical depression (TD) over the sea far east of the Philippines at 06 UTC on 17 August 2008. Moving westward, it was upgraded to tropical storm (TS) intensity over the same waters at 18 UTC that day. Keeping its westward track, it was upgraded to typhoon (TY) intensity at 18 UTC on the next day, and reached peak intensity with maximum sustained winds of 75 kt and a central pressure of 955 hPa over the same waters at 06 UTC on the next day. Moving west-northwestward, it hit the area around Hong Kong and was downgraded to TS intensity at 12 UTC on 22 August. NURI weakened to TD intensity at 00 UTC on 23 August and dissipated at 06 UTC that day.



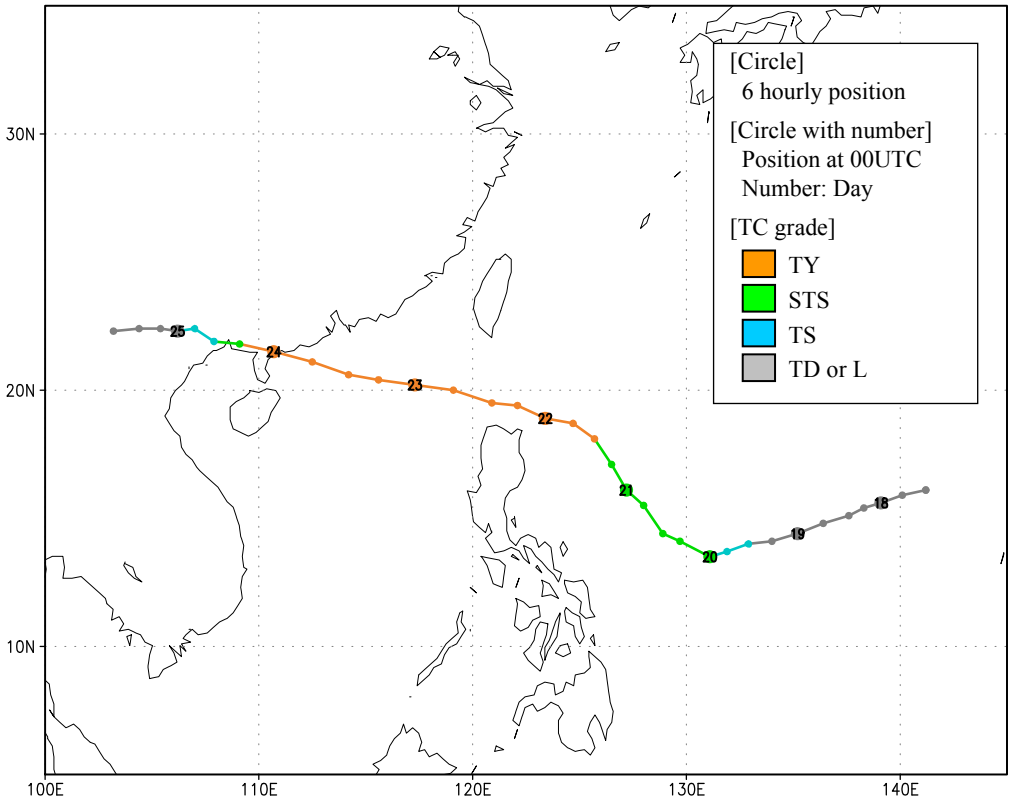
SINLAKU (0813)

SINLAKU formed as a tropical depression (TD) over the sea east of Luzon Island at 00 UTC on 8 September 2008. Moving to the north-northwest, it was upgraded to tropical storm (TS) intensity over the same waters at 18 UTC that day. Keeping its north-northwestward track, it was upgraded to typhoon (TY) intensity and reached peak intensity with maximum sustained winds of 100 kt and a central pressure of 935 hPa over the sea northeast of Luzon Island at 12 UTC on 10 September. Weakening and turning to the northwest, it was downgraded to severe tropical storm (STS) intensity around northern Taiwan at 06 UTC on 14 September. After the recurvature, it was upgraded to TY intensity again off the southern coast of Shikoku Island at 00 UTC on 19 September. Keeping its east-northeastward track, SINLAKU transformed into an extratropical cyclone east of Japan at 00 UTC on 21 September before dissipating far east of Japan at 18 UTC on 23 September.



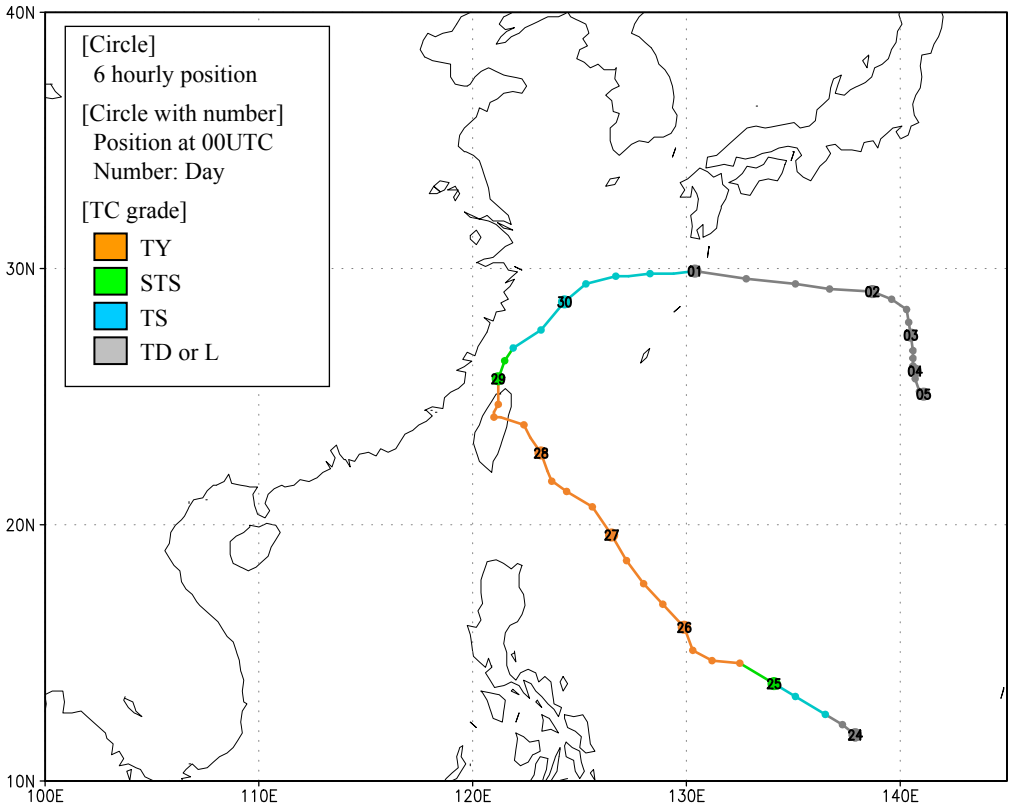
HAGUPIT (0814)

HAGUPIT formed as a tropical depression (TD) west of the Mariana Islands at 12 UTC on 17 September 2008. Moving west-southwestward, it was upgraded to tropical storm (TS) intensity east of the Philippines at 12 UTC on 19 September. At 00 UTC the next day, it turned clearly to the northwest before being upgraded to typhoon (TY) intensity east of Luzon Island at 12 UTC on 21 September. Turning gradually to the west-northwestward and moving off the northern coast of Luzon Island, it reached peak intensity with maximum sustained winds of 90 kt and a central pressure of 935 hPa off the northeastern coast of China's Hainan Island at 18 UTC on 23 September. It then hit southern China and was downgraded to TS intensity at 12 UTC on 24 September. Moving westward over China and Viet Nam, HAGUPIT weakened to TD intensity at 00 UTC the next day and dissipated at 00 UTC on 26 September.



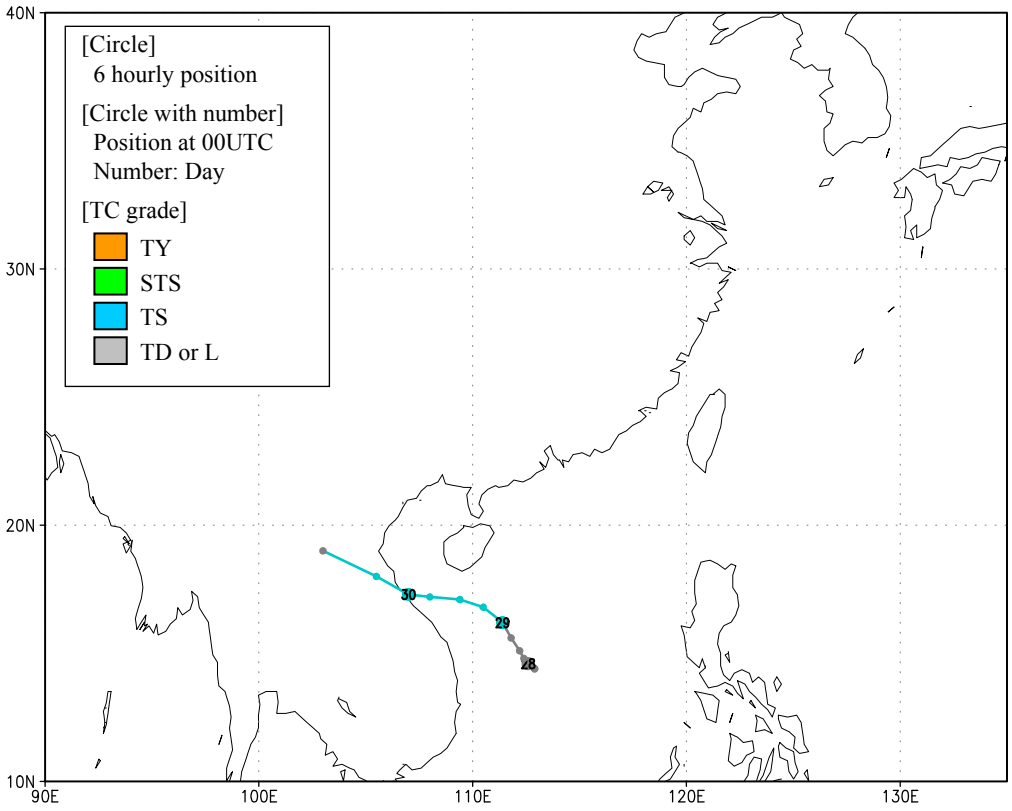
JANGMI (0815)

JANGMI formed as a tropical depression (TD) over the sea north of Yap Island at 00 UTC on 24 September 2008. Moving west-northwestward, it was upgraded to tropical storm (TS) intensity at 12 UTC on 24 September and to typhoon (TY) intensity east of the Philippines at 06 UTC on 25 September. It turned northwestward before reaching peak intensity with maximum sustained winds of 115 kt and a central pressure of 905 hPa over the sea southeast of Taiwan at 12 UTC on 27 September. It turned sharply to the north and weakened its intensity rapidly when it hit Taiwan on 28 September. Turning gradually eastward over the East China Sea, JANGMI transformed into an extratropical cyclone south of Kyushu Island at 00 UTC on 1 October. It continued to move eastward until turning southward and decelerating late on 2 October. It dissipated over the sea close to the Ogasawara Islands at 06 UTC on 5 October.



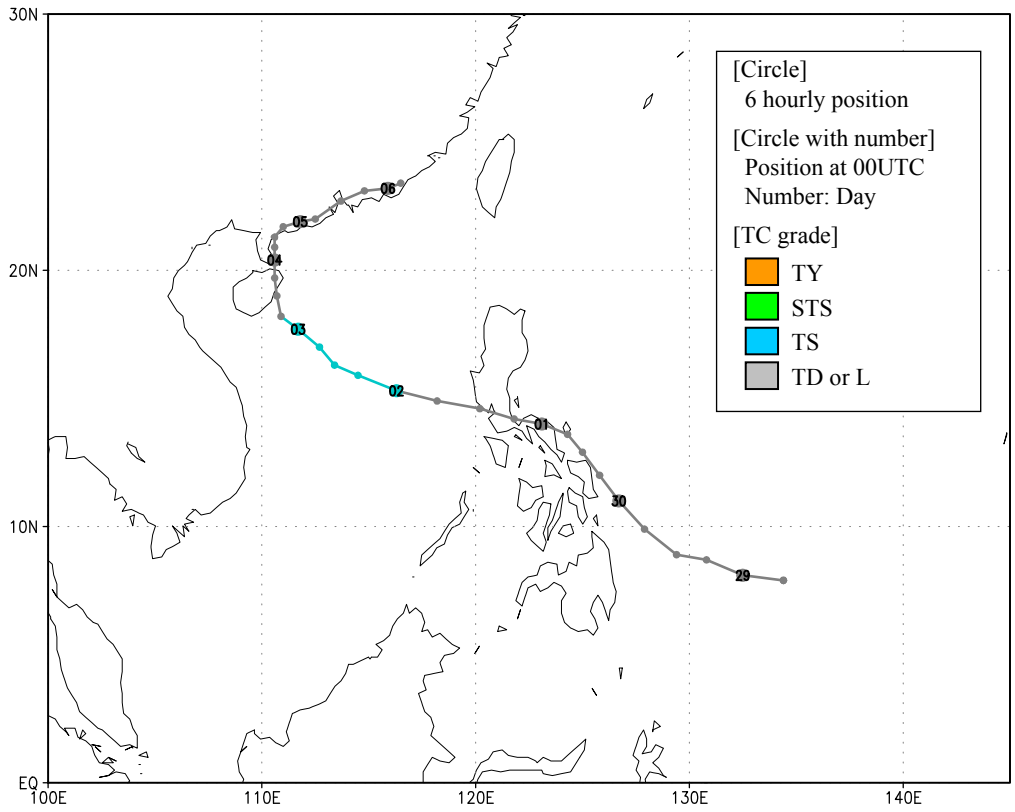
MEKKHALA (0816)

MEKKHALA formed as a tropical depression (TD) over the South China Sea at 18 UTC on 27 September 2008. Moving northwestward, it was upgraded to tropical storm (TS) intensity over the same sea at 00 UTC on 29 September. After reaching peak intensity with maximum sustained winds of 45 kt and a central pressure of 990 hPa at 18UTC the same day, it hit Viet Nam early on 30 September. Moving to the west-northwest, MEKKHALA was downgraded to TD intensity at 12 UTC before dissipating around Laos at 18 UTC the same day.



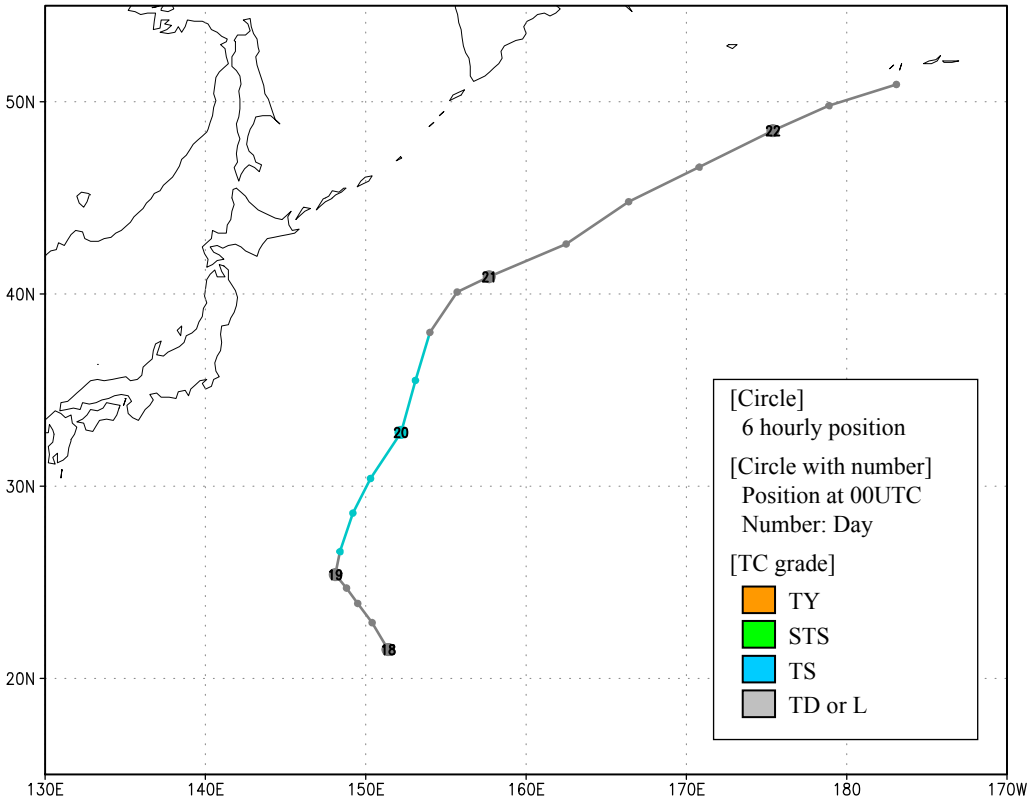
HIGOS (0817)

HIGOS formed as a tropical depression (TD) over the sea north of the Palau Islands at 18 UTC on 28 September 2008. It moved west-northwestward and crossed the Philippines before being upgraded to tropical storm (TS) intensity, reaching peak intensity with maximum sustained winds of 35 kt and a central pressure of 996 hPa over the South China Sea at 00 UTC on 2 October. Keeping its west-northwestward track, it was downgraded to TD intensity over the same waters at 06 UTC on 3 October before turning northward and crossing Hainan Island that day. It turned to the east-northeast and hit southern China the next day before moving east-northeastward along the southern coast of China and dissipating at 12 UTC on 6 October.



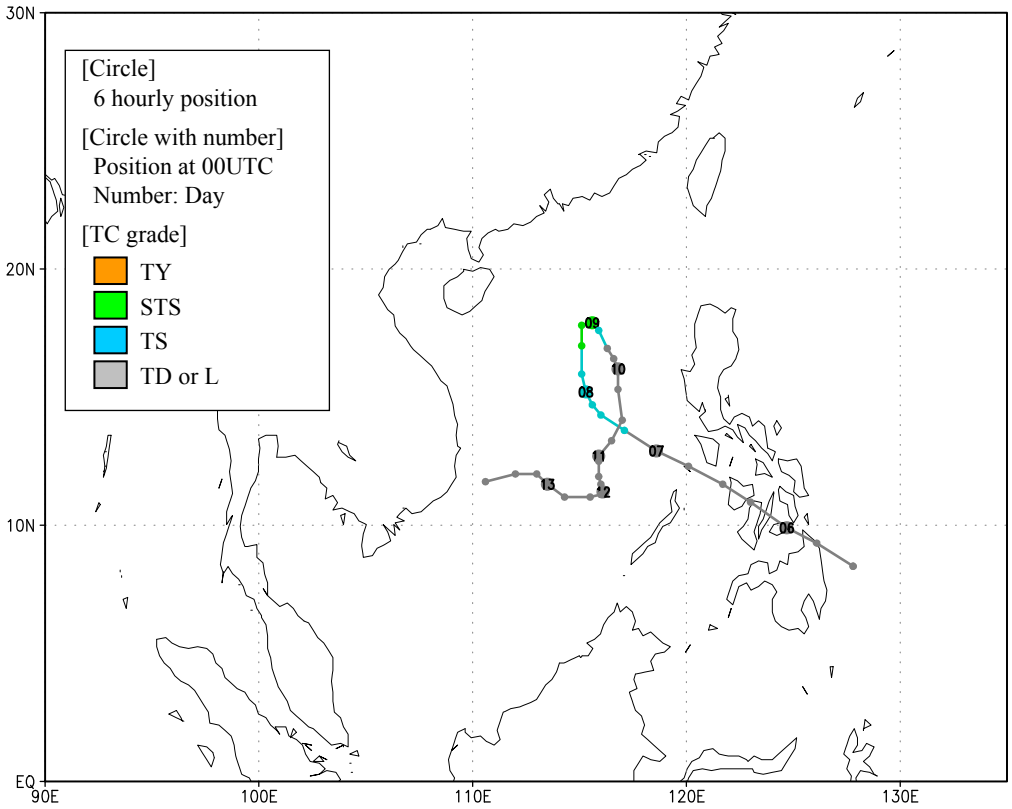
BAVI (0818)

BAVI formed as a tropical depression (TD) over the sea north of the Chuuk Islands at 00 UTC on 18 October 2008 before moving northwestward. After recurvature, it was upgraded to tropical storm (TS) intensity over the sea east of Chichijima Island at 06 UTC on 19 October and reached peak intensity with maximum sustained winds of 45 kt and a central pressure of 992 hPa east of Japan at 18 UTC that day. Keeping its northeastward track, BAVI transformed into an extratropical cyclone over the same waters at 12 UTC on 20 October and then crossed 180°E near the Aleutian Islands before 12 UTC on 22 October.



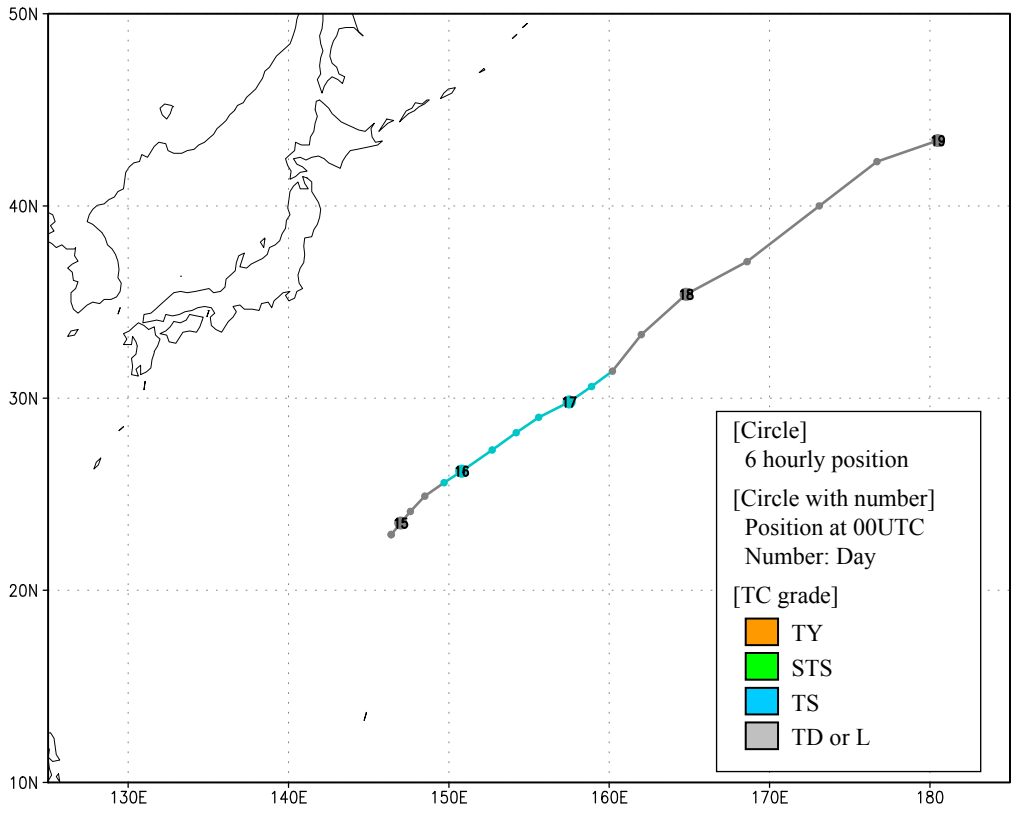
MAYSAK (0819)

MAYSAK formed as a tropical depression (TD) east of Mindanao Island at 12 UTC on 5 November 2008. Moving northwestward and crossed the Philippines, it was upgraded to tropical storm (TS) intensity southwest of Luzon Island at 06 UTC on 7 November. Turning gradually to the north, MAYSAK reached peak intensity with maximum sustained winds of 50 kt and a central pressure of 985 hPa over the South China Sea at 12 UTC the next day. Turning in a clockwise direction, it was downgraded to TD intensity at 12 UTC on 9 November. After keeping its southward track until around 00 UTC on 12 November, it turned sharply to the west and dissipated east of Viet Nam at 00 UTC on 14 November.



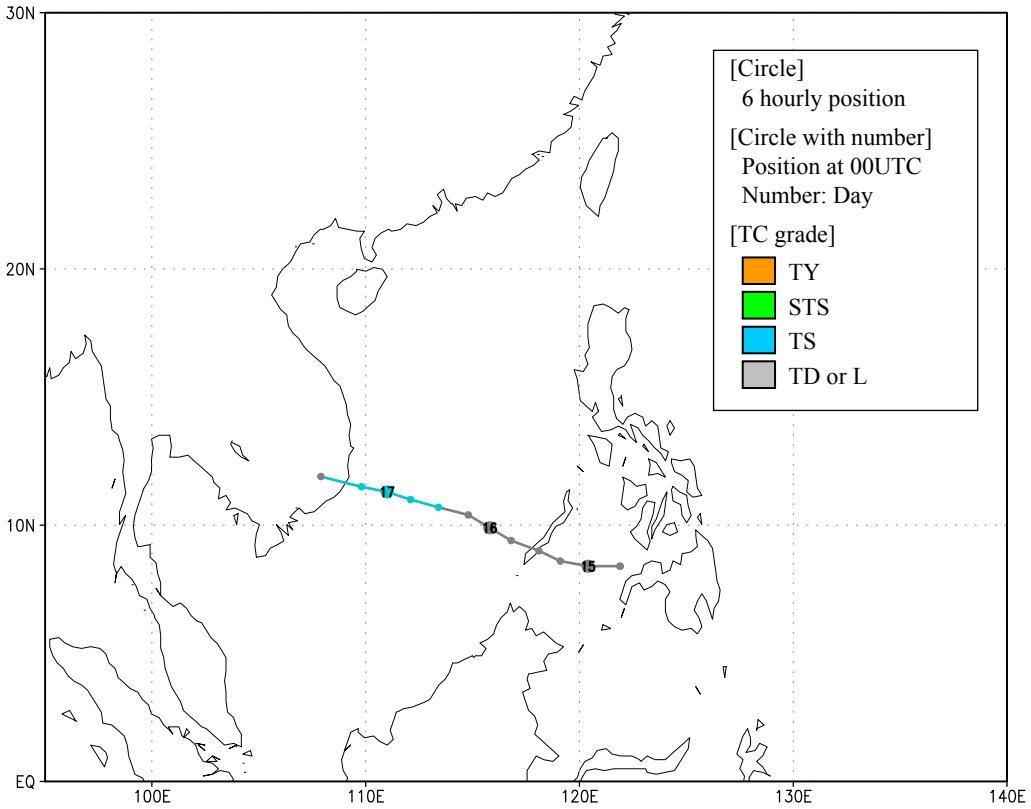
HAISHEN (0820)

HAISHEN formed as a tropical depression (TD) southeast of the Ogasawara Islands at 18 UTC on 14 November 2008. Moving northeastward, it was upgraded to tropical storm (TS) intensity west of Minamitorishima Island on 18 UTC on 15 November and reached peak intensity with maximum sustained winds of 40 kt and a central pressure of 1004 hPa six hours later. Keeping its northeastward track, it was transformed into an extratropical cyclone far east of Japan at 12 UTC on 17 November and crossed 180°E over the sea south of the Aleutian Islands before 00 UTC on 19 November.



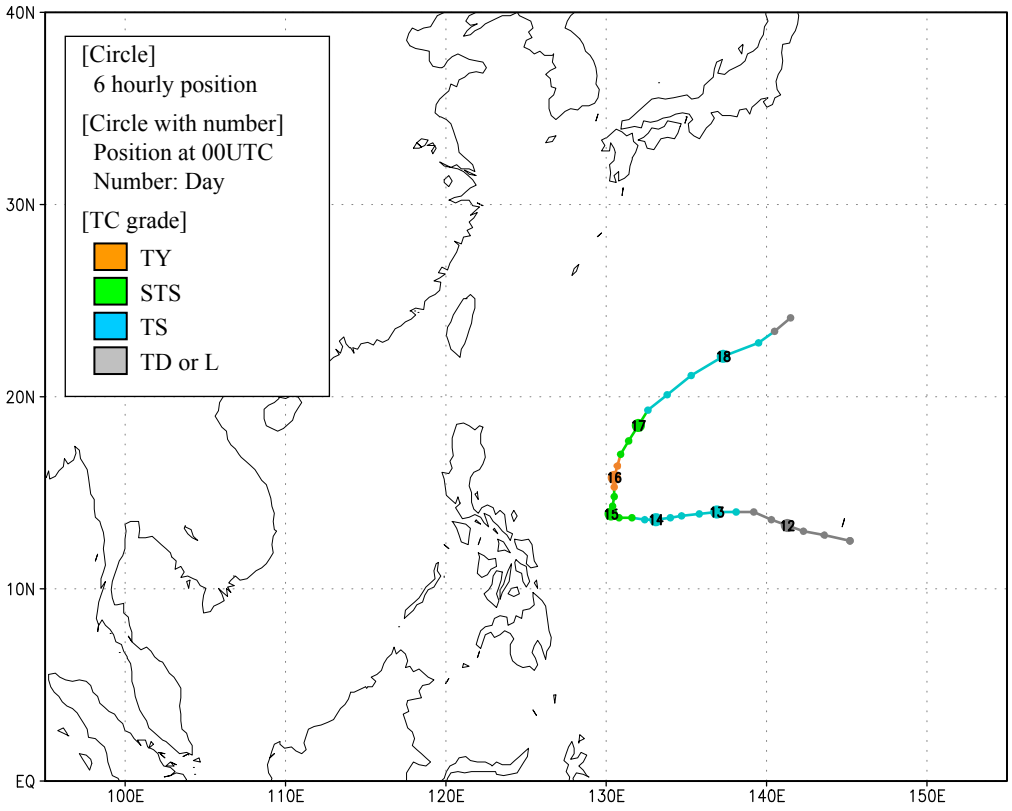
NOUL (0821)

NOUL formed as a tropical depression (TD) in the Sulu Sea at 18 UTC on 14 November 2008. Moving west-northwestward, it crossed Palawan Island and entered the South China Sea late on 15 November. It was upgraded to tropical storm (TS) intensity over the same sea at 12 UTC the next day. Keeping its west-northwestward track, NOUL reached peak intensity with maximum sustained winds of 40 kt and a central pressure of 994 hPa east of Viet Nam at 00 UTC on 17 November. After hitting the southern part of Viet Nam, it was downgraded to TD intensity at 12 UTC and dissipated at 18 UTC that day.



DOLPHIN (0822)

DOLPHIN was upgraded to tropical storm (TS) intensity west of the Mariana Islands at 06 UTC on 12 December 2008. Moving westward far east of the Philippines, it had kept TS intensity until early on 14 December. After turning sharply to the north around 00 UTC the next day, DOLPHIN reached peak intensity with maximum sustained wind of 65 kt and a central pressure of 970 hPa over the same sea at 12 UTC the same day. Gradually turning to the east-northeast and weakening its intensity, it was transformed into an extra-tropical cyclone south of Chichijima Island at 12 UTC on 18 December.



Appendices

RSMC Tropical Cyclone Best Track Data in 2008 Appendix 1

NEOGURI (0801)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Apr. 13/00	8.6	128.0	1006	-	0.5	TD
13/06	8.8	126.3	1004	-	1.0	TD
13/12	8.8	124.7	1004	-	1.0	TD
13/18	8.8	123.0	1004	-	1.5	TD
14/00	8.8	121.6	1004	-	1.5	TD
14/06	8.9	120.3	1004	-	1.5	TD
14/12	9.3	119.2	1004	-	1.5	TD
14/18	9.7	117.9	1002	-	1.5	TD
15/00	10.2	117.0	1002	-	2.0	TD
15/06	10.8	116.3	998	35	2.5	TS
15/12	11.9	115.3	996	40	2.5	TS
15/18	12.6	114.2	994	45	3.0	TS
16/00	13.1	113.0	990	50	3.5	STS
16/06	13.3	112.5	980	60	4.0	STS
16/12	13.8	112.4	975	65	4.5	TY
16/18	14.6	112.3	970	70	4.5	TY
17/00	15.2	112.1	965	75	5.0	TY
17/06	15.9	112.0	960	80	5.0	TY
17/12	16.5	111.9	960	80	5.0	TY
17/18	17.1	111.6	960	80	5.0	TY
18/00	17.8	111.5	965	80	5.0	TY
18/06	18.5	111.5	965	75	5.0	TY
18/12	19.1	111.5	970	70	4.5	TY
18/18	19.8	111.5	975	65	4.0	TY
19/00	20.7	111.7	985	55	3.5	STS
19/06	21.6	112.4	992	45	3.0	TS
19/12	22.9	113.0	998	35	2.5	TS
19/18	24.5	113.9	1004	-	2.0	TD
20/00						Dissip.

RAMMASUN (0802)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
May 07/00	7.8	133.3	1004	-	1.0	TD
07/06	7.8	132.5	1000	-	1.5	TD
07/12	8.1	131.8	1000	-	1.5	TD
07/18	8.5	131.6	996	35	2.0	TS
08/00	8.9	131.3	994	35	2.0	TS
08/06	9.4	131.3	992	40	2.0	TS
08/12	9.8	131.3	990	45	2.5	TS
08/18	10.2	131.5	985	50	3.0	STS
09/00	11.0	131.7	980	55	3.5	STS
09/06	11.8	132.0	970	65	4.0	TY
09/12	12.7	132.1	955	75	5.0	TY
09/18	13.6	132.1	945	85	5.5	TY
10/00	14.5	132.0	935	95	6.0	TY
10/06	15.5	132.1	925	100	6.5	TY
10/12	16.8	132.0	915	105	7.0	TY
10/18	18.1	131.9	915	105	7.0	TY
11/00	19.4	131.8	920	100	7.0	TY
11/06	20.7	132.1	925	95	6.0	TY
11/12	22.0	132.7	935	85	5.5	TY
11/18	23.7	133.5	945	80	5.0	TY
12/00	25.2	134.6	955	75	5.0	TY
12/06	27.3	136.3	965	70	4.5	TY
12/12	29.4	138.7	970	65	4.0	TY
12/18	30.5	140.2	980	55	3.5	STS
12/21	31.2	141.2	985	50	-	STS
13/00	31.8	142.2	988	-	3.0	L
13/06	33.0	143.9	992	-	2.5	L
13/12	33.6	145.3	1000	-	-	L
13/18	34.3	147.4	1004	-	-	L
14/00	34.9	149.9	1008	-	-	L
14/06	35.5	152.2	1010	-	-	L
14/12						Dissip.

MATMO (0803)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
May 14/06	16.3	123.8	1000	-	0.5	TD
14/12	16.5	123.8	1000	-	1.0	TD
14/18	17.2	123.9	1000	-	1.5	TD
15/00	18.3	124.5	998	-	1.5	TD
15/06	19.4	125.4	998	-	1.5	TD
15/12	20.8	126.8	996	35	2.0	TS
15/18	22.2	128.1	996	40	2.5	TS
16/00	23.8	129.9	994	45	3.0	TS
16/06	25.3	132.8	992	50	3.0	STS
16/12	26.2	135.7	994	45	3.0	TS
16/18	26.9	138.5	996	40	2.5	TS
17/00	27.2	140.9	1000	-	2.0	TD
17/06						Dissip.

HALONG (0804)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
May 14/12	11.8	116.9	1002	-	1.0	TD
14/18	12.0	116.8	1000	-	1.5	TD
15/00	12.2	116.8	1000	-	1.5	TD
15/06	12.5	116.8	1000	-	1.5	TD
15/12	12.9	116.8	1000	-	1.5	TD
15/18	13.3	116.9	1002	-	1.5	TD
16/00	14.0	117.0	1002	-	2.0	TD
16/06	14.4	117.5	996	35	2.5	TS
16/12	14.7	117.5	990	45	3.0	TS
16/18	15.1	118.2	990	45	3.0	TS
17/00	15.3	118.6	985	50	3.5	STS
17/06	15.9	119.2	975	60	4.0	STS
17/12	16.3	120.1	975	60	4.0	STS
17/18	16.9	120.9	985	50	3.5	STS
18/00	17.3	121.7	990	45	3.0	TS
18/06	18.6	123.8	990	45	3.0	TS
18/12	19.3	124.9	990	45	3.0	TS
18/18	19.8	125.8	985	50	3.5	STS
19/00	21.1	127.3	985	50	3.5	STS
19/06	22.0	128.6	980	55	3.5	STS
19/09	22.6	129.5	980	55	-	STS
19/12	23.2	130.5	985	50	3.5	STS
19/15	23.7	131.5	985	50	-	STS
19/18	24.6	132.8	990	45	3.5	TS
19/21	25.7	134.2	990	45	-	TS
20/00	26.8	135.5	992	40	3.0	TS
20/06	29.2	139.0	996	35	3.0	TS
20/12	31.9	142.5	1000	-	2.5	L
20/18	33.7	144.8	1000	-	-	L
21/00	36.2	148.3	1002	-	-	L
21/06	38.6	151.5	1002	-	-	L
21/12	41.1	154.7	1002	-	-	L
21/18	42.9	157.0	1004	-	-	L
22/00	44.3	158.5	1004	-	-	L
22/06	45.5	159.8	1004	-	-	L
22/12	46.8	160.8	1004	-	-	L
22/18	48.0	161.3	1006	-	-	L
23/00	49.1	161.3	1008	-	-	L
23/06	49.8	161.1	1006	-	-	L
23/12	50.8	160.6	1006	-	-	L
23/18	51.6	160.6	1006	-	-	L
24/00	51.6	160.2	1010	-	-	L
24/06	51.3	160.1	1010	-	-	L
24/12						Dissip.

NAKRI (0805)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
May 26/06	10.5	140.4	1008	-	1.0	TD
26/12	11.7	139.3	1010	-	1.5	TD
26/18	12.6	138.6	1008	-	1.5	TD
27/00	13.7	138.0	1006	-	2.0	TD
27/06	14.3	137.6	1000	35	2.5	TS
27/12	14.3	137.4	996	40	3.0	TS
27/18	14.4	137.2	990	45	3.0	TS
28/00	14.8	137.1	985	55	3.5	STS
28/06	15.5	136.8	980	65	4.0	TY
28/12	15.8	136.7	970	70	4.5	TY
28/18	16.0	136.6	955	80	5.5	TY
29/00	16.0	136.3	950	85	5.5	TY
29/06	16.2	135.8	940	95	6.5	TY
29/12	16.2	135.5	930	100	6.5	TY
29/18	16.4	135.1	930	100	6.5	TY
30/00	16.6	134.7	930	100	6.5	TY
30/06	17.0	134.1	940	95	6.0	TY
30/12	17.3	133.5	950	85	5.5	TY
30/18	17.9	133.0	960	80	5.0	TY
31/00	18.4	132.8	965	75	4.5	TY
31/06	19.2	132.8	970	70	4.5	TY
31/12	19.7	132.8	970	65	4.5	TY
31/18	20.2	132.8	970	65	4.5	TY
Jun. 01/00	20.6	132.9	970	70	4.5	TY
01/06	21.5	133.1	970	70	4.5	TY
01/12	22.3	133.3	970	70	4.5	TY
01/18	23.5	133.6	965	75	5.0	TY
02/00	25.1	134.4	960	75	5.0	TY
02/06	26.8	135.5	960	75	5.0	TY
02/12	28.3	137.1	965	75	5.0	TY
02/18	29.9	138.7	970	70	4.5	TY
02/21	30.8	139.5	975	60	-	STS
03/00	31.5	140.3	980	55	4.0	STS
03/03	32.1	141.1	985	50	-	STS
03/06	32.8	142.3	990	-	3.5	L
03/12	33.0	144.3	994	-	-	L
03/18	33.4	146.8	996	-	-	L
04/00	33.4	149.4	1000	-	-	L
04/06	33.2	151.7	1004	-	-	L
04/12	32.6	154.4	1004	-	-	L
04/18	31.7	158.2	1006	-	-	L
05/00	31.2	163.9	1008	-	-	L
05/06	30.9	167.2	1008	-	-	L
05/12	31.0	172.9	1008	-	-	L
05/18	31.7	176.8	1008	-	-	L
06/00	33.0	179.0w	1008	-	-	Out

FENGSHEN (0806)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Jun. 17/18	8.4	134.2	1006	-	0.5	TD
18/00	8.6	133.4	1008	-	1.0	TD
18/06	9.0	132.7	1006	-	1.0	TD
18/12	9.3	132.1	1006	-	1.5	TD
18/18	9.5	131.4	1002	-	2.0	TD
19/00	9.7	130.9	1000	35	2.5	TS
19/06	10.0	130.1	994	45	3.0	TS
19/12	10.3	128.9	985	55	3.5	STS
19/18	10.7	127.7	980	65	4.0	TY
20/00	11.0	126.9	970	70	4.5	TY
20/06	11.5	125.4	965	75	5.0	TY
20/12	11.6	124.3	960	75	5.0	TY
20/18	11.7	123.5	955	80	5.5	TY
21/00	11.9	122.7	945	90	6.0	TY
21/06	12.2	122.3	955	85	5.5	TY
21/12	13.1	121.8	965	75	4.5	TY
21/18	14.0	121.6	970	75	5.0	TY
22/00	14.8	121.0	975	75	4.5	TY
22/06	15.4	120.5	980	65	4.0	TY
22/12	15.9	119.6	985	55	3.5	STS
22/18	16.5	118.4	985	50	3.5	STS
23/00	17.1	117.8	985	50	3.0	STS
23/06	17.6	117.1	985	50	3.0	STS
23/12	18.0	116.5	985	50	3.0	STS
23/18	18.6	116.1	985	50	3.0	STS
24/00	19.4	115.9	985	50	3.0	STS
24/06	20.5	115.4	985	50	3.0	STS
24/12	21.1	115.0	985	50	3.0	STS
24/18	22.0	114.6	990	45	3.0	TS
25/00	22.9	113.9	994	40	2.5	TS
25/06	23.6	113.6	998	-	2.5	TD
25/12	24.3	113.4	998	-	2.0	TD
25/18	24.5	113.5	1000	-	1.5	TD
26/00	24.9	113.7	1000	-	-	TD
26/06	25.3	114.3	1000	-	-	TD
26/12	25.8	114.7	1000	-	-	TD
26/18	26.2	115.0	1000	-	-	TD
27/00	27.0	115.4	1002	-	-	TD
27/06						Dissip.

FUNG-WONG (0808)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Jul. 24/00	21.7	133.2	1002	-	1.0	TD
24/06	21.9	132.7	1000	-	1.5	TD
24/12	21.9	132.2	998	-	1.5	TD
24/18	21.9	131.6	996	-	2.0	TD
25/00	21.8	131.3	996	-	2.0	TD
25/06	21.9	130.7	994	35	2.5	TS
25/12	21.9	129.7	990	45	3.0	TS
25/18	21.7	128.9	990	45	3.0	TS
26/00	21.5	127.8	985	50	3.5	STS
26/06	21.3	127.0	980	55	3.5	STS
26/12	21.3	126.1	975	60	3.5	STS
26/18	21.2	125.6	975	60	4.0	STS
27/00	21.7	124.9	970	65	4.5	TY
27/03	22.0	124.4	970	65	-	TY
27/06	22.1	124.0	970	65	4.5	TY
27/09	22.4	123.6	965	70	-	TY
27/12	22.7	123.1	960	75	5.0	TY
27/15	22.8	122.7	960	75	-	TY
27/18	23.0	122.4	960	75	5.0	TY
27/21	23.3	121.9	960	75	-	TY
28/00	23.4	121.2	965	70	4.5	TY
28/03	24.1	121.0	970	65	-	TY
28/06	24.4	120.8	975	55	4.0	STS
28/12	25.2	119.8	975	55	3.5	STS
28/18	26.0	119.1	985	50	3.0	STS
29/00	26.3	118.2	990	45	2.5	TS
29/06	27.1	117.5	990	45	2.5	TS
29/12	28.2	117.2	992	-	2.0	TD
29/18	28.6	116.7	994	-	-	TD
30/00	29.5	116.2	996	-	-	TD
30/06	30.4	115.9	996	-	-	TD
30/12	31.4	116.0	998	-	-	TD
30/18	32.0	116.1	1000	-	-	TD
31/00	32.7	116.2	1000	-	-	TD
31/06	33.3	116.2	1002	-	-	TD
31/12	33.9	116.3	1002	-	-	TD
31/18	34.7	116.4	1002	-	-	TD
Aug. 01/00						Dissip.

KALMAEGI (0807)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Jul. 13/06	20.1	126.3	1004	-	1.0	TD
13/12	20.2	126.2	1006	-	1.0	TD
13/18	20.2	126.0	1004	-	1.0	TD
14/00	19.8	125.6	1004	-	1.5	TD
14/06	19.3	125.2	1004	-	1.5	TD
14/12	18.7	124.8	1004	-	1.5	TD
14/18	18.4	124.5	1000	-	1.5	TD
15/00	17.9	124.2	1000	-	1.5	TD
15/06	17.9	123.9	996	35	2.0	TS
15/12	18.1	123.7	994	40	2.0	TS
15/18	18.5	123.9	992	40	2.5	TS
16/00	18.9	124.1	990	45	2.5	TS
16/06	19.4	123.9	985	50	3.0	STS
16/12	20.2	123.6	985	50	3.0	STS
16/18	21.2	123.3	980	55	3.0	STS
16/21	21.8	123.1	980	55	-	STS
17/00	22.4	122.9	975	60	3.5	STS
17/03	22.7	122.6	975	60	-	STS
17/06	23.2	122.3	970	65	4.0	TY
17/09	23.7	122.1	970	65	-	TY
17/12	24.2	121.7	975	60	4.0	STS
17/15	24.4	121.6	980	55	-	STS
17/18	24.6	121.5	985	50	4.0	STS
17/21	24.9	121.3	990	45	-	TS
18/00	25.2	121.2	992	40	3.5	TS
18/06	26.1	120.5	994	35	3.0	TS
18/12	26.3	120.0	994	35	3.0	TS
18/18	26.9	119.7	996	-	2.5	TD
19/00	28.6	120.5	996	-	2.0	TD
19/06	30.0	120.6	998	-	2.0	TD
19/12	31.3	121.0	998	-	2.0	TD
19/18	32.9	121.5	998	-	1.5	TD
20/00	34.4	122.5	998	-	1.5	TD
20/06	36.2	124.0	998	-	1.5	TD
20/12	37.6	125.2	996	-	1.5	L
20/18	38.4	126.3	994	-	1.5	L
21/00	39.2	128.7	998	-	-	L
21/06	40.1	130.4	998	-	-	L
21/12	41.0	131.3	1000	-	-	L
21/18	42.0	132.3	1000	-	-	L
22/00	42.7	133.1	1002	-	-	L
22/06	43.3	134.6	1002	-	-	L
22/12	44.2	136.2	1002	-	-	L
22/18	44.8	137.8	1002	-	-	L
23/00	45.2	139.6	1004	-	-	L
23/06	45.7	140.6	1004	-	-	L
23/12	46.1	142.1	1004	-	-	L
23/18	46.4	143.1	1006	-	-	L
24/00	46.7	144.2	1006	-	-	L
24/06	47.1	145.0	1004	-	-	L
24/12						Dissip.

KAMMURI (0809)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Aug. 03/12	18.9	120.5	1002	-	0.5	TD
03/18	19.0	119.6	1002	-	1.0	TD
04/00	19.1	118.8	1000	-	1.5	TD
04/06	19.2	118.0	998	-	1.5	TD
04/12	19.3	117.4	996	-	2.0	TD
04/18	19.6	116.8	992	-	2.0	TD
05/00	20.0	116.2	990	35	2.0	TS
05/06	20.2	115.7	985	40	2.5	TS
05/12	20.4	115.2	985	40	3.0	TS
05/18	20.7	114.5	980	45	3.0	TS
06/00	20.9	113.9	975	50	3.5	STS
06/06	21.4	112.8	975	50	3.5	STS
06/12	21.4	111.5	980	45	3.0	TS
06/18	21.4	110.2	985	40	2.5	TS
07/00	21.1	109.3	985	40	2.5	TS
07/06	21.3	108.1	985	40	2.5	TS
07/12	21.4	106.9	990	35	2.0	TS
07/18	21.3	105.7	994	-	2.0	TD
08/00	21.2	104.5	996	-	-	TD
08/06	21.4	103.0	998	-	-	TD
08/12						Dissip.

PHANFONE (0810)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Aug. 09/12	27.3	151.4	1002	-	1.0	TD
09/18	27.8	152.4	1002	-	1.5	TD
10/00	28.9	153.9	1002	-	2.0	TD
10/06	30.8	155.9	1000	35	2.0	TS
10/12	32.5	158.2	998	45	2.5	TS
10/18	35.0	160.3	996	50	2.5	STS
11/00	39.4	163.2	998	40	2.5	TS
11/06	41.7	164.5	1000	-	2.0	L
11/12	42.6	165.2	1006	-	-	L
11/18	44.3	167.4	1012	-	-	L
12/00						Dissip.

VONGFONG (0811)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Aug. 13/18	23.7	132.6	1004	-	0.0	TD
14/00	25.1	132.8	1002	-	0.0	TD
14/06	26.1	133.1	1002	-	0.5	TD
14/12	27.1	133.5	1002	-	1.0	TD
14/18	28.1	134.0	1002	-	1.5	TD
15/00	29.2	134.6	1000	-	1.5	TD
15/06	30.2	135.5	996	35	2.0	TS
15/12	30.9	136.7	996	35	2.0	TS
15/15	31.4	137.8	996	35	-	TS
15/18	32.0	138.9	994	40	2.0	TS
15/21	32.4	139.7	994	40	-	TS
16/00	32.8	140.8	992	45	2.5	TS
16/03	33.2	141.8	992	45	-	TS
16/06	33.7	143.0	990	50	3.0	STS
16/12	34.6	145.4	990	50	3.0	STS
16/18	35.9	148.2	990	50	3.0	STS
17/00	37.5	151.2	990	50	2.5	STS
17/06	39.1	154.9	990	50	2.5	STS
17/12	40.7	159.2	990	50	-	STS
17/18	42.4	164.3	990	50	-	STS
18/00	44.1	168.5	992	-	-	L
18/06	46.1	172.0	992	-	-	L
18/12	47.5	176.5	992	-	-	L
18/18	48.1	178.5w	996	-	-	Out

NURI (0812)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Aug. 17/06	15.5	138.6	1006	-	1.0	TD
17/12	15.6	136.7	1004	-	1.5	TD
17/18	15.7	135.1	1000	35	2.0	TS
18/00	15.8	133.4	996	35	2.5	TS
18/06	16.0	131.7	990	45	3.0	TS
18/12	16.2	130.2	980	55	3.5	STS
18/18	16.7	128.6	970	65	4.0	TY
19/00	17.1	127.0	960	70	5.0	TY
19/06	17.6	125.5	955	75	5.0	TY
19/12	18.0	124.3	955	75	5.0	TY
19/18	18.4	123.2	955	75	5.0	TY
20/00	18.7	122.0	955	75	5.0	TY
20/06	18.9	121.1	955	75	5.0	TY
20/12	19.6	120.5	955	75	5.0	TY
20/18	19.9	119.0	955	75	5.0	TY
21/00	20.1	118.0	960	70	4.5	TY
21/06	20.3	117.1	960	70	4.5	TY
21/12	20.5	116.5	965	65	4.5	TY
21/18	20.8	115.8	970	60	4.0	STS
22/00	21.5	115.1	975	55	4.0	STS
22/06	22.1	114.4	980	50	3.5	STS
22/12	22.5	114.2	990	45	3.0	TS
22/18	22.7	113.2	996	40	2.5	TS
23/00	23.1	112.4	1000	-	2.0	TD
23/06						Dissip.

SINLAKU (0813)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Sep. 08/00	15.4	126.6	1004	-	1.0	TD
08/06	15.8	126.3	1002	-	1.5	TD
08/12	16.2	125.9	1002	-	2.0	TD
08/18	16.7	125.7	996	35	2.5	TS
09/00	17.3	125.5	990	45	3.0	TS
09/06	17.8	125.2	985	55	3.5	STS
09/12	18.5	125.1	975	65	4.0	TY
09/18	19.1	124.9	970	70	4.5	TY
10/00	19.8	124.4	965	80	5.0	TY
10/06	20.2	124.2	945	90	6.0	TY
10/12	20.6	124.3	935	100	6.5	TY
10/18	20.8	124.2	935	100	6.5	TY
11/00	20.9	124.4	935	100	6.5	TY
11/06	21.5	124.6	935	100	6.5	TY
11/12	22.0	124.8	935	100	6.5	TY
11/15	22.1	124.8	940	95	-	TY
11/18	22.3	124.8	940	95	6.0	TY
11/21	22.6	124.7	940	95	-	TY
12/00	22.8	124.5	940	95	6.0	TY
12/03	23.2	124.3	940	95	-	TY
12/06	23.4	124.0	940	95	6.0	TY
12/09	23.5	123.7	940	95	-	TY
12/12	23.6	123.5	945	90	5.5	TY
12/15	23.7	123.3	945	90	-	TY
12/18	23.8	123.1	945	90	5.5	TY
12/21	24.0	123.0	945	90	-	TY
13/00	24.1	122.8	945	90	5.5	TY
13/03	24.2	122.6	945	90	-	TY
13/06	24.3	122.5	945	90	5.5	TY
13/09	24.4	122.4	945	90	-	TY
13/12	24.5	122.4	950	90	5.5	TY
13/15	24.6	122.2	950	90	-	TY
13/18	24.7	121.9	960	80	5.0	TY
13/21	24.4	121.7	960	75	-	TY
14/00	24.7	121.8	975	65	4.5	TY
14/03	25.2	121.7	975	65	-	TY
14/06	25.3	121.3	985	60	4.0	STS
14/09	25.2	121.0	985	60	-	STS
14/12	25.3	120.9	985	60	3.5	STS
14/18	25.7	120.9	985	55	3.0	STS
15/00	26.2	121.2	985	50	3.0	STS
15/06	26.7	121.7	985	50	3.0	STS
15/12	26.9	122.4	985	50	3.0	STS
15/18	27.0	123.1	985	50	3.0	STS
16/00	27.1	123.5	990	45	2.5	TS
16/06	27.2	124.2	992	40	2.0	TS
16/12	27.2	124.8	992	40	2.0	TS
16/18	27.2	125.4	992	40	2.0	TS
17/00	27.3	126.2	990	45	2.5	TS
17/06	27.9	127.1	990	45	2.5	TS
17/12	28.6	127.8	985	50	3.0	STS
17/15	29.1	128.1	985	50	-	STS
17/18	29.4	128.4	985	50	3.0	STS
17/21	29.7	128.7	985	50	-	STS
18/00	30.0	129.0	985	50	3.0	STS
18/03	30.1	129.9	980	55	-	STS
18/06	30.5	130.5	980	60	3.5	STS
18/09	30.7	130.9	980	60	-	STS
18/12	30.8	131.5	985	60	3.5	STS
18/15	31.2	132.2	985	60	-	STS
18/18	31.8	132.6	985	60	3.5	STS
18/21	32.2	133.3	985	60	-	STS
19/00	32.5	134.1	980	65	3.5	TY
19/03	32.7	134.9	980	65	-	TY
19/06	33.1	135.7	980	65	3.0	TY
19/09	33.6	136.9	980	65	-	TY
19/12	33.8	137.9	985	65	3.0	TY
19/15	34.2	138.8	985	65	-	TY
19/18	34.3	139.8	985	65	2.5	TY
19/21	34.6	141.0	990	60	-	STS
20/00	34.9	142.1	990	55	2.0	STS
20/06	35.1	144.7	992	55	2.0	STS
20/12	35.2	147.1	992	50	2.0	STS
20/18	35.1	149.9	994	45	1.5	TS
21/00	35.0	152.8	996	-	1.5	L
21/06	35.0	155.0	1000	-	-	L
21/12	35.0	157.7	1000	-	-	L
21/18	34.8	160.2	1000	-	-	L
22/00	34.2	162.1	1002	-	-	L
22/06	33.7	163.6	1002	-	-	L
22/12	33.4	164.7	1004	-	-	L
22/18	33.3	165.6	1006	-	-	L
23/00	33.4	166.6	1006	-	-	L
23/06	33.7	167.9	1006	-	-	L
23/12	34.3	169.7	1008	-	-	L
23/18						Dissip.

HAGUPIT (0814)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Sep. 17/12	16.1	141.2	1008	-	0.5	TD
17/18	15.9	140.1	1008	-	0.5	TD
18/00	15.6	139.1	1008	-	0.5	TD
18/06	15.4	138.3	1008	-	0.5	TD
18/12	15.1	137.6	1008	-	0.5	TD
18/18	14.8	136.4	1006	-	1.0	TD
19/00	14.4	135.2	1006	-	1.5	TD
19/06	14.1	134.0	1004	-	2.0	TD
19/12	14.0	132.9	1002	35	2.5	TS
19/18	13.7	131.9	994	45	3.0	TS
20/00	13.5	131.1	990	50	3.0	STS
20/06	14.1	129.7	985	50	3.0	STS
20/12	14.4	128.9	985	50	3.0	STS
20/18	15.5	128.0	985	50	3.0	STS
21/00	16.1	127.2	980	55	3.5	STS
21/06	17.1	126.5	975	55	3.5	STS
21/12	18.1	125.7	970	65	4.0	TY
21/18	18.7	124.7	960	70	5.0	TY
22/00	18.9	123.4	955	75	5.0	TY
22/06	19.4	122.1	950	80	5.5	TY
22/12	19.5	120.9	950	80	5.5	TY
22/18	20.0	119.1	950	80	5.5	TY
23/00	20.2	117.3	945	85	5.5	TY
23/06	20.4	115.6	945	85	5.5	TY
23/12	20.6	114.2	945	85	5.5	TY
23/18	21.1	112.5	935	90	6.0	TY
24/00	21.5	110.7	955	75	5.0	TY
24/06	21.8	109.1	975	60	4.5	STS
24/12	21.9	107.9	985	45	4.0	TS
24/18	22.4	107.0	992	35	4.0	TS
25/00	22.3	106.2	996	-	3.5	TD
25/06	22.4	105.4	998	-	-	TD
25/12	22.4	104.4	998	-	-	TD
25/18	22.3	103.2	1000	-	-	TD
26/00						Dissip.

HIGOS (0817)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Sep. 28/18	7.9	134.4	1006	-	0.5	TD
29/00	8.1	132.5	1006	-	0.5	TD
29/06	8.7	130.8	1004	-	1.0	TD
29/12	8.9	129.4	1004	-	1.0	TD
29/18	9.9	127.9	1004	-	1.0	TD
30/00	11.0	126.7	1004	-	1.5	TD
30/06	12.0	125.8	1004	-	1.5	TD
30/12	12.9	125.0	1006	-	1.5	TD
30/18	13.6	124.3	1006	-	2.0	TD
Oct. 01/00	14.0	123.1	1006	-	2.0	TD
01/06	14.2	121.8	1004	-	2.0	TD
01/12	14.6	120.2	1004	-	2.0	TD
01/18	14.9	118.2	1000	-	2.0	TD
02/00	15.3	116.3	996	35	2.5	TS
02/06	15.9	114.5	996	35	2.5	TS
02/12	16.3	113.4	996	35	2.5	TS
02/18	17.0	112.7	996	35	2.5	TS
03/00	17.7	111.7	996	35	2.5	TS
03/06	18.2	110.9	998	-	2.5	TD
03/12	19.0	110.7	998	-	2.0	TD
03/18	19.7	110.6	998	-	2.0	TD
04/00	20.4	110.6	998	-	2.0	TD
04/06	20.9	110.6	1000	-	-	TD
04/12	21.3	110.6	1002	-	-	TD
04/18	21.7	111.0	1002	-	-	TD
05/00	21.9	111.8	1002	-	-	TD
05/06	22.0	112.5	1002	-	-	TD
05/12	22.7	113.7	1002	-	-	TD
05/18	23.1	114.8	1004	-	-	TD
06/00	23.2	115.9	1008	-	-	TD
06/06	23.4	116.5	1008	-	-	TD
06/12						Dissip.

JANGMI (0815)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Sep. 24/00	11.8	137.9	1004	-	1.5	TD
24/06	12.2	137.3	1002	-	2.0	TD
24/12	12.6	136.5	998	35	2.5	TS
24/18	13.3	135.1	992	45	3.0	TS
25/00	13.8	134.1	985	55	3.5	STS
25/06	14.6	132.5	975	65	4.0	TY
25/12	14.7	131.2	970	70	4.0	TY
25/18	15.1	130.3	965	75	4.5	TY
26/00	16.0	129.9	960	80	5.0	TY
26/06	16.9	128.9	955	85	5.0	TY
26/12	17.7	128.0	940	95	6.0	TY
26/18	18.6	127.2	930	100	6.5	TY
27/00	19.6	126.5	920	105	6.5	TY
27/06	20.7	125.6	910	110	7.0	TY
27/12	21.3	124.4	905	115	7.0	TY
27/15	21.6	123.9	905	115	-	TY
27/18	21.7	123.7	905	115	7.0	TY
27/21	22.1	123.5	905	115	-	TY
28/00	22.8	123.2	910	110	7.0	TY
28/03	23.4	122.7	915	105	-	TY
28/06	23.9	122.4	925	100	6.0	TY
28/09	24.2	121.3	935	95	-	TY
28/12	24.2	121.0	950	85	5.5	TY
28/15	24.4	121.0	960	75	-	TY
28/18	24.7	121.2	970	65	5.0	TY
29/00	25.7	121.2	985	50	4.5	STS
29/06	26.4	121.5	990	50	4.0	STS
29/12	26.9	121.9	992	45	3.5	TS
29/18	27.6	123.2	992	45	3.5	TS
30/00	28.7	124.3	994	45	3.5	TS
30/06	29.4	125.3	994	40	3.0	TS
30/12	29.7	126.7	996	35	2.5	TS
30/15	29.7	127.3	996	35	-	TS
30/18	29.8	128.3	996	35	2.5	TS
30/21	29.8	129.4	998	35	-	TS
Oct. 01/00	29.9	130.4	1002	-	2.5	L
01/06	29.6	132.8	1002	-	-	L
01/12	29.4	135.1	1002	-	-	L
01/18	29.2	136.7	1004	-	-	L
02/00	29.1	138.7	1004	-	-	L
02/06	28.8	139.6	1004	-	-	L
02/12	28.4	140.3	1006	-	-	L
02/18	27.9	140.4	1006	-	-	L
03/00	27.4	140.5	1008	-	-	L
03/06	26.8	140.6	1006	-	-	L
03/12	26.5	140.6	1008	-	-	L
03/18	26.2	140.6	1006	-	-	L
04/00	26.0	140.7	1008	-	-	L
04/06	25.7	140.7	1006	-	-	L
04/12	25.2	140.9	1008	-	-	L
04/18	25.1	141.1	1010	-	-	L
05/00	25.1	141.1	1010	-	-	L
05/06						Dissip.

MEKKHALA (0816)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Sep. 27/18	14.4	112.9	1000	-	0.5	TD
28/00	14.6	112.6	1000	-	1.0	TD
28/06	14.8	112.4	998	-	1.0	TD
28/12	15.1	112.2	996	-	1.5	TD
28/18	15.6	111.8	994	-	1.5	TD
29/00	16.2	111.4	992	35	2.0	TS
29/06	16.8	110.5	992	40	2.5	TS
29/12	17.1	109.4	992	40	2.5	TS
29/18	17.2	108.0	990	45	3.0	TS
30/00	17.3	107.0	990	45	3.0	TS
30/06	18.0	105.5	998	35	2.5	TS
30/12	19.0	103.0	1004	-	2.0	TD
30/18						Dissip.

BAVI (0818)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Oct. 18/00	21.5	151.4	1010	-	0.5	TD
18/06	22.9	150.4	1010	-	1.0	TD
18/12	23.9	149.5	1008	-	1.5	TD
18/18	24.7	148.8	1006	-	2.0	TD
19/00	25.4	148.1	1004	-	2.5	TD
19/06	26.6	148.4	1000	35	2.5	TS
19/12	28.6	149.2	996	40	3.0	TS
19/18	30.4	150.3	992	45	3.0	TS
20/00	32.8	152.2	992	45	3.0	TS
20/06	35.5	153.1	992	45	3.0	TS
20/12	38.0	154.0	990	-	2.5	L
20/18	40.1	155.7	988	-	-	L
21/00	40.9	157.7	984	-	-	L
21/06	42.6	162.5	980	-	-	L
21/12	44.8	166.4	976	-	-	L
21/18	46.6	170.8	966	-	-	L
22/00	48.5	175.4	956	-	-	L
22/06	49.8	178.9	948	-	-	L
22/12	50.9	176.9w	948	-	-	Out

MAYSAK (0819)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Nov. 05/12	8.4	127.8	1008	-	1.0	TD
05/18	9.3	126.1	1006	-	1.5	TD
06/00	9.9	124.7	1006	-	1.0	TD
06/06	10.9	123.0	1006	-	1.0	TD
06/12	11.6	121.7	1006	-	1.0	TD
06/18	12.3	120.1	1006	-	1.5	TD
07/00	12.9	118.6	1004	-	2.0	TD
07/06	13.7	117.1	1002	35	2.0	TS
07/12	14.3	116.0	1000	35	2.0	TS
07/18	14.7	115.6	998	40	2.5	TS
08/00	15.2	115.3	990	45	3.0	TS
08/06	15.9	115.1	990	45	3.0	TS
08/12	17.0	115.1	985	50	3.0	STS
08/18	17.8	115.1	985	50	3.0	STS
09/00	17.9	115.6	985	50	3.0	STS
09/06	17.6	115.9	990	45	3.0	TS
09/12	16.9	116.3	998	-	3.0	TD
09/18	16.5	116.6	1000	-	-	TD
10/00	16.1	116.8	1000	-	-	TD
10/06	15.3	116.8	1000	-	-	TD
10/12	14.1	117.0	1002	-	-	TD
10/18	13.3	116.5	1004	-	-	TD
11/00	12.7	115.9	1006	-	-	TD
11/06	12.5	115.9	1006	-	-	TD
11/12	11.9	115.9	1006	-	-	TD
11/18	11.6	116.0	1006	-	-	TD
12/00	11.3	116.1	1006	-	-	TD
12/06	11.2	116.0	1006	-	-	TD
12/12	11.1	115.5	1006	-	-	TD
12/18	11.1	114.3	1006	-	-	TD
13/00	11.6	113.5	1006	-	-	TD
13/06	12.0	113.0	1006	-	-	TD
13/12	12.0	112.0	1006	-	-	TD
13/18	11.7	110.6	1006	-	-	TD
14/00						Dissip.

HAISHEN (0820)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Nov. 14/18	22.9	146.4	1010	-	1.0	TD
15/00	23.5	147.0	1010	-	1.0	TD
15/06	24.1	147.6	1008	-	1.0	TD
15/12	24.9	148.5	1008	-	1.5	TD
15/18	25.6	149.7	1006	35	2.0	TS
16/00	26.2	150.8	1004	40	2.0	TS
16/06	27.3	152.7	1004	40	2.5	TS
16/12	28.2	154.2	1006	35	2.5	TS
16/18	29.0	155.6	1006	35	2.5	TS
17/00	29.8	157.5	1006	35	2.0	TS
17/06	30.6	158.9	1006	35	-	TS
17/12	31.4	160.2	1010	-	-	L
17/18	33.3	162.0	1008	-	-	L
18/00	35.4	164.8	1008	-	-	L
18/06	37.1	168.6	1004	-	-	L
18/12	40.0	173.1	1002	-	-	L
18/18	42.3	176.7	1000	-	-	L
19/00	43.4	179.5w	998	-	-	Out

NOUL (0821)

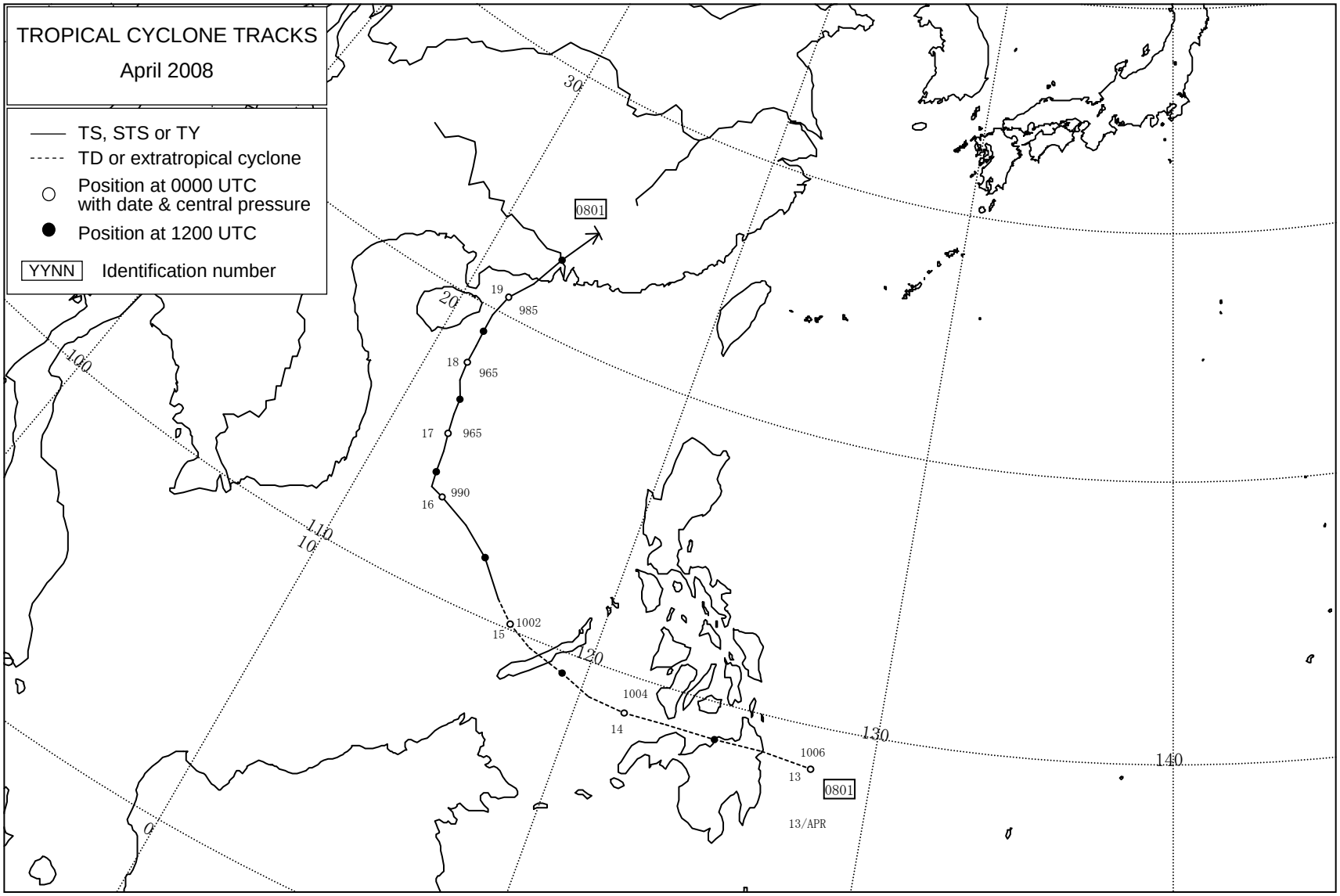
Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Nov. 14/18	8.4	121.9	1004	-	1.0	TD
15/00	8.4	120.4	1006	-	1.0	TD
15/06	8.6	119.1	1004	-	1.0	TD
15/12	9.0	118.1	1004	-	1.0	TD
15/18	9.4	116.8	1002	-	1.0	TD
16/00	9.9	115.8	1002	-	1.5	TD
16/06	10.4	114.8	1000	-	1.5	TD
16/12	10.7	113.4	998	35	2.0	TS
16/18	11.0	112.1	996	35	2.0	TS
17/00	11.3	111.0	994	40	2.5	TS
17/06	11.5	109.8	998	35	2.0	TS
17/12	11.9	107.9	1004	-	1.5	TD
17/18						Dissip.

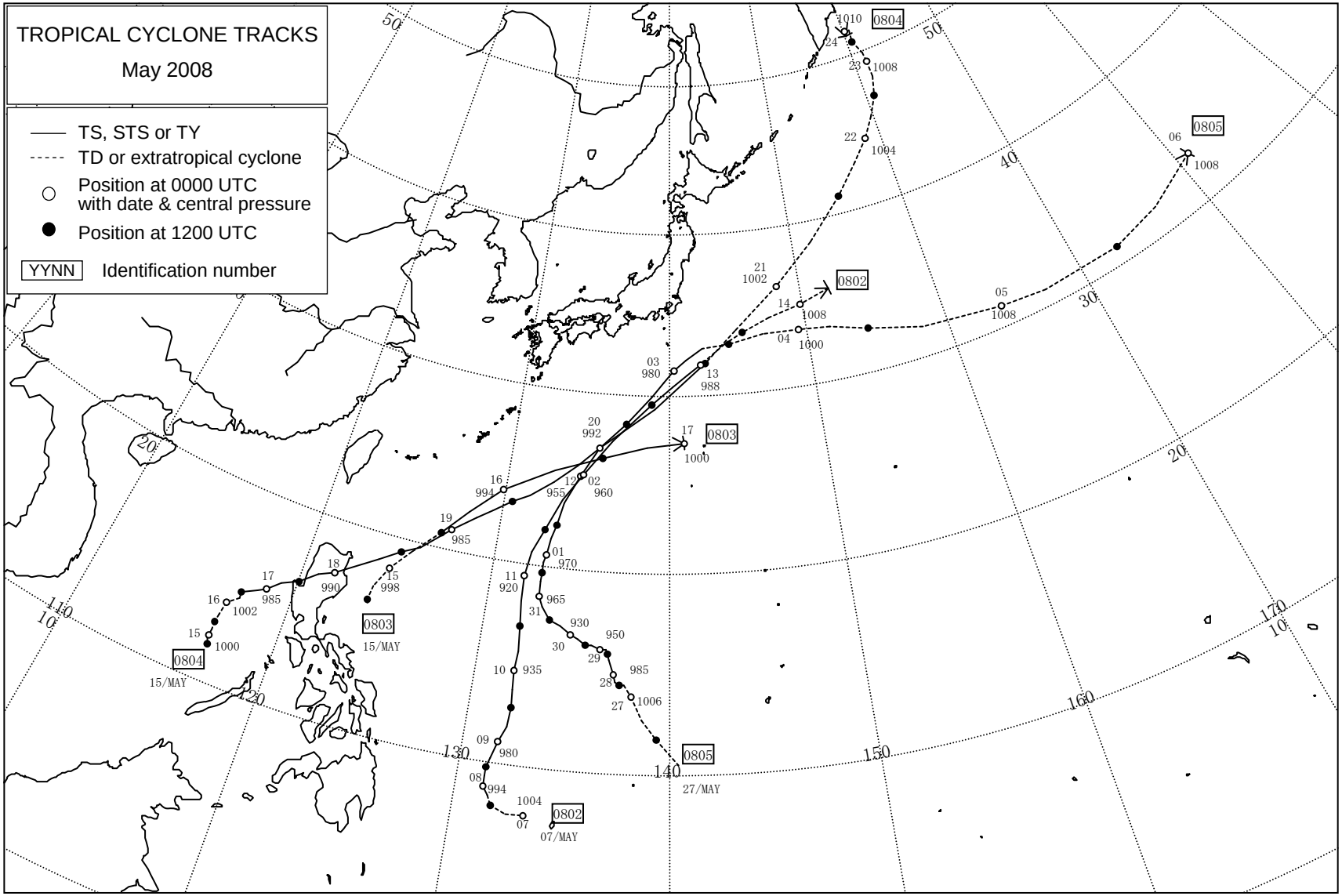
DOLPHIN (0822)

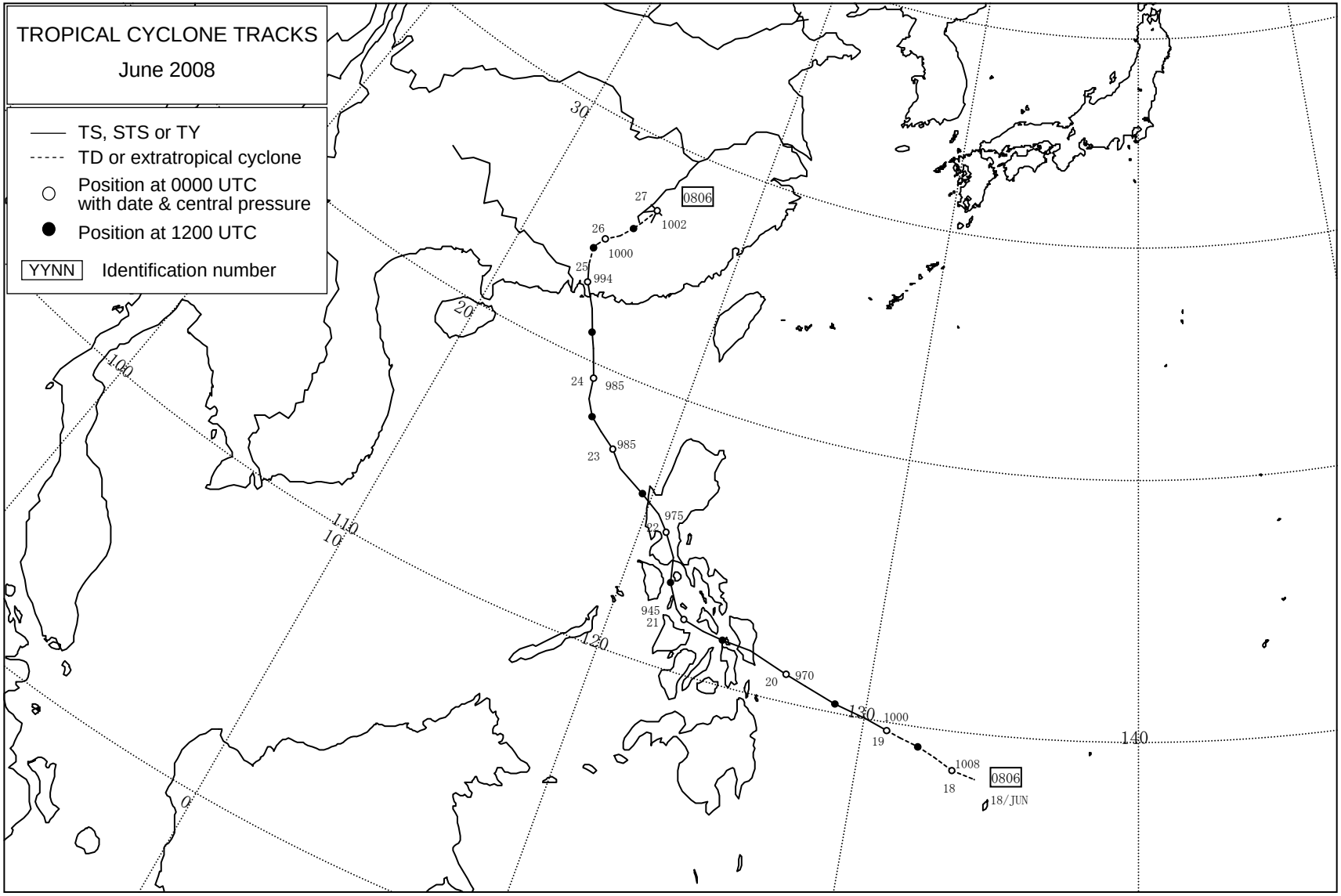
Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Dec. 11/06	12.5	145.2	1000	-	0.5	TD
11/12	12.8	143.6	1002	-	0.5	TD
11/18	13.0	142.3	1000	-	0.5	TD
12/00	13.3	141.3	1002	-	1.0	TD
12/06	13.6	140.3	1000	-	1.0	TD
12/12	14.0	139.2	1000	-	1.5	TD
12/18	14.0	138.1	996	35	2.0	TS
13/00	14.0	136.9	996	35	2.0	TS
13/06	13.9	135.8	992	40	2.0	TS
13/12	13.8	134.7	992	40	2.0	TS
13/18	13.7	134.0	990	45	2.5	TS
14/00	13.6	133.1	990	45	2.5	TS
14/06	13.6	132.4	990	45	2.5	TS
14/12	13.7	131.6	985	50	3.0	STS
14/18	13.7	130.8	985	50	3.0	STS
15/00	13.9	130.3	980	55	3.5	STS
15/06	14.3	130.4	980	55	3.5	STS
15/12	14.8	130.5	975	60	4.0	STS
15/18	15.3	130.5	970	65	4.0	TY
16/00	15.8	130.5	970	65	4.0	TY
16/06	16.4	130.7	970	65	4.0	TY
16/12	17.0	130.9	975	60	4.0	STS
16/18	17.7	131.4	980	55	3.5	STS
17/00	18.5	132.0	985	50	3.5	STS
17/06	19.3	132.6	990	45	3.0	TS
17/12	20.1	133.8	992	40	3.0	TS
17/18	21.1	135.3	994	40	2.5	TS
18/00	22.1	137.3	996	35	2.0	TS
18/06	22.8	139.5	1002	35	1.5	TS
18/12	23.4	140.5	1008	-	1.5	L
18/18	24.1	141.5	1010	-	-	L
19/00						Dissip.

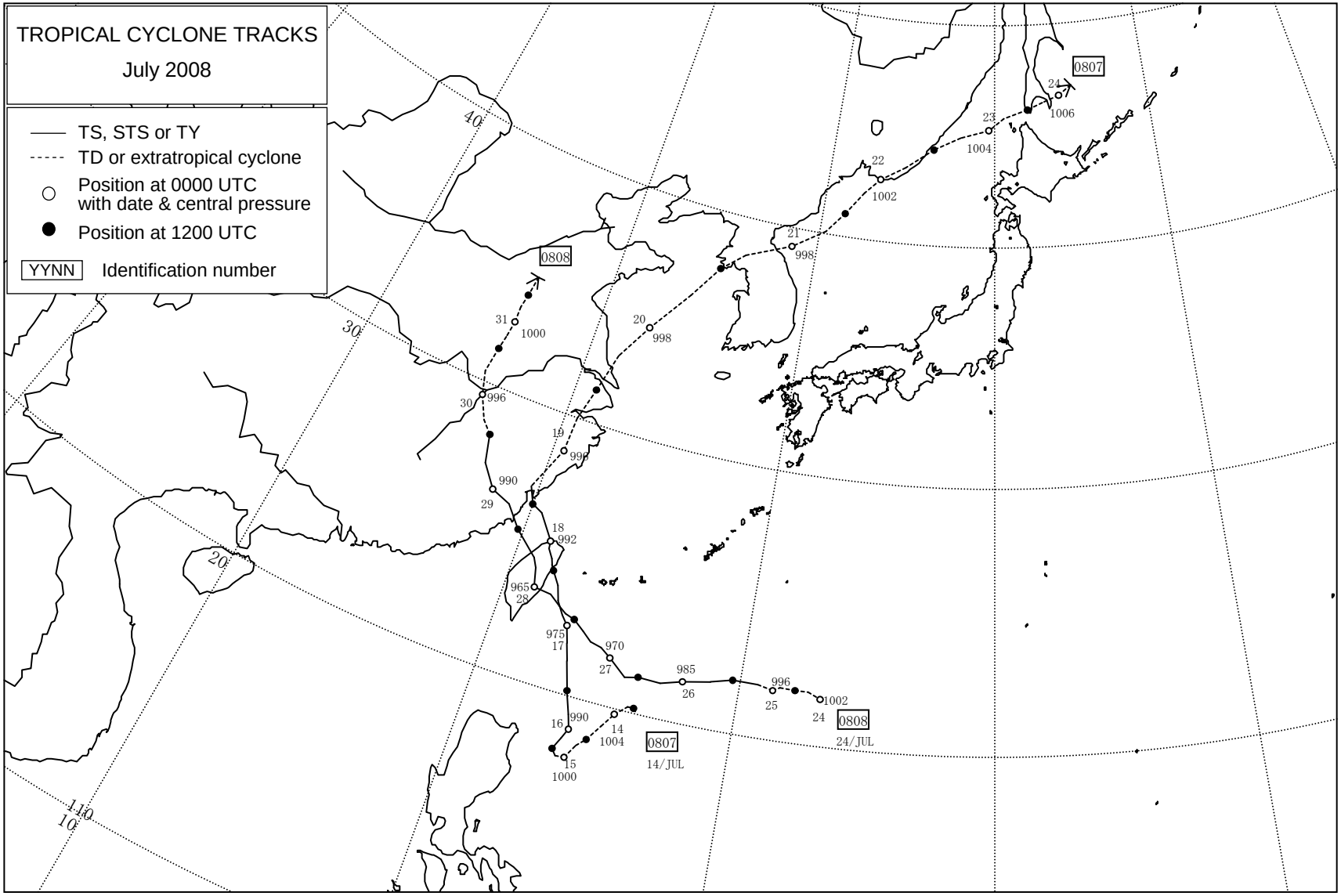
Appendix 2

Monthly Tracks of Tropical Cyclones in 2008


TROPICAL CYCLONE TRACKS
April 2008
TS, STS or TY
TD or extratropical cyclone
Position at 0000 UTC
with date & central pressure
Position at 1200 UTC
YYNN Identification number
0801
19
985
18
965
17
965
16
990
15
1002
1004
14
1006
13
0801
13/APR
30
20
100
110
10
120
130
140
0


TROPICAL CYCLONE TRACKS
May 2008
TS, STS or TY
TD or extratropical cyclone
Position at 0000 UTC
with date & central pressure
Position at 1200 UTC
YYNN Identification number
0804
0805
0802
0803
0804
0803
0805
0802
15/MAY
27/MAY
07/MAY
50
40
30
20
10
110
120
130
140
150
160
170


TROPICAL CYCLONE TRACKS
June 2008
TS, STS or TY
TD or extratropical cyclone
Position at 0000 UTC
with date & central pressure
Position at 1200 UTC
YYNN Identification number
30
20
10
0
100
110
120
130
140
27
0806
1002
26
1000
25
994
24
985
985
23
975
22
945
21
970
20
1000
19
1008
18
0806
18/JUN


TROPICAL CYCLONE TRACKS
July 2008
TS, STS or TY
TD or extratropical cyclone
Position at 0000 UTC
with date & central pressure
Position at 1200 UTC
YYNN Identification number
40
30
20
10
110
0807
24
1006
23
1004
22
1002
21
998
0808
31
1000
20
998
30
996
19
996
990
29
18
992
965
28
975
17
970
27
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26
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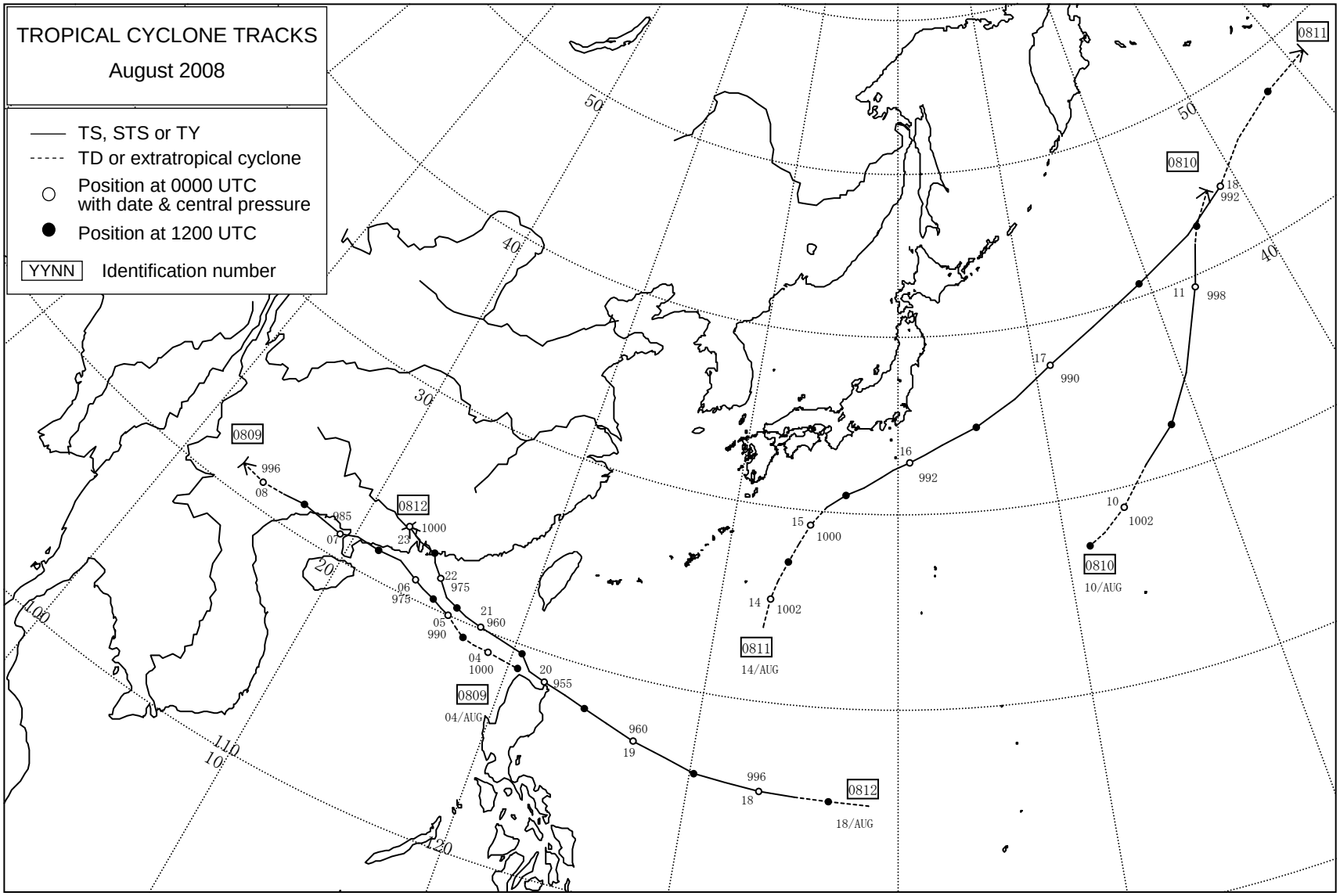
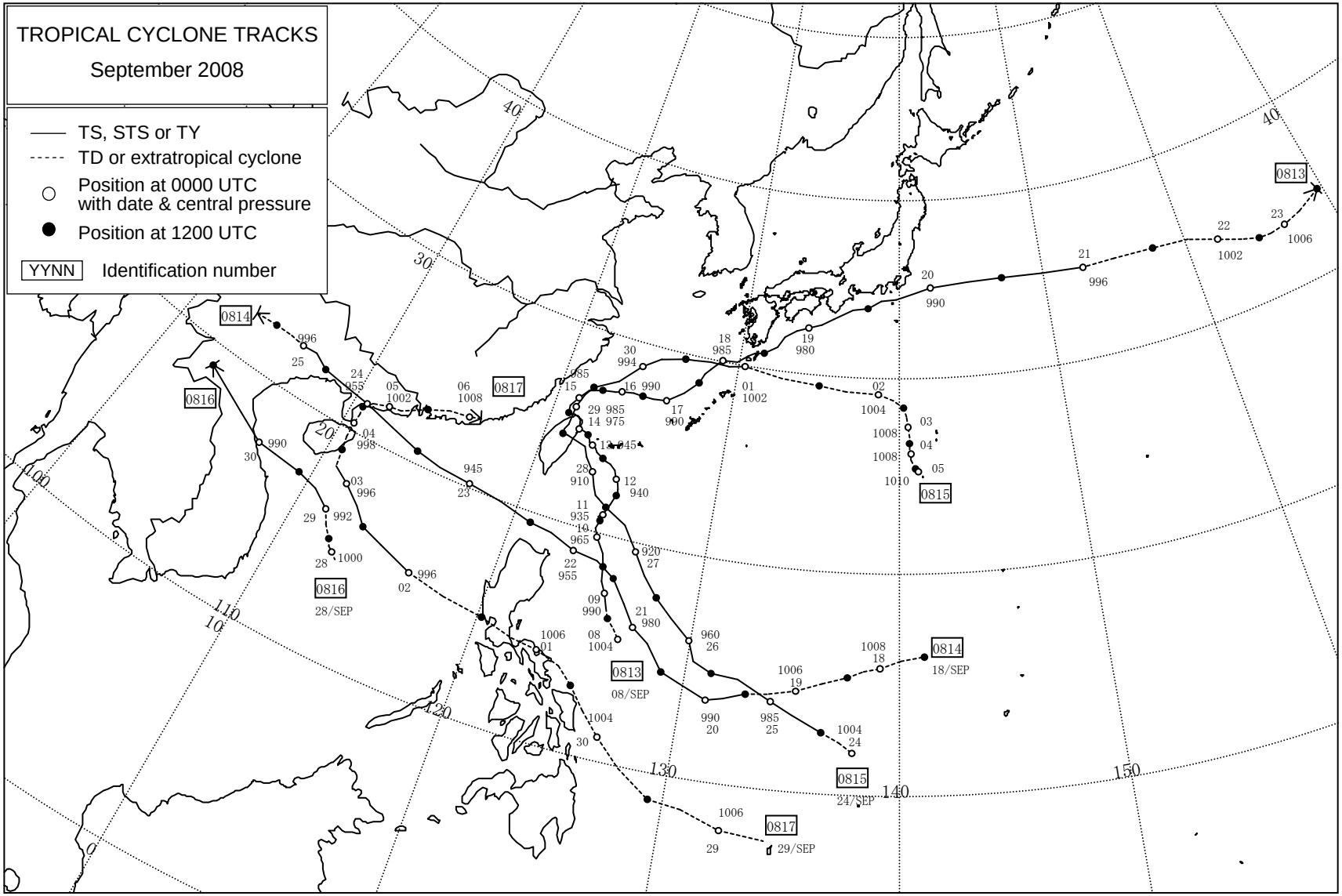
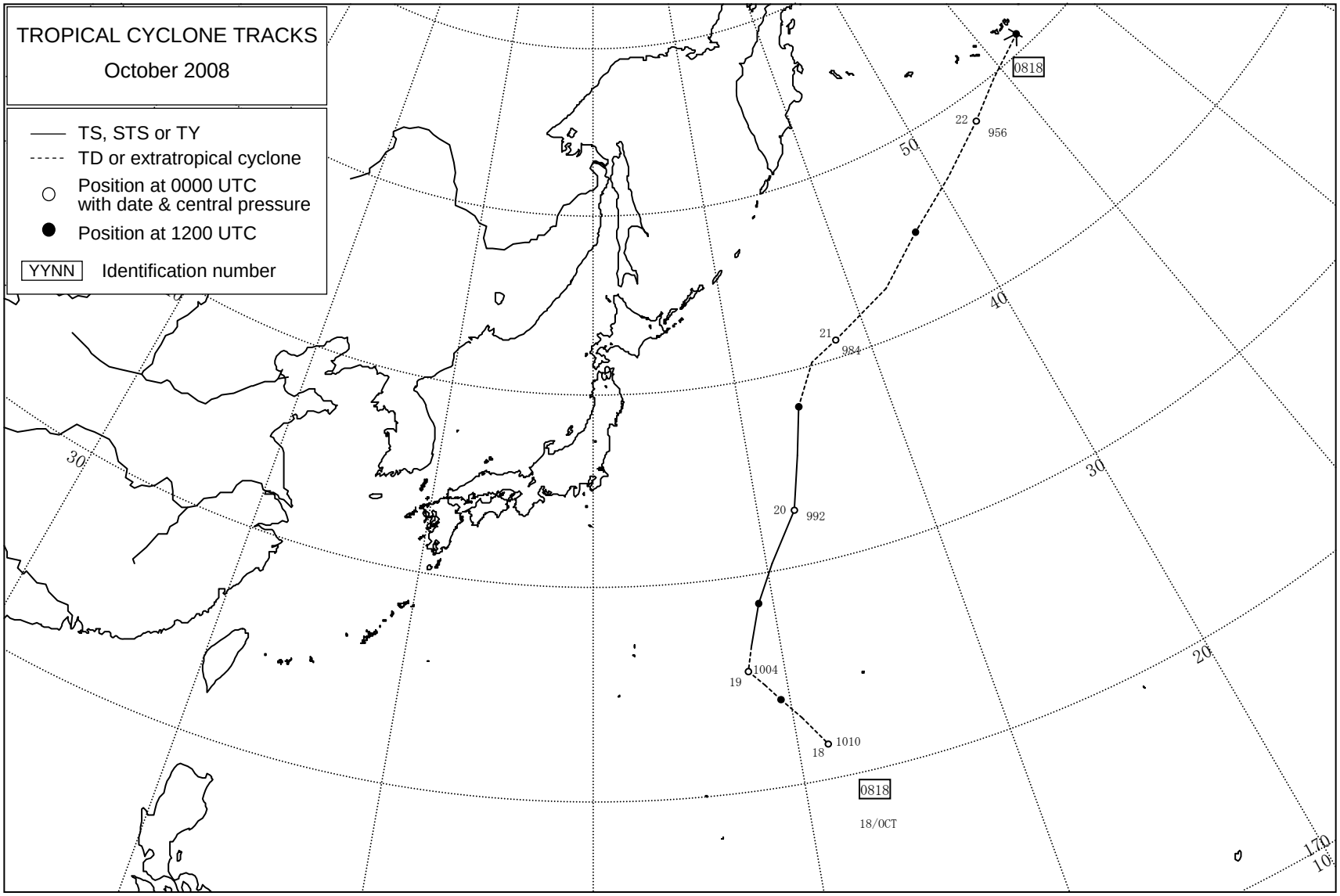
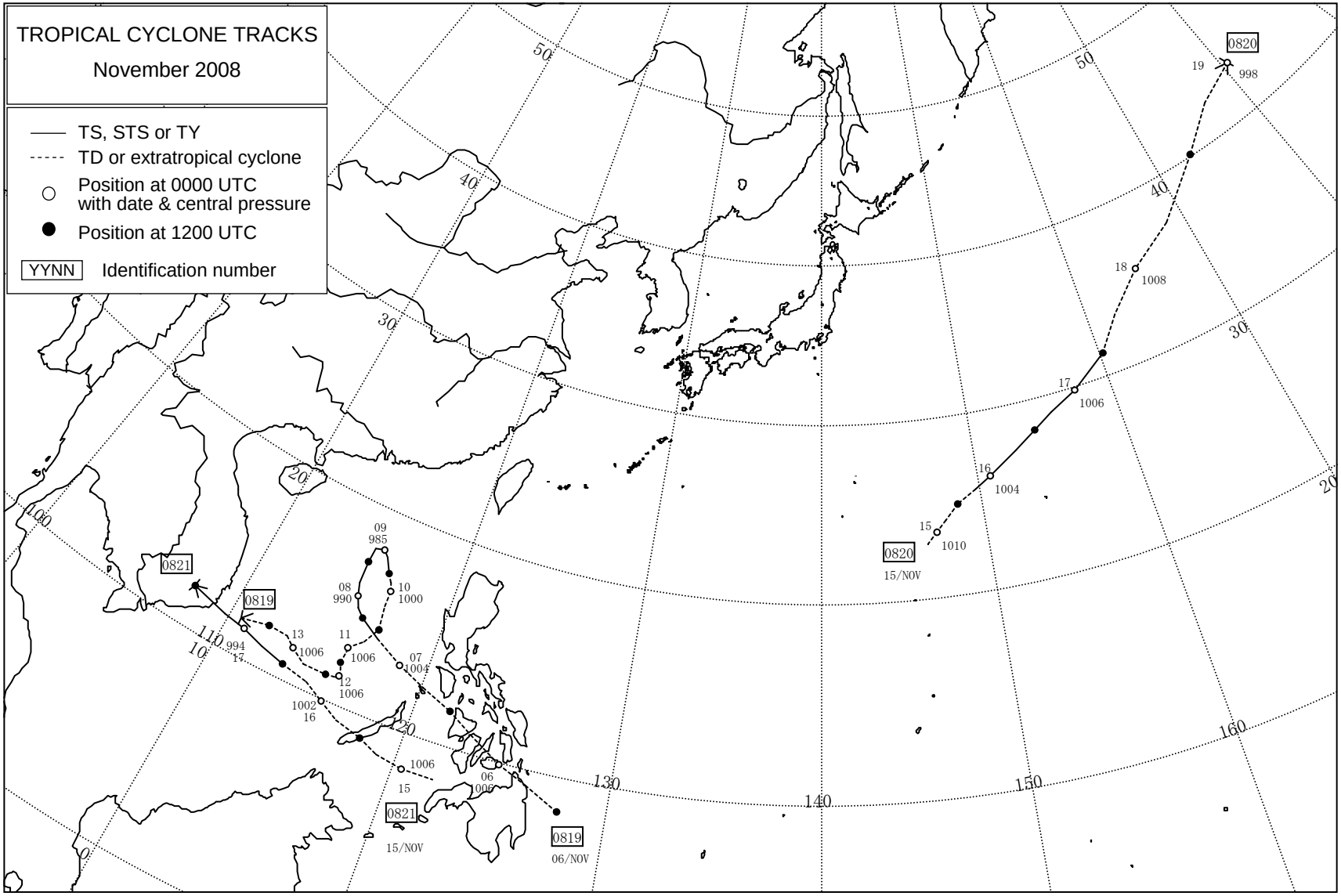
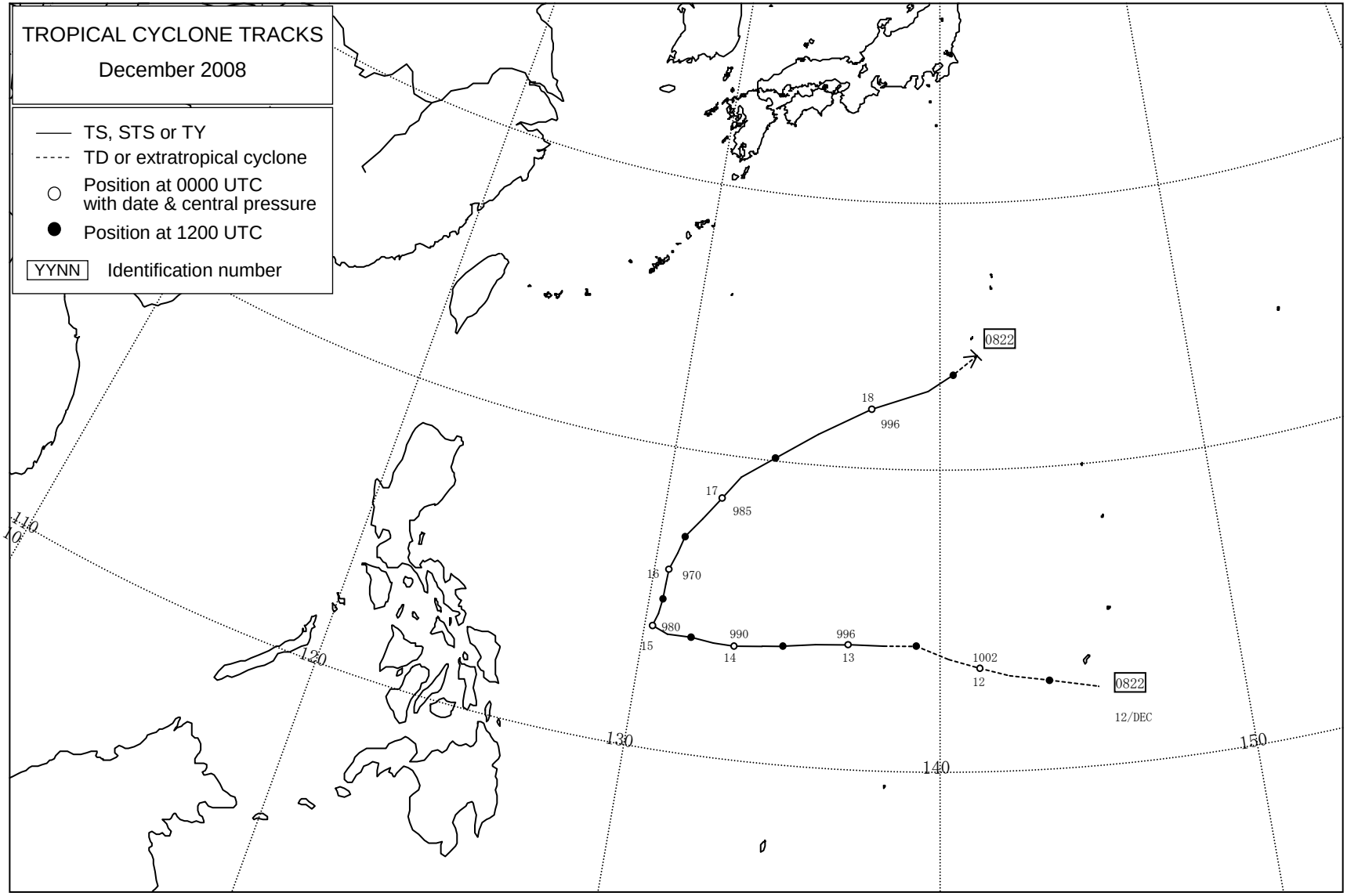
25
1002
24
0808
24/JUL
16
990
14
1004
0807
14/JUL
15
1000


TROPICAL CYCLONE TRACKS
August 2008
TS, STS or TY
TD or extratropical cyclone
Position at 0000 UTC
with date & central pressure
Position at 1200 UTC
YYNN Identification number
0809
0812
0811
0810
04/AUG
14/AUG
10/AUG
18/AUG
50
40
30
20
100
110
120


TROPICAL CYCLONE TRACKS
September 2008
TS, STS or TY
TD or extratropical cyclone
Position at 0000 UTC with date & central pressure
Position at 1200 UTC
YYNN Identification number
0813
0814
0816
0817
0815
28/SEP
08/SEP
18/SEP
24/SEP
29/SEP
40
30
20
10
0
100
110
120
130
140
150


TROPICAL CYCLONE TRACKS
October 2008
TS, STS or TY
TD or extratropical cyclone
Position at 0000 UTC
with date & central pressure
Position at 1200 UTC
YYNN
Identification number
0818
22
956
21
984
20
992
19
1004
18
1010
0818
18/0CT
50
40
30
20
170
10
30


TROPICAL CYCLONE TRACKS
November 2008
TS, STS or TY
TD or extratropical cyclone
Position at 0000 UTC
with date & central pressure
Position at 1200 UTC
YYNN Identification number
0820
19
998
18
1008
17
1006
16
1004
15
1010
0820
15/NOV
0821
0819
09
985
08
990
10
1000
13
1006
11
1006
07
1004
994
17
12
1006
1002
16
1006
15
06
1006
0821
15/NOV
0819
06/NOV
10
20
30
40
50
100
110
120
130
140
150
160


TROPICAL CYCLONE TRACKS
December 2008
TS, STS or TY
TD or extratropical cyclone
Position at 0000 UTC
with date & central pressure
Position at 1200 UTC
YYNN
Identification number
0822
18
996
17
985
16
970
15
980
14
990
13
996
12
1002
0822
12/DEC
110
120
130
140
150

Appendix 3

Track and Intensity Analysis and Forecast Errors for Each Tropical Cyclone in 2008

Date/Time		Center Position (km)				Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	T=24	T=48	T=72	T=24	T=48	T=72	T=24	T=48	T=72
TY NEOGURI (0801)											
Apr.	15/06	35	252	347	546	14	32	29	-20	-35	-35
	15/12	86	138	291	426	17	30	22	-20	-35	-25
	15/18	22	68	72	214	15	20	5	-20	-25	-10
	16/00	0	86	119	231	15	10	-5	-20	-20	0
	16/06	0	170	286	520	10	10	-7	-15	-15	5
	16/12	15	218	364	664	0	5	-8	-5	-10	10
	16/18	11	115	260		-5	-5		-5	0	
	17/00	0	77	213		0	7		-10	-10	
	17/06	0	117	358		-5	4		5	-5	
	17/12	0	74	334		0	-2		-5	5	
	17/18	34	44			-5			0		
	18/00	15	71			-5			0		
	18/06	46	194			-2			0		
	18/12	21	281			-8			10		
	18/18	0									
	19/00	24									
	19/06	33									
	19/12	46									
	mean	22	136	264	434	3	11	6	-8	-15	-9
	sampl	18	14	10	6	14	10	6	14	10	6

Date/Time		Center Position (km)				Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	T=24	T=48	T=72	T=24	T=48	T=72	T=24	T=48	T=72
TY RAMMASUN (0802)											
May	07/18	115	198	355	402	5	30	45	-5	-25	-30
	08/00	47	186	270	291	5	35	30	-5	-30	-20
	08/06	68	190	214	296	15	45	25	-15	-35	-15
	08/12	78	148	158	344	25	50	10	-20	-35	-5
	08/18	68	62	123	249	30	45	0	-25	-30	0
	09/00	0	34	153	225	35	35	-10	-30	-25	5
	09/06	0	77	39	150	30	15	-5	-25	-10	5
	09/12	0	54	47	125	30	10	0	-20	0	0
	09/18	22	44	83	97	25	10	0	-20	-5	5
	10/00	0	94	211		10	0		-10	0	
	10/06	0	156	354		-5	-15		0	10	
	10/12	0	123	397		-15	-20		10	15	
	10/18	0	133	271		-15	-20		10	20	
	11/00	0	157			-15			10		
	11/06	0	205			-15			10		
	11/12	0	252			-5			5		
	11/18	0	164			0			0		
	12/00	32									
	12/06	45									
	12/12	51									
	12/18	10									
	mean	25	134	206	242	8	17	11	-8	-12	-6
	sampl	21	17	13	9	17	13	9	17	13	9

Date/Time		Center Position (km)				Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	T=24	T=48	T=72	T=24	T=48	T=72	T=24	T=48	T=72
STS MATMO (0803)											
May	15/12	21	390			2			-5		
	15/18	76	309			0			0		
	16/00	20									
	16/06	113									
	16/12	120									
	16/18										
	mean	58	350			1			-2		
	sampl	6	2			2			2		

Date/Time		Center Position (km)				Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	T=24	T=48	T=72	T=24	T=48	T=72	T=24	T=48	T=72
STS HALONG (0804)											
May	16/06	39	113	111	133	10	-5	-5	-10	5	5
	16/12	0	90	179	356	5	-5	-5	-5	5	5
	16/18	25	203	280	618	5	0	-10	-5	0	10
	17/00	0	159	183	475	4	5	-7	-5	-5	10
	17/06	0	118	202	512	4	10	-11	-5	-10	15
	17/12	0	137	267		0	0		0	0	
	17/18	0	176	270		0	-10		0	10	
	18/00	24	236	251		0	-12		0	15	
	18/06	91	161	362		5	-11		-5	15	
	18/12	90	108			-5			5		
	18/18	25	82			-10			10		
	19/00	0	49			-2			5		
	19/06	23	72			2			0		
	19/12	0									
	19/18	30									
	20/00	52									
	20/06	97									
	mean	29	131	234	419	1	-3	-8	-1	4	9
	sampl	17	13	9	5	13	9	5	13	9	5

Date/Time		Center Position (km)				Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	T=24	T=48	T=72	T=24	T=48	T=72	T=24	T=48	T=72
TY NAKRI (0805)											
May	27/06	0	33	164	355	12	40	30	-20	-40	-30
	27/12	0	35	100	254	10	35	0	-15	-30	-5
	27/18	15	78	75	201	20	30	-15	-20	-25	0
	28/00	0	39	57	116	25	30	-20	-25	-25	5
	28/06	0	39	101	79	30	15	-25	-30	-20	10
	28/12	0	102	183	147	30	-5	-25	-25	-5	15
	28/18	0	134	271	362	20	-20	-30	-20	5	20
	29/00	0	126	233	372	-10	-50	-50	-5	25	25
	29/06	0	128	251	415	-20	-55	-40	15	50	35
	29/12	0	101	180	340	-35	-50	-30	30	45	25
	29/18	0	111	189	273	-45	-45	-15	35	40	10
	30/00	0	98	127	157	-50	-45	-5	40	35	5
	30/06	0	87	148	229	-25	-25	0	20	20	0
	30/12	0	31	117	171	-30	-20	10	30	15	-15
	30/18	0	30	88	334	-10	5	15	5	-10	-20
	31/00	0	68	46	332	0	20	14	-5	-20	-15
	31/06	10	10	203		0	25		-10	-25	
	31/12	0	11	177		10	25		-15	-30	
	31/18	0	39	67		20	26		-25	-30	
Jun.	01/00	0	30	36		30	18		-30	-15	
	01/06	0	35			25			-25		
	01/12	0	23			25			-30		
	01/18	0	133			20			-25		
	02/00	10	174			14			-10		
	02/06										
	02/12										
	02/18										
	03/00										
	mean	1	71	141	259	3	-2	-12	-7	-2	4
	sampl	28	24	20	16	24	20	16	24	20	16

Date/Time		Center Position (km)				Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	T=24	T=48	T=72	T=24	T=48	T=72	T=24	T=48	T=72
TY FENGSHEN (0806)											
Jun.	19/00	45	339	822	963	24	40	0	-30	-40	-15
	19/06	11	455	815	964	20	20	-10	-25	-25	0
	19/12	40	314	500	656	5	-20	-50	-5	5	30
	19/18	16	267	334	613	10	-25	-50	-10	5	35
	20/00	45	195	175	479	20	-10	-20	-15	0	25
	20/06	0	110	185	515	10	-10	-15	-15	0	15
	20/12	50	134	279	569	5	-5	-5	-10	0	5
	20/18	11	60	291	511	0	-5	-5	-5	10	10
	21/00	0	82	93	176	-15	-35	-40	5	35	40
	21/06	0	77	162	216	-20	-35	-40	10	30	30
	21/12	35	55	247	314	-15	-20	-25	10	20	25
	21/18	22	193	366	484	-15	-25	-30	15	25	30
	22/00	31	177	316	607	-15	-25	-29	15	25	30
	22/06	11	183	329		-15	-15		15	15	
	22/12	21	186	430		-15	-15		15	15	
	22/18	54	118	244		-15	-20		15	20	
	23/00	11	95	361		-5	-9		5	10	
	23/06	48	85			-5			5		
	23/12	24	54			-5			5		
	23/18	39	80			-10			10		
	24/00	10	190			-4			10		
	24/06	35									
	24/12	24									
	24/18	10									
	25/00	24									
	mean	25	164	350	544	-3	-13	-25	1	9	20
	sampl	25	21	17	13	21	17	13	21	17	13

Date/Time		Center Position (km)				Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	T=24	T=48	T=72	T=24	T=48	T=72	T=24	T=48	T=72
TY KALMAEGI (0807)											
Jul.	15/06	31	116	105	188	7	20	-14	-5	-15	25
	15/12	39	124	199	202	5	10	-14	-5	-10	25
	15/18	92	137	167		10	0		-10	0	
	16/00	77	67	151		5	-22		-5	25	
	16/06	47	91	253		5	-34		-5	40	
	16/12	33	143	406		-10	-39		10	40	
	16/18	22	99			-20			20		
	17/00	0	102			-32			35		
	17/06	20	49			-39			40		
	17/12	42	199			-29			35		
	17/18	61									
	18/00	33									
	18/06	32									
	18/12	56									
	mean	42	113	213	195	-10	-11	-14	11	13	25
	sampl	14	10	6	2	10	6	2	10	6	2

Date/Time		Center Position (km)				Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	T=24	T=48	T=72	T=24	T=48	T=72	T=24	T=48	T=72
TY FUNG-WONG (0808)											
Jul.	25/06	0	160	89	139	5	0	-15	-5	0	20
	25/12	0	94	15	135	5	5	-15	-5	-5	20
	25/18	25	46	83	225	-5	-10	-15	5	5	15
	26/00	25	33	83	321	0	-15	-20	0	10	20
	26/06	25	35	141	238	-5	-25	-20	5	25	20
	26/12	0	46	90		-5	-20		0	20	
	26/18	0	0	83		-10	-10		5	10	
	27/00	0	75	67		-15	-15		10	15	
	27/06	0	59	51		-15	-15		15	10	
	27/12	0	40			-10			15		
	27/18	0	89			-10			10		
	28/00	0	71			-5			10		
	28/06	0	54			2			0		
	28/12	0									
	28/18	11									
	29/00	50									
	29/06	54									
	mean	11	62	78	211	-5	-12	-17	5	10	19
	sampl	17	13	9	5	13	9	5	13	9	5

Date/Time		Center Position (km)				Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	T=24	T=48	T=72	T=24	T=48	T=72	T=24	T=48	T=72
STS KAMMURI (0809)											
Aug.	05/00	56	113	159		10	9		-5	-40	
	05/06	61	148	193		10	9		-10	-40	
	05/12	46	64	121		5	4		-5	-35	
	05/18	31	73			0			0		
	06/00	0	94			-10			10		
	06/06	22	76			-5			5		
	06/12	47	109			0			-35		
	06/18	31									
	07/00	0									
	07/06	52									
	07/12	41									
	mean	35	97	157		1	7		-6	-38	
	sampl	11	7	3		7	3		7	3	

Date/Time		Center Position (km)				Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	T=24	T=48	T=72	T=24	T=48	T=72	T=24	T=48	T=72
STS PHANFONE (0810)											
Aug.	10/06	119									
	10/12	159									
	10/18	118									
	11/00	76									
	mean	118									
	sampl	4									

Date/Time		Center Position (km)				Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	T=24	T=48	T=72	T=24	T=48	T=72	T=24	T=48	T=72
STS VONGFONG (0811)											
Aug.	15/06	10	207	334		2	8		-10	-15	
	15/12	0	68			2			-10		
	15/18	74	67			4			-15		
	16/00	0	90			4			-15		
	16/06	0	69			4			-15		
	16/12	0									
	16/18	0									
	17/00	24									
	17/06	79									
	mean	21	100	334		3	8		-13	-15	
	sampl	9	5	1		5	1		5	1	

Date/Time		Center Position (km)				Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	T=24	T=48	T=72	T=24	T=48	T=72	T=24	T=48	T=72
TY NURI (0812)											
Aug.	17/18	11	192			30			-30		
	18/00	0	138	287	516	30	20	0	-25	-15	5
	18/06	0	49	174	420	30	15	0	-25	-10	5
	18/12	0	57	69	205	5	0	-15	0	0	15
	18/18	24	44	153	343	0	-5	-25	0	5	20
	19/00	11	105	285	460	0	-10	-30	0	10	25
	19/06	0	53	167	271	-5	-15	-30	5	15	30
	19/12	0	47	118	170	-10	-20	-30	10	20	30
	19/18	54	71	143	246	-10	-20	-26	10	20	25
	20/00	21	25	83		-15	-15		15	20	
	20/06	0	96	175		-15	-20		10	25	
	20/12	0	175	187		-10	-10		10	15	
	20/18	11	84	122		-10	-4		10	5	
	21/00	0	25			-15			20		
	21/06	0	47			-10			15		
	21/12	0	64			-15			15		
	21/18	15	24			-11			10		
	22/00	15									
	22/06	0									
	22/12	21									
	22/18	11									
	mean	9	76	164	329	-2	-7	-20	3	9	19
	sampl	21	17	12	8	17	12	8	17	12	8

Date/Time		Center Position (km)				Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	T=24	T=48	T=72	T=24	T=48	T=72	T=24	T=48	T=72
TY SINLAKU (0813)											
Sep.	08/18	0	15	94	126	15	35	10	-20	-35	-15
	09/00	33	54	94	138	15	30	5	-25	-30	-15
	09/06	22	90	167	215	25	20	0	-25	-25	-10
	09/12	0	76	74	202	25	5	-10	-25	-15	-5
	09/18	22	53	23	250	15	-5	-10	-20	-10	-5
	10/00	0	33	61	122	10	-5	-10	-20	-10	-5
	10/06	0	43	78	152	0	-15	-20	-15	0	5
	10/12	0	63	91	162	-15	-25	-30	-5	5	5
	10/18	0	79	57	69	-15	-20	-20	-5	0	5
	11/00	0	64	70	11	-10	-15	-25	0	5	15
	11/06	0	101	90	42	-5	-10	-30	-5	0	15
	11/12	0	42	69	39	-10	-15	-10	0	0	0
	11/18	0	49	84	60	-10	0	-5	0	-5	0
	12/00	0	46	22	49	-10	-10	0	0	5	0
	12/06	0	44	64	24	5	-15	0	-10	5	0
	12/12	0	24	101	33	0	-15	0	-10	5	0
	12/18	0	38	100	52	-10	-15	0	0	10	0
	13/00	10	23	105	98	-25	-15	-5	25	15	10
	13/06	15	78	196	352	-30	-25	-32	25	25	35
	13/12	0	156	199	378	-30	-25	-32	25	25	35
	13/18	0	164	314	557	-25	-25	-32	20	25	35
	14/00	0	111	157	390	-5	-15	-20	5	15	20
	14/06	0	131	251	338	-5	-17	-30	15	30	30
	14/12	10	56	195	228	-5	-22	-20	15	30	25
	14/18	0	54	136	98	-5	-17	-15	15	30	25
	15/00	20	33	137	71	-15	-15	-15	20	25	25
	15/06	22	20	54	87	-17	-20	-15	25	25	15
	15/12	0	41	98	192	-17	-20	-30	25	25	20
	15/18	59	33	147	254	-17	-20	-30	25	25	20
	16/00	44	37	220	396	-10	-15	-10	10	15	0
	16/06	49	145	328	529	-5	0	5	5	-5	-15
	16/12	0	81	201	466	0	-5	9	0	-5	-20
	16/18	0	112	230	461	0	0	11	0	-10	-20
	17/00	30	87	230	423	-5	10	8	5	-20	-20
	17/06	54	135	233	455	0	12	6	-5	-20	-20
	17/12	22	115	377	572	-5	7	6	-5	-20	-15
	17/18	48	96	345	618	-5	7	4	-5	-25	-10
	18/00	0	104	265		5	6		-15	-15	
	18/06	0	56	247		10	6		-15	-20	
	18/12	10	193	346		7	4		-20	-15	
	18/18	29	176	402		7	2		-20	-10	
	19/00	0	123			2			-10		
	19/06	0	130			0			-10		
	19/12	0	123			2			-5		
	19/18	0	260			0			0		
	20/00	0									
	20/06	0									
	20/12	76									
	20/18	18									
	mean	12	84	165	235	-4	-7	-11	-1	1	4
	sampl	49	45	41	37	45	41	37	45	41	37

Date/Time		Center Position (km)				Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	T=24	T=48	T=72	T=24	T=48	T=72	T=24	T=48	T=72
TS HIGOS (0817)											
Oct.	02/00	215	286			-4			10		
	02/06	136									
	02/12	154									
	02/18	148									
	03/00	54									
	mean	141	286			-4			10		
	sampl	5	1			1			1		

Date/Time		Center Position (km)				Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	T=24	T=48	T=72	T=24	T=48	T=72	T=24	T=48	T=72
TY HAGUPIT (0814)											
Sep.	19/12	31	34	300	668	5	5	15	-5	-5	-10
	19/18	103	144	234	517	0	10	5	5	-5	-5
	20/00	69	198	325	643	5	15	10	0	-10	-10
	20/06	32	115	256	584	0	10	0	5	-5	-5
	20/12	0	121	327	585	-5	0	10	5	0	-10
	20/18	32	75	226	300	5	0	15	0	0	-10
	21/00	60	69	229	303	5	0	-5	0	-5	5
	21/06	0	107	275	304	5	-5	-25	-5	0	20
	21/12	0	85	216	271	-5	-5	-5	5	0	10
	21/18	0	69	139	151	-10	15	-7	5	-10	15
	22/00	0	74	175		-5	-5		0	5	
	22/06	0	119	231		-10	-15		5	15	
	22/12	0	109	224		-10	-20		5	25	
	22/18	0	170	226		5	-7		-5	20	
	23/00	0	162			-10			10		
	23/06	0	118			-5			5		
	23/12	0	43			-5			5		
	23/18	0	45			-2			5		
	24/00	0									
	24/06	15									
	mean	16	103	242	433	-2	0	1	2	2	0
	sampl	22	18	14	10	18	14	10	18	14	10

Date/Time		Center Position (km)				Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	T=24	T=48	T=72	T=24	T=48	T=72	T=24	T=48	T=72
TY JANGMI (0815)											
Sep.	24/12	57	340	353	378	20	35	55	-25	-35	-40
	24/18	60	170	128	196	15	35	50	-20	-30	-40
	25/00	33	46	111	281	10	40	40	-20	-30	-30
	25/06	0	24	159	323	10	45	20	-15	-35	-20
	25/12	0	53	182	386	10	40	-5	-15	-35	-5
	25/18	0	81	172	368	15	40	-15	-20	-35	10
	26/00	11	24	156	378	15	25	-30	-15	-20	25
	26/06	15	81	256	415	20	15	-30	-15	-15	25
	26/12	0	90	224	432	25	-10	-22	-20	5	20
	26/18	0	126	244	535	20	-10	-17	-15	10	15
	27/00	0	112	265	614	15	-15	-9	-10	15	5
	27/06	0	51	104	306	0	-20	-9	0	15	10
	27/12	0	57	74	180	0	-12	-2	-5	15	0
	27/18	0	44	142	242	-10	-7	0	10	5	0
	28/00	0	30	163		-15	-4		15	0	
	28/06	11	24	71		-10	-4		5	5	
	28/12	10	78	22		-12	-11		10	15	
	28/18	0	107	33		-7	-11		5	15	
	29/00	33	90			-9			5		
	29/06	40	152			-9			10		
	29/12	10	121			-11			15		
	29/18	82	155			-11			15		
	30/00	60									
	30/06	31									
	30/12	29									
	30/18	0									
	mean	19	93	159	360	4	10	2	-5	-8	-2
	sampl	26	22	18	14	22	18	14	22	18	14

Date/Time		Center Position (km)				Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	T=24	T=48	T=72	T=24	T=48	T=72	T=24	T=48	T=72
TS MEKKHALA (0816)											
Sep.	29/00	31	350			-5			5		
	29/06	48	196			-18			20		
	29/12	0									
	29/18	11									
	30/00	21									
	30/06	21									
	mean	22	273			-12			12		
	sampl	6	2			2			2		

Date/Time		Center Position (km)				Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	T=24	T=48	T=72	T=24	T=48	T=72	T=24	T=48	T=72
TS BAVI (0818)											
Oct.	19/06	0	261			0			0		
	19/12	22									
	19/18	36									
	20/00	29									
	20/06	29									
	mean	23	261			0			0		
	sampl	5	1			1			1		

Date/Time		Center Position (km)				Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	T=24	T=48	T=72	T=24	T=48	T=72	T=24	T=48	T=72
STS MAYSAK (0819)											
Nov.	07/06	0	79	359		8	6		-5	-5	
	07/12	58	189			9			-5		
	07/18	32	226			9			-5		
	08/00	39	248			0			0		
	08/06	0	116			-5			5		
	08/12	0									
	08/18	0									
	09/00	31									
	09/06	56									
	mean	24	172	359		4	6		-2	-5	
	sampl	9	5	1		5	1		5	1	

Date/Time		Center Position (km)				Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	T=24	T=48	T=72	T=24	T=48	T=72	T=24	T=48	T=72
TS HAISHEN (0820)											
Nov.	15/18	23	301			0			0		
	16/00	41	295			0			0		
	16/06	99	0								
	16/12	76	0								
	16/18	0	0								
	17/00	53	0								
	mean	49	298			0			0		
	sampl	6	2			2			2		

Date/Time		Center Position (km)				Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	T=24	T=48	T=72	T=24	T=48	T=72	T=24	T=48	T=72
TS NOUL (0821)											
Nov.	16/12	35									
	16/18	45									
	17/00	40									
	17/06	55									
	mean	44									
	sampl	4									

Date/Time		Center Position (km)				Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	T=24	T=48	T=72	T=24	T=48	T=72	T=24	T=48	T=72
TY DOLPHIN (0822)											
Dec.	12/18	49	124	64	86	-5	-15	0	5	15	0
	13/00	22	70	55	201	-10	-10	0	10	10	0
	13/06	11	46	133	301	-10	-10	0	10	10	0
	13/12	0	32	70	222	-10	-5	-5	10	5	5
	13/18	39	55	147	400	-10	0	-10	10	0	10
	14/00	45	57	224	461	-5	5	-10	5	-5	10
	14/06	0	145	346	676	-5	5	-15	5	-5	15
	14/12	0	112	347	752	0	5	-12	0	-5	15
	14/18	0	202	518	1058	5	0	-14	-5	0	15
	15/00	22	257	572	1201	5	-10	-16	0	15	20
	15/06	11	231	564	1331	5	-15	-17	0	20	20
	15/12	15	185	606		-5	-17		5	20	
	15/18	22	120	464		-5	-9		5	10	
	16/00	0	119	485		-5	-2		5	5	
	16/06	11	64	590		-5	-2		5	0	
	16/12	15	154			-2			10		
	16/18	15	275			-2			10		
	17/00	0	349			2			5		
	17/06	11	492			0			0		
	17/12	11									
	17/18	46									
	18/00	0									
	18/06	22									
	mean	16	163	346	608	-3	-5	-9	5	6	10
	sampl	23	19	15	11	19	15	11	19	15	11

Appendix 4

Monthly and Annual Frequencies of Tropical Cyclones

Monthly and annual frequencies of tropical cyclones that attained TS intensity or higher in the western North Pacific and the South China Sea for 1951 - 2008

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1951		1	1	2	1	1	3	3	2	4	1	2	21
1952						3	3	5	3	6	3	4	27
1953		1			1	2	1	6	3	5	3	1	23
1954			1		1		1	5	5	4	3	1	21
1955	1	1	1	1		2	7	6	4	3	1	1	28
1956			1	2		1	2	5	6	1	4	1	23
1957	2			1	1	1	1	4	5	4	3		22
1958	1			1	1	4	7	5	5	3	2	2	31
1959		1	1	1			2	5	5	4	2	2	23
1960				1	1	3	3	10	3	4	1	1	27
1961	1		1		2	3	4	6	6	4	1	1	29
1962		1		1	2		5	8	4	5	3	1	30
1963				1		4	4	3	5	4		3	24
1964					2	2	7	5	6	5	6	1	34
1965	2	1	1	1	2	3	5	6	7	2	2		32
1966				1	2	1	4	10	9	5	2	1	35
1967		1	2	1	1	1	7	9	9	4	3	1	39
1968				1	1	1	3	8	3	5	5		27
1969	1		1	1			3	4	3	3	2	1	19
1970		1				2	3	6	5	5	4		26
1971	1		1	3	4	2	8	5	6	4	2		36
1972	1				1	3	7	5	4	5	3	2	31
1973							7	5	2	4	3		21
1974	1		1	1	1	4	4	5	5	4	4	2	32
1975	1						2	4	5	5	3	1	21
1976	1	1		2	2	2	4	4	5	1	1	2	25
1977			1			1	3	3	5	5	1	2	21
1978	1			1		3	4	8	5	4	4		30
1979	1		1	1	2		4	2	6	3	2	2	24
1980				1	4	1	4	2	6	4	1	1	24
1981			1	2		3	4	8	4	2	3	2	29
1982			3		1	3	3	5	5	3	1	1	25
1983						1	3	5	2	5	5	2	23
1984						2	5	5	4	7	3	1	27
1985	2				1	3	1	8	5	4	1	2	27
1986		1		1	2	2	4	4	3	5	4	3	29
1987	1			1		2	4	4	6	2	2	1	23
1988	1				1	3	2	8	8	5	2	1	31
1989	1			1	2	2	7	5	6	4	3	1	32
1990	1			1	1	3	4	6	4	4	4	1	29
1991			2	1	1	1	4	5	6	3	6		29
1992	1	1				2	4	8	5	7	3		31
1993			1			1	4	7	5	5	2	3	28
1994				1	1	2	7	9	8	6		2	36
1995				1		1	2	6	5	6	1	1	23
1996		1		1	2		6	5	6	2	2	1	26
1997				2	3	3	4	6	4	3	2	1	28
1998							1	3	5	2	3	2	16
1999				2		1	4	6	6	2	1		22
2000					2		5	6	5	2	2	1	23
2001					1	2	5	6	5	3	1	3	26
2002	1	1			1	3	5	6	4	2	2	1	26
2003	1			1	2	2	2	5	3	3	2		21
2004				1	2	5	2	8	3	3	3	2	29
2005	1		1	1	1		5	5	5	2	2		23
2006					1	1	3	7	3	4	2	2	23
2007				1	1		3	4	5	6	4		24
2008				1	4	1	2	4	4	2	3	1	22
Normal 1971-2000	0.5	0.1	0.4	0.8	1.0	1.7	4.2	5.4	5.0	3.9	2.5	1.3	26.7

Appendix 5

Code Forms of RSMC Products

(1) 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
GUST VgVgVg KT
50KT RdRdRd NM (or 50KT RdRdRd NM octant RdRdRd NM octant)
30KT RdRdRd NM (or 30KT RdRdRd NM octant RdRdRd NM octant)
FORECAST
24HF YYGGggF UTC LaLa.LaF N LoLoLo.LoF E (or W) FrFrFr NM 70%
MOVE direction SpSpSp KT
PRES PPPP HPA
MXWD VmVmVm KT
GUST VgVgVg KT
Ft1Ft1HF YYGGggF UTC LaLa.LaF N LoLoLo.LoF E (or W) FrFrFr NM 70%
MOVE direction SpSpSp KT
PRES PPPP HPA
GUST VgVgVg KT
MXWD VmVmVm KT
Ft2Ft2HF YYGGggF UTC LaLa.LaF N LoLoLo.LoF E (or W) FrFrFr NM 70%
MOVE direction SpSpSp KT
PRES PPPP HPA
MXWD VmVmVm KT
GUST VgVgVg KT =

Notes:

a. Underlined parts are fixed.

b. Abbreviations

PSTN	:	Position
MOVE	:	Movement
PRES	:	Pressure
MXWD	:	Maximum wind
HF	:	Hour forecast

c. Symbolic letters

i i	:	'20', '21', '22', '23', '24' or '25'
YYGGgg	:	Time of observation submitting the data for analysis 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 (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 such as 'N', 'NNE', 'NE' and 'ENE'
SpSpSp	:	Speed of movement
PPPP	:	Central pressure

VmVmVm	:	Maximum sustained wind
VgVgVg	:	Maximum gust wind
RdRdRd	:	Radii of 30knots and 50knots wind
octant	:	Eccentric distribution of wind given in 8 azimuthal direction such as 'NORTH', 'NORTHEAST' and 'EAST'
Ft1Ft1	:	48 (00, 06, 12 and 18 UTC) or 45 (03, 09, 15 and 21 UTC)
Ft2Ft2	:	72 (00, 06, 12 and 18 UTC) or 69 (03, 09, 15 and 21 UTC)
$YYGGgg_F$	:	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 150000
RSMC TROPICAL CYCLONE ADVISORY
NAME STS 0320 NEPARTAK (0320)
ANALYSIS
PSTN 150000UTC 12.6N 117.8E FAIR
MOVE WNW 13KT
PRES 980HPA
MXWD 055KT
GUST 080KT
50KT 40NM
30KT 240NM NORTHEAST 160NM SOUTHWEST
FORECAST
24HF 160000UTC 14.7N 113.7E 110NM 70%
MOVE WNW 11KT
PRES 965HPA
MXWD 070KT
GUST 100KT
48HF 170000UTC 16.0N 111.0E 170NM 70%
MOVE WNW 07KT
PRES 970HPA
MXWD 065KT
GUST 095KT
72HF 180000UTC 19.5N 110.0E 250NM 70%
MOVE NNW 09KT
PRES 985HPA
MXWD 050KT
GUST 070KT =

(2) 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=84	LaLa.La N LoLoLo.Lo E (or W)	appp HPA	awww KT=

Notes:

a. Underlined parts are fixed.

b. Symbolic letters

i i	:	'20', '21', '22', '23', '24' or '25'
YYGGgg	:	Initial time of the model in UTC
class	:	Intensity classification of the tropical cyclone 'T', 'STS', 'TS' or 'TD'
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 hPa
www	:	Absolute value of change in maximum wind speed from T=0, in knots

Example:

FXPQ20 RJTD 180600
RSMC GUIDANCE FOR FORECAST
NAME TY 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=84 20.7N 128.8E +021HPA -022KT=

(3) 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
YYGGg	:	Time of observation submitting the data for analysis in UTC
nt nt	:	Serial number of the tropical cyclone in order of its formation in the year given in '01' - '99'
LaLaLa	:	Latitude given in 0.1°
Qc	:	Quadrant of the earth. 1: N/E, 2: S/E, 3: S/W and 4: N/W
LoLoLoLo	:	Longitude in 0.1°
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=

(4) 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.=

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

FKPQ i i RJTD YYGGgg	
TC ADVISORY	
DTG:	yyyymmdd/time Z
TCAC:	TOKYO
TC:	name
NR:	number
PSN:	N LaLa.LaLa E LoLoLo.LoLo
MOV:	direction SpSpSp KT
C:	PPPP HPA
MAX WIND:	WWW KT
FCST PSN +6HR:	YY/GGgg Z NLaLa.LaLa ELoLoLo.LoLo*
FCST MAX WIND +6HR:	WWW KT*
FCST PSN +12HR:	YY/GGgg Z NLaLa.LaLa ELoLoLo.LoLo
FCST MAX WIND +12HR:	WWW KT
FCST PSN +18HR:	YY/GGgg Z NLaLa.LaLa ELoLoLo.LoLo*
FCST MAX WIND +18HR:	YY/GGgg Z NLaLa.LaLa ELoLoLo.LoLo*
FCST PSN +24HR:	YY/GGgg Z N LaLa.LaLa E LoLoLo.LoLo
FCST MAX WIND +24HR:	WWW KT
RMK:	NIL =
NXT MSG:	yyyymmdd/time Z

* 6 hour and 18 hour forecasts are added from 22 May 2008.

Notes:

a. Underlined parts are fixed.

b. Abbreviations

DTG	:	Date and time
TCAC	:	Tropical Cyclone Advisory Centre
TC	:	Tropical Cyclone
NR	:	Number
PSN	:	Position

MOV	:	Movement
C	:	Central pressure
MAX WIND	:	Maximum wind
FCST	:	Forecast
RMK	:	Remarks
NXT MSG	:	Next message

c. Symbolic letters

i i	:	'30', '31', '32', '33', '34' or '35'
YYGGgg	:	Date(YY), hour(GG) and minute(gg) in UTC (Using "Z")
yyyymmdd/time	:	Year(yyyy), month(mm), date(dd), hour and minute (time) in UTC (Using "Z")
name	:	Name assigned to the tropical cyclone by RSMC Tokyo-Typhoon Center
Number	:	Advisory number (starting with "01" for each cyclone)
LaLa.LaLa	:	Latitude of the center position
LoLoLo.LoLo	:	Longitude of the center position
direction	:	Direction of movement given in 16 azimuthal direction such as 'N', 'NNE', 'NE' and 'ENE'
SpSpSp	:	Speed of movement. "SLW" for less than 3 kt "STNR" for less than 1 kt.
PPPP	:	Central pressure
WWW	:	Maximum sustained wind

Example:

FKPQ30 RJTD 271200
TC ADVISORY

DTG:	20080927/1200Z
TCAC:	TOKYO
TC:	JANGMI
NR:	15
PSN:	N2120 E12425
MOV:	NW 13KT
C:	910HPA
MAX WIND:	115KT
FCST PSN +6HR:	27/1800Z N2200 E12330
FCST MAX WIND +6HR:	115KT
FCST PSN +12HR:	28/0000Z N2240 E12250
FCST MAX WIND +12HR:	115KT
FCST PSN +18HR:	28/0600Z N2340 E12205
FCST MAX WIND +18HR:	95KT
FCST PSN +24HR:	28/1200Z N2440 E12105
FCST MAX WIND +24HR:	80KT
RMK:	NIL
NXT MSG:	20080927/1800Z =

(6) 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 parts are fixed.

b. [1)] REMARKS is given optionally.

c. Symbolic letters

MMM	:	Month in UTC given such as 'JAN' and 'FEB'
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

Specifications of JMA NWP (GSM, TEPS)

The Global Spectral Model (GSM) and the Typhoon Ensemble Prediction System (TEPS) are used in JMA as a primary basis for TC forecasts. GSM (TL959L60) has about 20 km horizontal resolution and 60 vertical layers. Details on the GSM are found in Nakagawa (2009). TEPS (TL319L60), became operational in February 2008, has 11 members with approx. 60 km horizontal resolution and 60 vertical layers. A singular vector (SV) method is employed for the initial perturbation setup. The general specifications of GSM and TEPS are summarized in Table 6.1.

Table 6.1 Specifications of GSM and TEPS

NWP Models	GSM (Global Spectral Model), TL959L60	TEPS (Typhoon Ensemble Prediction System), TL319L60
Resolution	20 km, 60 layers (Top: 0.1hPa)	60 km, 60 layers (Top: 0.1hPa)
Area	Global	Global
Method for initial value	Global Data Assimilation System (4DVAR) Outer resolution: TL959L60 Inner resolution: T159L60 Window: Init-3h to Init + 3h	GSM initial condition (truncated) + SV perturbation 10 Perturbed member + 1 Control member SV target area (e.g. Fig 8.1) : 1 fixed (Dry SV / N20-60,E100-180) + TC adapted (Moist SV / Max 3 TCs)
Forecast time (and initials)	84h (00, 06, 18 UTC) 216h (12 UTC)	132h (00, 06, 12, 18 UTC)
Operational as from	21 November 2007	February 2008 (de facto from T0801)

[Recent upgrades on GSM and the Global Data Assimilation System]

GSM:

- Implementation of the Reduced Gaussian grid on GSM (5 August 2008)

Global Data Assimilation Systems:

- Improvement on the bias correction scheme of satellite radiance data (August 2008)
- Assimilation of clear sky radiance data from 5 geostationary satellites (August 2008)
- Upgrade of the quality control threshold of conventional data (October 2008)
- Upgrade of the linear radiance transfer model (RTTOV 7 to RTTOV 8: October 2008)

TEPS:

TEPS is an ensemble prediction system used mainly for TC track forecasts up to five days ahead. Initial perturbations are created by the combination of dry singular vectors (SVs) with one fixed target area (20-60N, 100-180E) and moist SVs with the TC adaptive target area (set around 24-hour forecast TC positions for up to three TCs). Figure 6.1 shows an example of SV target areas. At this initial time, there were three TCs in the area. Figure 6.2 shows an example of TEPS forecast tracks for JANGMI (TC0815). In this case, the control member and about one-half of perturbed members forecast TC tracks entering into the South China Sea, which turned to be false, while the other half members predicted tracks appropriately following the observed one. The details on TEPS are found in Yamaguchi and Komori (2009).

[References]

Nakagawa, M., 2009: Outline of the High Resolution Global Model at the Japan Meteorological Agency. RSMC Tokyo-Typhoon Center Technical Review, **11**, 1-13.

Yamaguchi, M. and T. Komori, 2009: Outline of the Typhoon Ensemble Prediction System at the Japan Meteorological Agency. RSMC Tokyo-Typhoon Center Technical Review, **11**, 14-24.

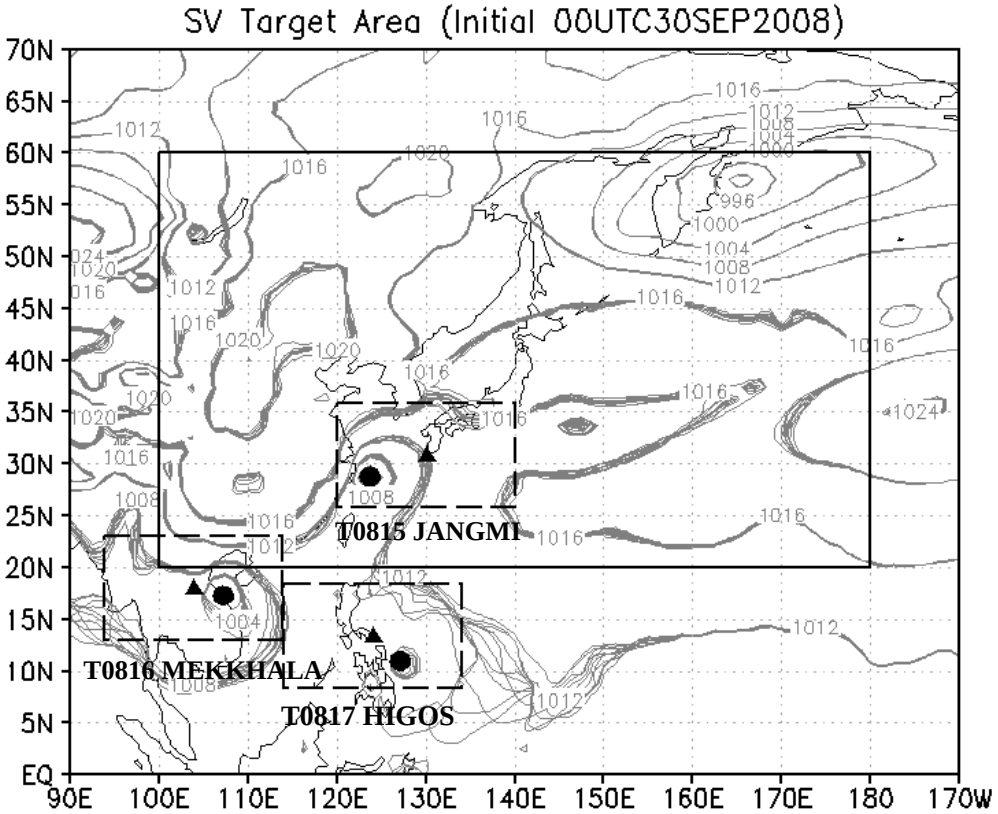


Figure 6.1 Example of SV target area of TEPS (Initial time: 00UTC 30 September 2008). Black circles and triangles show TC central positions and operational 24-hour forecast positions. Gray contours show the initial sea level pressure of each member. Large thick rectangular shows fixed SV target area and small dashed rectangular show adaptive target area of each TC. Adaptive areas are set around 24-hour forecast TC positions.

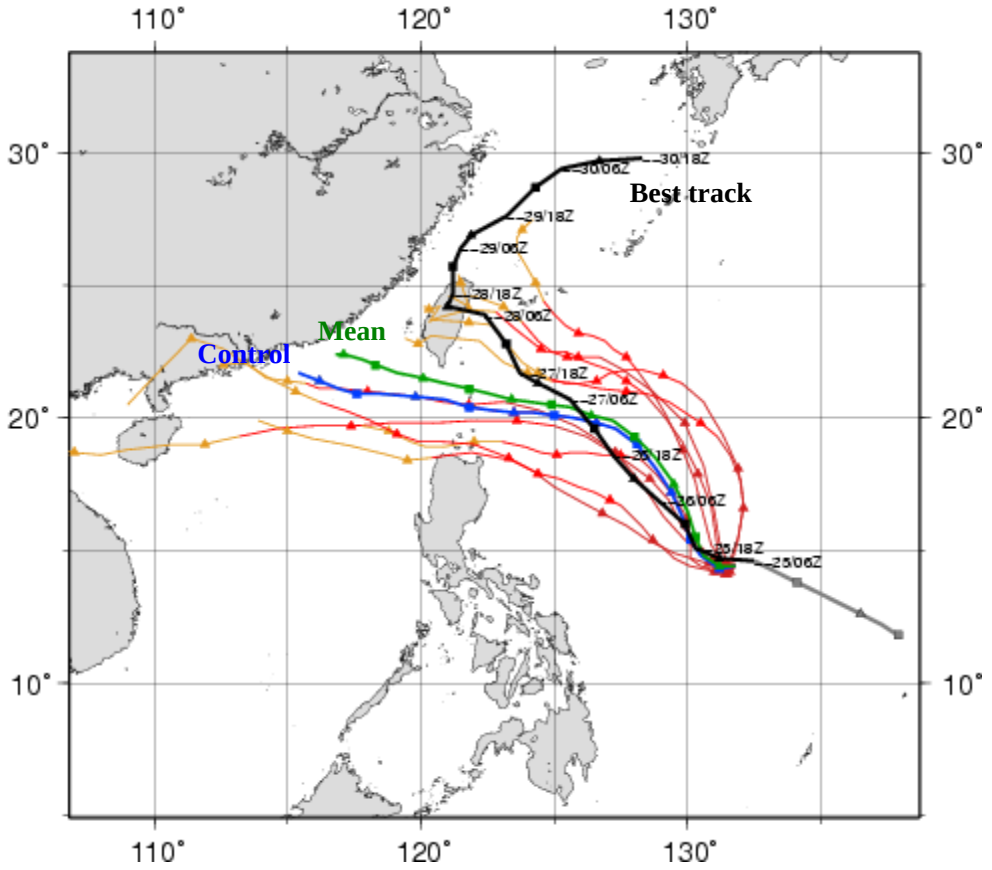


Figure 6.2 Example of TEPS forecast track (Initial time: 06UTC 25 September 2008). Black, blue, green lines denote TC best track, forecast track of control member and ensemble mean respectively. Red (up to 96-hour) and yellow (up to 120-hour) lines show TC forecast tracks of each perturbed members.

Appendix 7

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

Area	20S-60N, 80E-160W	20S-60N, 60E-160W
Resolution	2.5×2.5 degrees	1.25×1.25 degrees
Levels and 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)
Forecast hours	For 00 and 12 UTC: 0, 6, 12, 18, 24, 30, 36, 48, 60 and 72 hours	For 00 and 12 UTC: 0 – 84 (every 6 hours) For 12 UTC only: * 96, 120, 144, 168 and 192 hours ** 90 – 192 (every 6 hours)
Frequency (initial times)	Twice a day (00 and 12 UTC)	Twice a day (00 and 12 UTC)

Area	Globe		Globe
Resolution	2.5×2.5 degrees		1.25×1.25 degrees
Levels and elements	Surface (P, R, U, V, T) 1000hPa (Z) 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)* 70hPa (Z,U,V, T)* 50hPa (Z,U,V, T)* 30hPa (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)	Surface (P, U, V, T, RH, R) 1000hPa (Z, U, V, T, RH, ω) 925hPa (Z, U, V, T, RH, ω) 850hPa (Z, U, V, T, RH, ω, ψ, χ) 700hPa (Z, U, V, T, RH, ω) 600hPa (Z, U, V, T, RH, ω) 500hPa (Z, U, V, T, RH, ω, ζ) 400hPa (Z, U, V, T, RH, ω) 300hPa (Z, U, V, T, RH, ω) 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)
Forecast hours	For 00 and 12 UTC: 24, 48 and 72 hours For 12 UTC only: 96 – 192 (every 24 hours) * 96 and 120 only	For 00 and 12 UTC: 0 hours (analysis) * 00UTC only	For 00 and 12 UTC: 0 – 84 (every 6 hours) For 12 UTC only: 96 – 192 (every 12 hours)
Frequency (initial times)	Twice a day (00 and 12 UTC)		Twice a day (00 and 12 UTC)

Area	Globe
Resolution	2.5×2.5 degrees
Levels and elements	Surface (P) 1000hPa (Z) 850hPa (T, U, V) 500hPa (Z) 250hPa (U, V) *Above GPVs consists of ensemble mean and standard deviation of ensemble forecast members.
Forecast hours	0 – 192 hours (every 12 hours)
Frequency (initial times)	Once a day (12 UTC)

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

Products/ Data	Satellite data	Typhoon Information	Global Wave Model	Observational data
Contents	MTSAT-1R data (GRIB) • High density atmospheric motion vector (VIS, IR, WV)	Tropical cyclone related information (BUFR) • tropical cyclone analysis data	• Significant wave height • Prevailing wave period • Prevailing wave direction (GRIB) Forecast hours: 0, 6, 12, 18, 24, 30, 36, 42, 48, 54, 60, 66, 72, 78, 84 (for 00 and 12 UTC); 96, 108, 120, 132, 144, 156, 168 ,180 and 192 hours (for 12 UTC)	(a) Surface data (SYNOP, SHIP) (b) Upper-air data (TEMP, parts A-D) (PILOT, parts A-D)
Frequency (initial times)	VIS: twice a day (00 and 06UTC) IR and WV: 4 times a day (00, 06, 12 and 18UTC)	4 times a day (00, 06, 12 and 18 UTC)	Twice a day (00 and 12 UTC)	(a) Mostly 4 times a day (b) Mostly twice a day

Appendix 8

User's Guide to the Attached DVD

Preface

This DVD contains all the texts, tables and charts of the RSMC Annual Report 2008 along with satellite images of the tropical cyclones that attained TS intensity or higher in the western North Pacific and the South China Sea in 2008. This document is a brief user's guide to the DVD, which was mastered in ISO-9660 format.

Directory and File layout

```
[Root]
|------AdbeRdr920_en_US.exe (Adobe Reader Installer)
|------Readme.txt (brief explanation of the DVD)
|------TopMenu.exe (start menu setup program)
|------SATAIDmanual.pdf (user manual for the satellite image viewer)
|------Annual_Report
        |---Text (text of Annual Report 2008 in PDF)
        |---Figure (figures for MS PowerPoint)
        |---Table (tables for MS Excel)
        |---Appendix (appendices for MS Excel and PowerPoint)
|------Programs
        |---Gmslpd
            |--Gmslpd.exe (viewer; tropical cyclone version in English)
            |--Gsetup.exe (setup programs)
|------Satellite_Image_Data
        |---T0801 (hourly satellite image data)
        |---T0802 (hourly satellite image data)
                :
        |---T0822 (hourly satellite image data)
|------Andata
        |--Besttrack
            |--E_BST_2008.txt (best track data for 2008)
            |--E_BST_200804.txt (best track data for TCs generated in April 2008)
                    :
            |--E_BST_200812.txt (best track data for TCs generated in December 2008)
```

How to use the DVD

When the DVD runs, a start menu automatically appears displaying a panel with buttons marked *Annual Report 2008*, *MTSAT Satellite Image*, *About DVD* and *Close* as well as a file list box for a number of introductory documents. Click the button or the file name of the content you wish to see and follow the instructions on the display.

Hardware/OS requirements for using the DVD:

Hardware : PC/AT compatible
OS : Microsoft Windows ver. 3.1 or later

< Annual Report 2008 >

Annual Report 2008 is provided in two formats as PDF files and MS Word/Excel/PowerPoint files.

- PDF files:

Click the *Annual Report 2008* button to open the text in PDF. If you cannot open the PDF file, install Adobe Acrobat Reader using the installer (ar405eng.exe) in the file list box of the start menu window and try again. Adobe Acrobat Reader (or Adobe Acrobat) is required to view PDF files.

- MS Word/Excel/PowerPoint files:

The original figures and tables prepared with Microsoft Word, Excel or PowerPoint are contained in the Annual Report folder of the DVD.

< MTSAT Satellite Image >

- Installation of the program for displaying satellite images

Click the *MTSAT Satellite Image* button to run the setup program (Gsetup.exe) for the satellite image viewer. Follow the instructions, and the satellite image viewer *Gmslpd.exe* will be installed onto the computer's hard disk. A list of the tropical cyclones occurring in 2008 is displayed in the selection window of the satellite images for tropical cyclones.

- Displaying satellite images

Choose and click a tropical cyclone from the list to see hourly satellite images of it. You can also display the track of the tropical cyclone superimposed onto the satellite image and measure its intensity using the Dvorak method.

- User manual for the viewer

Besides the above features, the viewer has many other useful functions. See the User Manual (SATAIDmanual.pdf) for further details on its use.

- Explanation of satellite image data

Period : From the generation stage to the weakening stage of each tropical cyclone

Images	: Infrared images (00 to 23 UTC) Visible images (00 to 09 and 21 to 23 UTC)
Range	: 40 degrees in both latitude and longitude (The image window moves to follow the track of the tropical cyclone so that its center remains in the middle of the window.)
Time interval	: Hourly
Resolution	: 0.04 degrees in both latitude and longitude
Compression of file	: Compressed using the *compress.exe* command of Microsoft Windows

< About DVD >

Click the *About DVD* button to open the *Readme.txt* file.

< Close >

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

< File list box >

Document files can be opened from the file list box in the start menu window. Choose a file and click the *Open* button, or simply double-click the file name.

For further information, please contact:

RSMC Tokyo - Typhoon Center
Forecast Division
Forecast Department
Japan Meteorological Agency
1-3-4 Otemachi, Chiyoda-ku, Tokyo 100-8122, Japan
FAX: +81-3-3211-8303
E-mail: rsmc-tokyo@met.kishou.go.jp