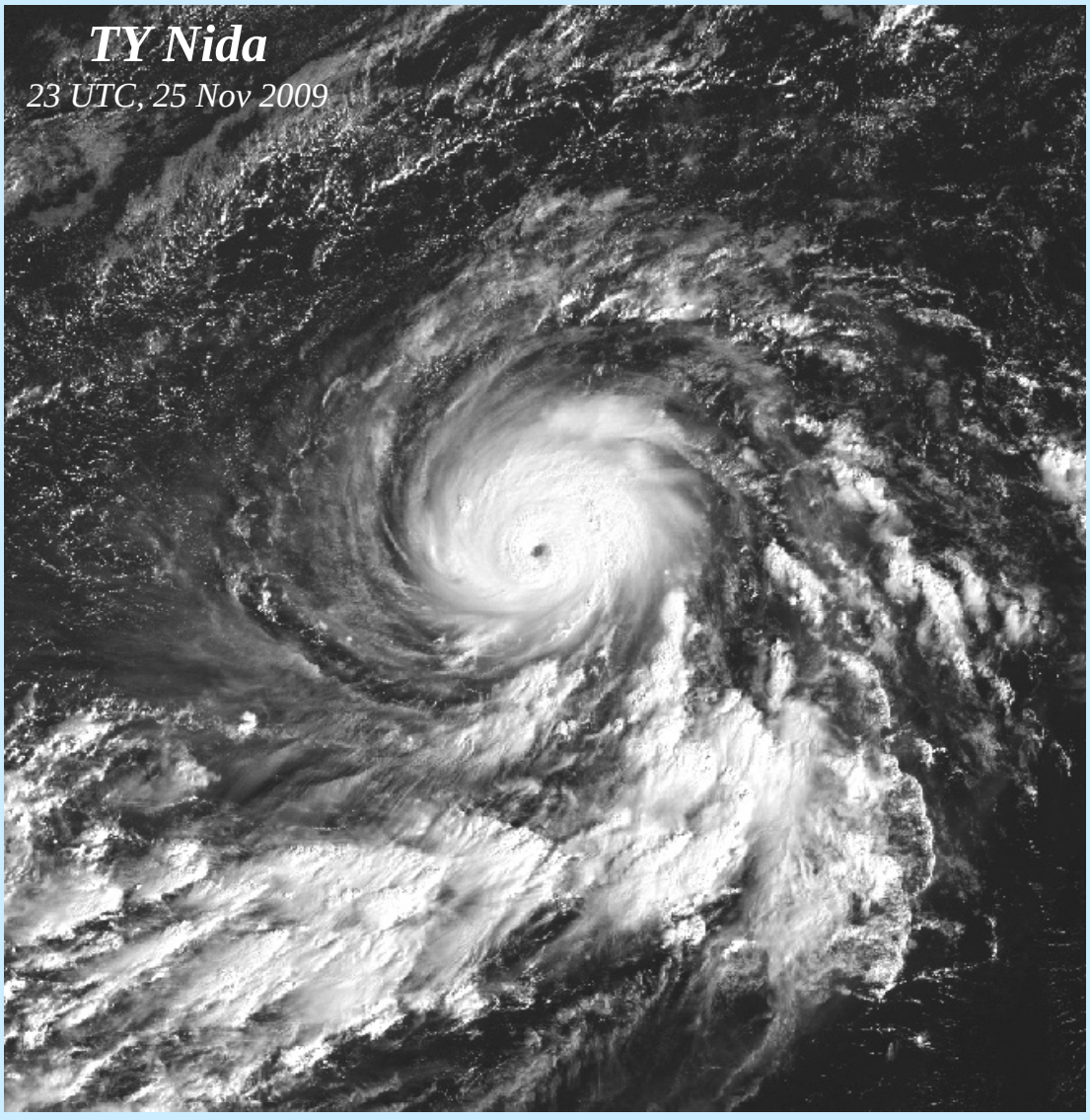
Annual Report on the Activities of the RSMC Tokyo - Typhoon Center 2009



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 2009, 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 2009. Chapter 3 describes atmospheric and oceanic conditions in the tropics and notes the highlights of TC activities in 2009. 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 2009 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 2009 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 2009

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.

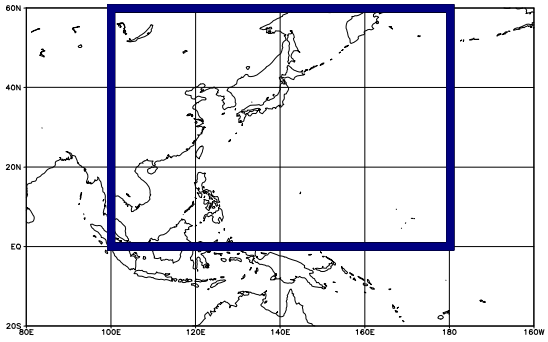


Figure 1.1
Area of responsibility of the RSMC Tokyo - Typhoon Center

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. Using mainly TEPS, JMA extended its TC track forecast up to 5 days ahead as from April 2009. 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

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 is issued four times a day after the observation times at 00, 06, 12 and 18UTC and reports the following elements in the analysis, 24-, 48- and 72-hour forecasts of a TC:

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 Tropical Cyclone Advisory for Five-day Track Forecast (WTPQ50-55 RJTD: via GTS)

In addition to three-day track and intensity forecast, five-day track forecast was started in April 2009. The RSMC Tropical Cyclone Advisory for Five-day Track Forecast is issued four times a day after the observation times at 00, 06, 12 and 18UTC including the following elements in the analysis, 24-, 48-, 72-, 96- and 120-hour forecasts of a TC:

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
96-, 120 and forecasts	Center position and radius of the probability circle Direction and speed of movement

(3) 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.*

(4) 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

(5) 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.

(6) 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.

(7) 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 6-, 12-, 18- and 24-hour forecasts***:

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

Analysis	Center position Direction and speed of movement Central pressure Maximum sustained wind speed (10-minute average)
Forecast	Center position Maximum sustained wind speed (10-minute average)

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), CMA (China), 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 (up to 72 hours)
- JMA's operational TC analysis using satellite image (conventional Dvorak analysis and Early-stage Dvorak analysis)

Chapter 2

Major Activities of the RSMC Tokyo - Typhoon Center in 2009

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 2009 are listed in Table 2.1.

Product	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TCNA20	0	0	0	0	40	30	17	103	105	170	37	8	510
TCNA21	0	0	0	0	43	32	23	115	118	180	46	8	565
IUCC10	0	0	0	0	83	62	40	218	223	350	83	16	1075
WTPQ20-25	0	0	0	0	89	65	48	232	246	359	96	17	1152
WTPQ30-35	0	0	0	0	22	16	12	57	60	89	23	4	283
WTPQ50-55	0	0	0	0	33	15	3	51	64	124	30	3	323
FXPQ20-25	0	0	0	0	86	64	46	228	236	359	92	16	1127
FKPQ30-35	0	0	0	0	43	32	23	115	118	179	47	8	565
AXPQ20	1	0	0	0	0	2	0	2	2	4	8	3	22

Notes:

TCNA20/21 RJTD	SAREP (TACs)
IUCC10 RJTD	SAREP (BUFR format)
WTPQ20-25 RJTD	RSMC Tropical Cyclone Advisory
WTPQ30-35 RJTD	RSMC Prognostic Reasoning
WTPQ50-55 RJTD	RSMC Tropical Cyclone Advisory for five-day track forecast (from 2009)
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 2009

2.2 Publication

In March 2009, *the eleventh issue of the RSMC Technical Review* was issued with the following three topics.

1. Outline of the High Resolution Global Model at the Japan Meteorological Agency
2. Outline of the Typhoon Ensemble Prediction System at the Japan Meteorological Agency
3. Outline of the Storm Surge Prediction Model at the Japan Meteorological Agency

In December 2009, the Center published the *Annual Report on the Activities of the RSMC Tokyo - Typhoon Center in 2008*. 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 2008 to 31st October 2009 was conducted for the following two typhoons:

1. TY Ketsana (0916), from 00 UTC 26 September to 23 UTC 30 September 2009
2. TY Parma (0917), from 00 UTC 09 October to 23 UTC 13 October 2009

The results were distributed to all the Typhoon Committee Members in April 2010, and are also available on the WMO Distributed Database server at ftp://ddb.kishou.go.jp/pub/monitoring/.

Chapter 3

Summary of the 2009 Typhoon Season

In 2009, 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, 13 reached typhoon (TY) intensity, 3 reached severe tropical storm (STS) intensity, and 6 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	Kujira	(0901)	021800 May	-	071800 May	041800	17.1	131.0	940	85
TY	Chan-hom	(0902)	031200 May	-	090000 May	061200	14.4	114.6	975	65
STS	Linfa	(0903)	180000 Jun	-	220600 Jun	200600	20.5	117.3	975	60
TS	Nangka	(0904)	230600 Jun	-	261800 Jun	231200	12.3	124.2	994	40
TS	Soudelor	(0905)	110000 Jul	-	120000 Jul	110600	19.8	114.0	992	35
TY	Molave	(0906)	160600 Jul	-	190600 Jul	171800	21.0	119.6	975	65
TS	Goni	(0907)	031200 Aug	-	080600 Aug	040600	21.3	114.0	990	40
TY	Morakot	(0908)	030000 Aug	-	101800 Aug	061500	23.4	124.6	945	75
TS	Etau	(0909)	090600 Aug	-	130000 Aug	100000	30.0	134.4	992	40
TY	Vamco	(0910)	171800 Aug	-	260000 Aug	200000	18.6	157.4	945	90
STS	Krovanh	(0911)	281200 Aug	-	011200 Sep	301800	32.7	140.0	975	60
STS	Dujuan	(0912)	031800 Sep	-	100600 Sep	050000	20.0	132.4	980	50
TS	Mujigae	(0913)	100000 Sep	-	120000 Sep	110000	19.8	109.0	994	40
TY	Choi-wan	(0914)	121800 Sep	-	201200 Sep	151200	17.9	145.0	915	105
TY	Koppu	(0915)	131800 Sep	-	151200 Sep	141800	21.5	113.1	975	65
TY	Ketsana	(0916)	260000 Sep	-	300600 Sep	280600	15.8	111.9	960	70
TY	Parma	(0917)	290600 Sep	-	140000 Oct	010000	11.8	131.1	930	100
TY	Melor	(0918)	300000 Sep	-	081200 Oct	040600	17.0	140.9	910	110
TS	Nepartak	(0919)	090600 Oct	-	140000 Oct	120000	23.5	144.3	992	45
TY	Lupit	(0920)	151200 Oct	-	270000 Oct	181800	18.0	134.2	930	95
TY	Mirinae	(0921)	270600 Oct	-	021800 Nov	281200	16.2	135.5	955	80
TY	Nida	(0922)	231200 Nov	-	030000 Dec	251800	13.6	141.4	905	115

Table 3.1 List of the tropical cyclones reaching TS intensity or higher in 2009

3.1 Atmospheric and Oceanographic Conditions in the Tropics

In terms of the sea surface temperature (SST) of the western North Pacific and the South China Sea, positive anomalies appeared from May through July east of the Mariana Islands. From October to December, the positive anomalies prevailed and became conspicuous east of the Caroline Islands over the central Pacific in accordance with the El Niño events which started in the summer of 2009. No specific trend was found elsewhere around the year.

Regarding atmospheric conditions, the Intertropical Convergence Zone (ITCZ) enhanced in summer (see Fig. 3.1 for the case of September) resulted in the formation of 14 named TCs from July to September which is almost the same as the 30-year average* of 14.6. From November to December, ITCZ was located close to the equator and only 1 named TCs (fewer than the average* of 3.7) was generated. That contributed to the fewer than normal TC formations in the year (22 in 2009 compared to 26.7 in average*). The monthly and annual frequencies of named TCs since 1951 are presented in Appendix 4.

To see atmospheric and oceanographic conditions, 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 2009.ppt and Streamline 2009.ppt).

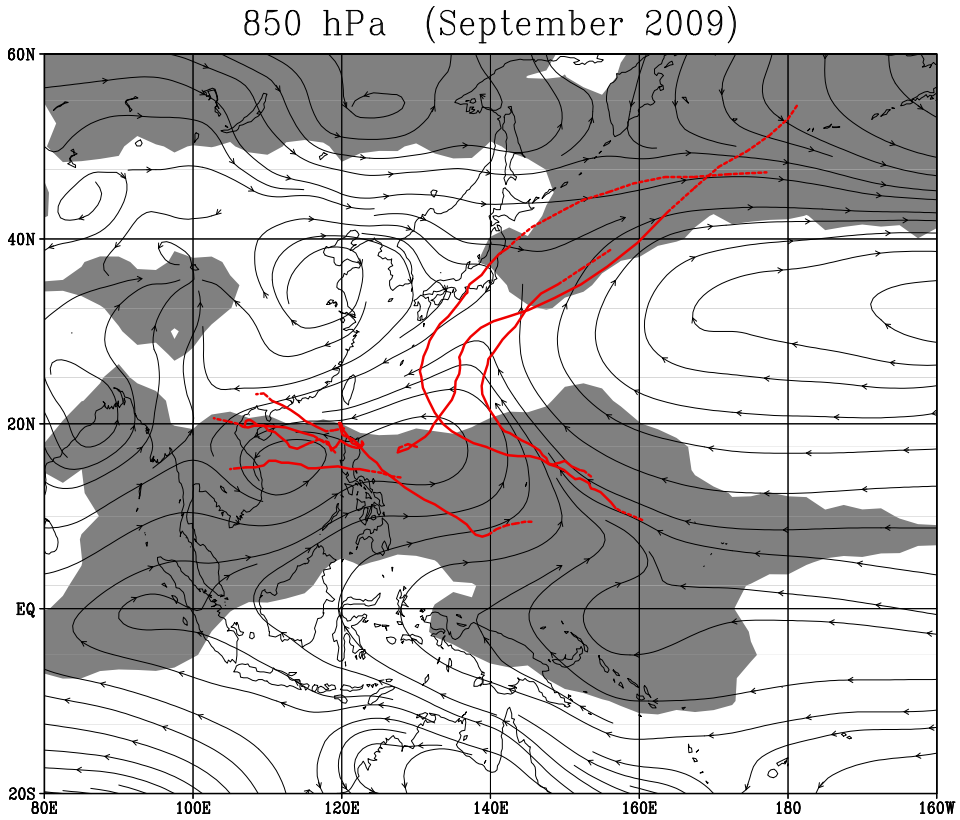


Figure 3.1 Monthly mean streamline at 850 hPa (lines with arrows) and areas of less than 230 w/m^2 of OLR (shaded) in September 2009. The tracks of the seven named TCs formed in September are superimposed onto the figure.

3.2 Tropical Cyclones in 2009

Over the western North Pacific and the South China Sea, 22 named TCs formed in 2009. Monthly and 30-year average* TC formations are shown in Figure 3.2. Tracks of the 22 TCs are shown in Figure 3.3 (black lines show the tracks of TCs formed in May to July, green lines are those in August and September, and blue lines are those in October and November). Figure 3.4 shows genesis points of the 22 TCs (dots) and frequency distribution of the past years (1951 - 2008).

The TC season in 2009 began in May with the formation of Kujira (0901), which formed east of the Philippines and moved northeastward to the southeast of Japan. Through May to July, all TCs formed around the Philippines and the South China Sea (see a black circle in Fig. 3.3). In August and September convective activities in the tropics were enhanced and 12 (the 30-year average* of 10.4) named TCs formed. In October and November all TCs formed east of 140E degree (see a blue circle in Fig. 3.3).

Among others, Typhoon Morakot (0908) which hit Taiwan brought extremely heavy precipitation. Typhoon Ketsana (0916) which passed Luzon Island and moved westward crossing the South China Sea brought severe damage to both the Philippines and Viet Nam. Typhoon Parma (0917) which crossed Luzon Island three times brought damage to the Philippines and Typhoon Melor (0918) landed Japan for the first time since 2007. The detailed descriptions of each TC in 2009 are found in the attached DVD.

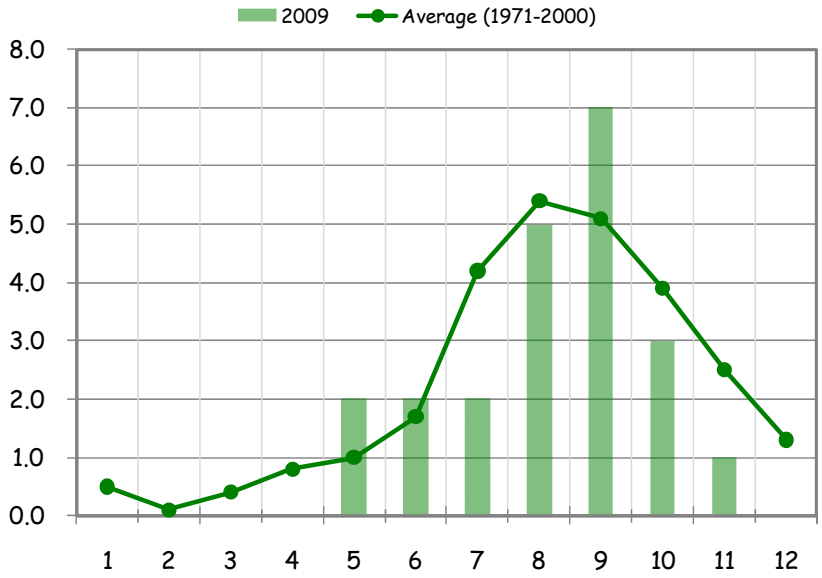


Figure 3.2 Monthly formations of TCs in 2009 compared to the 30-year average*

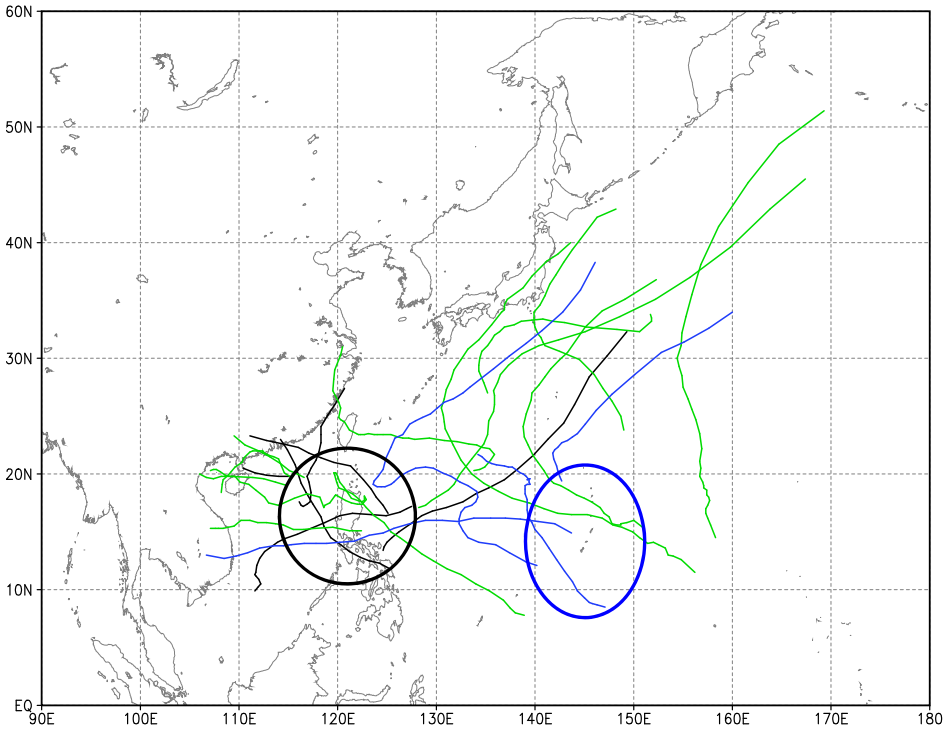


Figure 3.3 Tracks of the 22 named TCs in 2009 (black lines: formed in May to July, green lines: August and September, blue lines: October and November).

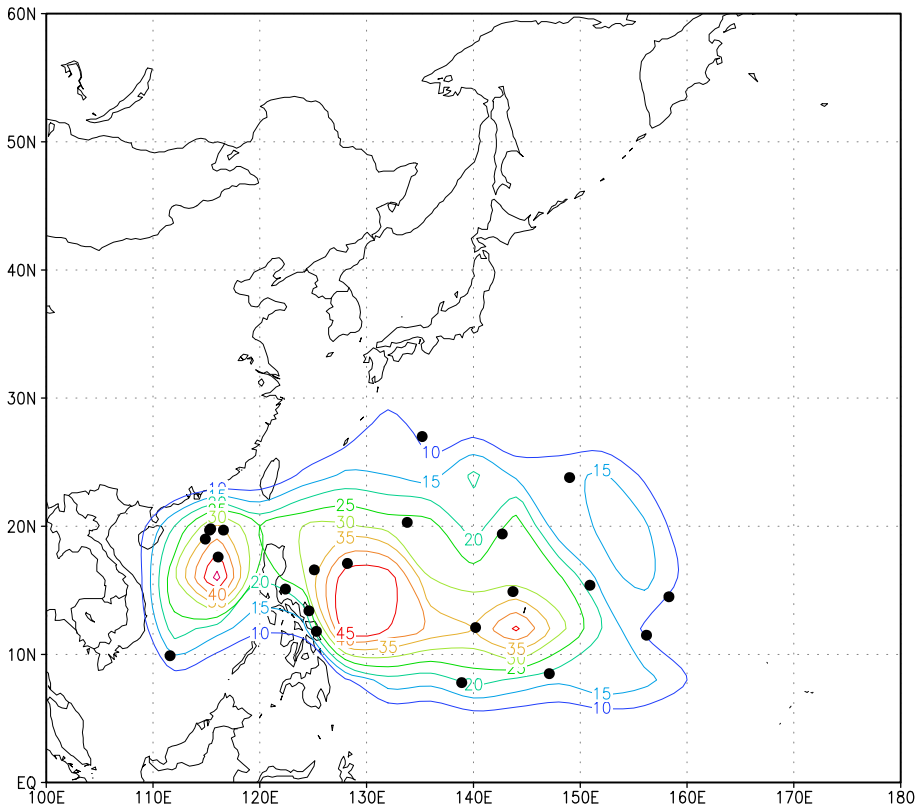


Figure 3.4 Genesis points of the 22 TCs generated in 2009 (dots) and frequency distribution of genesis points for 1951 - 2008 (lines)

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

Chapter 4

Verification of Forecasts in 2009

4.1 Verification of Operational Forecasts

Operational forecasts of the 22 TCs of TS intensity or higher in 2009 were verified with the RSMC TC best track data. The verified elements are forecasts of the center position (up to 5 days), central pressure and maximum sustained wind (up to 3 days). The position and intensity errors of operational forecasts for each TC in 2009 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), 72-hour (since 1997), 96- and 120- hour (since 2009) forecasts of center position. The errors in 2009 were 122 km, 216 km, 312 km, 415 km and 528 km for 24-hour, 48-hour, 72-hour, 96-hour and 120-hour forecasts respectively.

The details of the errors for each TC in 2009 are summarized in Table 4.1. The forecasts for Lupit (0920) which changed its directions several times resulted in large forecast track errors. Vamco (0910) which moved simply northward had relatively small errors.

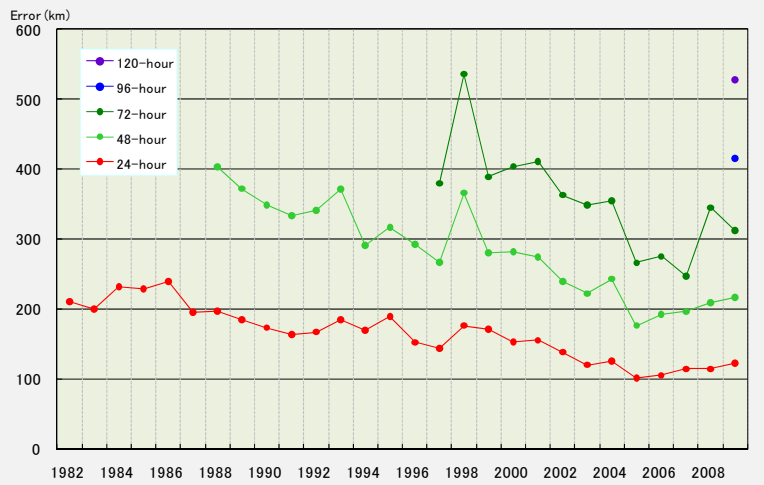


Figure 4.1 Annual means of position errors in 24-, 48-, 72-, 96- and 120-hour operational track forecasts

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-, 72-, 96- and 120-hour forecasts in 2009 were 52% (54% in 2008), 39% (45%), 35% (45%), 34% and 39% respectively. Figure 4.2 shows a histogram of 24-hour forecast position errors. About 74% (75% in 2008) of 24-hour forecasts, 79% (80%) of 48-hour forecasts, 83% (72%) of 72-hour forecasts, 76% of 96-hour forecasts and 74% of 120-hour forecasts had errors of less than 150km, 300km, 450 km, 500km, and 600km 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				96-hour Forecast				120-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 (%)	Mean (km)	S.D. (km)	Num	EO/EP (%)	Mean (km)	S.D. (km)	Num	EO/EP (%)
TY	Kujira	(0901)	119	49	16	57	256	105	11	51	431	155	7	52	737	191	3	48	-	-	0	-
TY	Chan-hom	(0902)	189	94	18	92	364	244	14	71	408	251	10	42	585	159	6	54	882	62	2	0
STS	Linfa	(0903)	91	44	12	45	188	55	8	42	356	23	4	40	-	-	0	-	-	-	0	-
TS	Nangka	(0904)	132	36	10	73	255	32	6	53	456	24	2	-	-	-	0	-	-	-	0	-
TS	Soudelor	(0905)	-	-	0	-	-	-	0	-	-	-	0	-	-	-	0	-	-	-	0	-
TY	Molave	(0906)	102	59	8	57	208	68	3	49	-	-	0	-	-	-	0	-	-	-	0	-
TS	Goni	(0907)	91	71	7	40	174	162	3	27	-	-	0	-	-	-	0	-	-	-	0	-
TY	Morakot	(0908)	111	66	26	42	192	83	21	31	280	114	16	26	251	170	12	17	339	224	8	23
TS	Etau	(0909)	141	71	11	37	379	99	6	32	491	30	2	25	-	-	0	-	-	-	0	-
TY	Vamco	(0910)	121	69	29	51	193	80	25	38	236	107	21	34	328	252	17	31	328	184	13	23
STS	Krovanh	(0911)	152	111	12	24	180	171	8	9	458	282	4	32	-	-	0	-	-	-	0	-
STS	Dujuan	(0912)	136	83	21	41	219	99	17	29	245	95	13	28	390	196	9	66	572	384	5	53
TS	Mujigae	(0913)	273	73	4	121	-	-	0	-	-	-	0	-	-	-	0	-	-	-	0	-
TY	Choi-wan	(0914)	82	50	27	40	107	86	23	20	128	75	19	16	234	84	15	22	440	138	11	34
TY	Koppu	(0915)	124	26	3	56	-	-	0	-	-	-	0	-	-	-	0	-	-	-	0	-
TY	Ketsana	(0916)	84	36	13	47	106	39	9	26	154	48	5	15	345	-	1	-	-	-	0	-
TY	Parma	(0917)	121	75	47	66	218	123	42	48	288	167	38	39	394	191	37	33	467	226	34	33
TY	Melor	(0918)	88	65	30	33	168	121	26	25	232	145	22	21	365	212	18	27	452	113	14	30
TS	Nepartak	(0919)	159	142	15	64	265	144	11	44	785	348	7	87	1571	87	3	101	-	-	0	-
TY	Lupit	(0920)	167	99	42	61	367	286	38	55	575	426	33	50	720	391	29	46	1012	558	25	66
TY	Mirinae	(0921)	99	43	22	86	174	85	18	63	232	128	14	47	400	208	10	46	667	171	6	73
TY	Nida	(0922)	75	39	34	51	125	49	30	34	142	60	26	21	138	93	22	13	212	157	18	19
Annual Mean (Total)			121	79	407	52	216	163	319	39	312	260	243	35	415	321	182	34	528	387	136	39

Table 4.1 Mean position errors of 24-, 48-, 72-, 96- and 120-hour operational forecasts for each TC in 2009. 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.

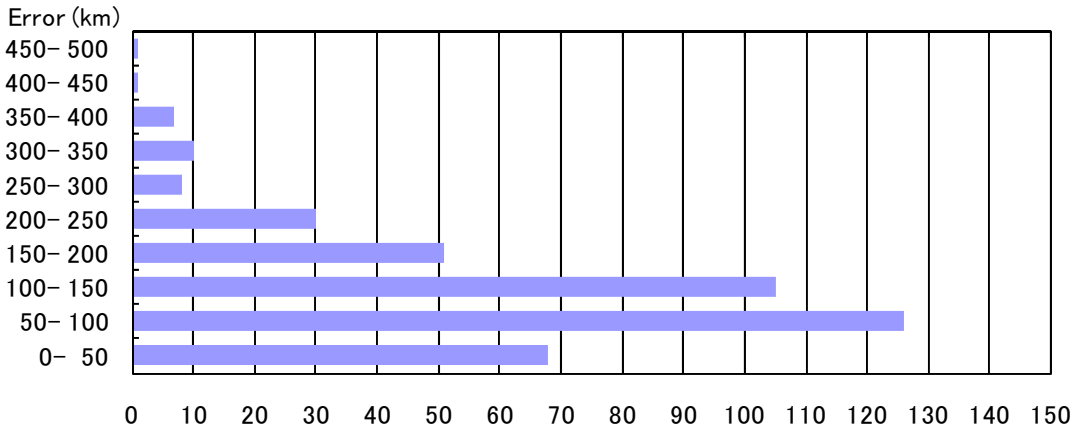


Figure 4.2 Histogram of 24-hour forecast position errors in 2009
(Those for 48-, 72-, 96- and 120-hour forecasts are included on the attached DVD).

Table 4.2 presents the mean hitting ratios and radii of the 70% probability circles* of operational forecasts for each TC in 2009. 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 145 km (147 km in 2008), and their hitting ratio was 69% (77%). The corresponding ones for 48-hour forecasts were 256 km (254 km in 2008) and 70% (69%), those for 72-hour forecasts were 361 km (372 km in 2008) and 70% (63%), those for 96-hour forecasts were 537 km and 76 % and those for 120-hour forecasts were 695 km and 79 %.

Tropical Cyclone			24-hour Forecast			48-hour Forecast			72-hour Forecast			96-hour Forecast			120-hour Forecast		
			Ratio (%)	Num.	Radius (km)	Ratio (%)	Num.	Radius (km)	Ratio (%)	Num.	Radius (km)	Ratio (%)	Num.	Radius (km)	Ratio (%)	Num.	Radius (km)
TY	Kujira	(0901)	88	16	162	64	11	327	57	7	455	33	3	519	-	0	-
TY	Chan-hom	(0902)	39	18	158	57	14	290	60	10	408	33	6	445	0	2	556
STS	Linfa	(0903)	92	12	158	100	8	294	100	4	408	-	0	-	-	0	-
TS	Nangka	(0904)	60	10	135	0	6	204	0	2	296	-	0	-	-	0	-
TS	Soudelor	(0905)	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-
TY	Molave	(0906)	75	8	149	67	3	241	-	0	-	-	0	-	-	0	-
TS	Goni	(0907)	71	7	138	33	3	204	-	0	-	-	0	-	-	0	-
TY	Morakot	(0908)	69	26	142	62	21	216	56	16	296	92	12	476	88	8	643
TS	Etau	(0909)	64	11	163	33	6	327	0	2	408	-	0	-	-	0	-
TY	Vamco	(0910)	66	29	144	72	25	252	81	21	353	82	17	566	100	13	752
STS	Krovanh	(0911)	58	12	146	75	8	292	50	4	426	-	0	-	-	0	-
STS	Dujuan	(0912)	71	21	165	82	17	322	100	13	433	89	9	650	100	5	926
TS	Mujigae	(0913)	0	4	130	-	0	-	-	0	-	-	0	-	-	0	-
TY	Choi-wan	(0914)	89	27	139	87	23	246	100	19	349	100	15	516	91	11	676
TY	Koppu	(0915)	33	3	130	-	0	-	-	0	-	-	0	-	-	0	-
TY	Ketsana	(0916)	85	13	132	100	9	204	100	5	296	100	1	519	-	0	-
TY	Parma	(0917)	60	47	139	64	42	240	63	38	342	73	37	485	88	34	652
TY	Melor	(0918)	77	30	140	85	26	259	86	22	384	89	18	498	100	14	645
TS	Nepartak	(0919)	67	15	148	55	11	288	14	7	400	0	3	788	-	0	-
TY	Lupit	(0920)	52	42	147	37	38	248	27	33	345	41	29	532	28	25	640
TY	Mirinae	(0921)	82	22	142	83	18	266	93	14	394	90	10	544	67	6	757
TY	Nida	(0922)	88	34	135	100	30	221	100	26	329	100	22	635	100	18	819
Annual Mean (Total)			69	407	145	70	319	256	70	243	361	76	182	537	79	136	695

Table 4.2 Mean hitting ratios (%) and radii (km) of 70% probability circles for 24-, 48-, 72-, 96- and 120-hour operational forecasts for each TC in 2009

* 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 2009. The RMSEs for maximum wind speed forecasts are included on the attached DVD. The annually averaged RMSEs of the central pressure and the maximum wind speed for 24-hour forecasts were 13.2 hPa (13.9 hPa in 2008) and 6.4 m/s (7.3 m/s). For 48-hour forecasts, the corresponding ones were 20.1 hPa (20.2 hPa in 2008) and 8.7 m/s (10.1 m/s), while those for 72-hour forecasts were 22.6 hPa (20.5 hPa) and 9.5 m/s (9.4 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	Kujira	(0901)	10.3	15.3	16	5.5	16.7	11	-13.6	22.6	7
TY	Chan-hom	(0902)	-2.8	7.2	18	-4.7	8.9	14	-6.1	10.4	10
STS	Linfa	(0903)	2.6	5.3	12	8	9.5	8	1.5	8.7	4
TS	Nangka	(0904)	-2.4	4.1	10	-6.3	7.7	6	-2	4.5	2
TS	Soudelor	(0905)	-	-	0	-	-	0	-	-	0
TY	Molave	(0906)	9.2	10.2	8	4.3	6.6	3	-	-	0
TS	Goni	(0907)	2.6	3.6	7	2	2	3	4	4	1
TY	Morakot	(0908)	-1	11.2	26	2.3	15	21	4.2	13.6	16
TS	Etau	(0909)	-3.5	4.8	11	-4.2	5.1	6	-2	2	2
TY	Vamco	(0910)	2.1	12.4	29	1.6	18.4	25	-1.4	15.9	21
STS	Krovanh	(0911)	-1.4	6.3	12	2.4	5.5	8	-5.2	6.8	4
STS	Dujuan	(0912)	-2	4	21	-8.2	9.2	17	-11.2	12	13
TS	Mujigae	(0913)	2	2.4	4	-	-	0	-	-	0
TY	Choi-wan	(0914)	-0.8	17.1	27	-1.7	29.2	23	-4.7	34.6	19
TY	Koppu	(0915)	3.3	9.1	3	-	-	0	-	-	0
TY	Ketsana	(0916)	-3.4	6	13	-2.7	8.5	9	-9	12.8	5
TY	Parma	(0917)	-6.6	18.7	47	-13.4	26.8	42	-20.8	28	38
TY	Melor	(0918)	-1.3	16.5	30	0	18.6	26	3	19	22
TS	Nepartak	(0919)	-5.8	6.1	15	-7.4	8.3	11	-9.3	10	7
TY	Lupit	(0920)	-3.5	10.6	42	-7.8	18.1	38	-8.8	20.7	33
TY	Mirinae	(0921)	-7.4	16.2	22	-17.1	24	18	-27.5	33.5	14
TY	Nida	(0922)	2.4	18.3	34	5.4	28.8	30	2.9	25.9	26
Annual Mean (Total)			-1.4	13.2	407	-3.7	20.1	319	-7.4	22.6	243

Table 4.3 Mean intensity errors of 24-, 48- and 72-hour operational central pressure forecasts for each TC in 2009

Figure 4.3 shows a histogram of maximum wind speed errors for 24-hour forecasts. About 53% (45% in 2008) of 24-hour forecasts had errors of less than ±3.75 m/s, with figures of ±6.25 m/s for 59% (45%) of 48-hour forecasts and ±6.25 m/s for 52% (46%) of 72-hour forecasts.

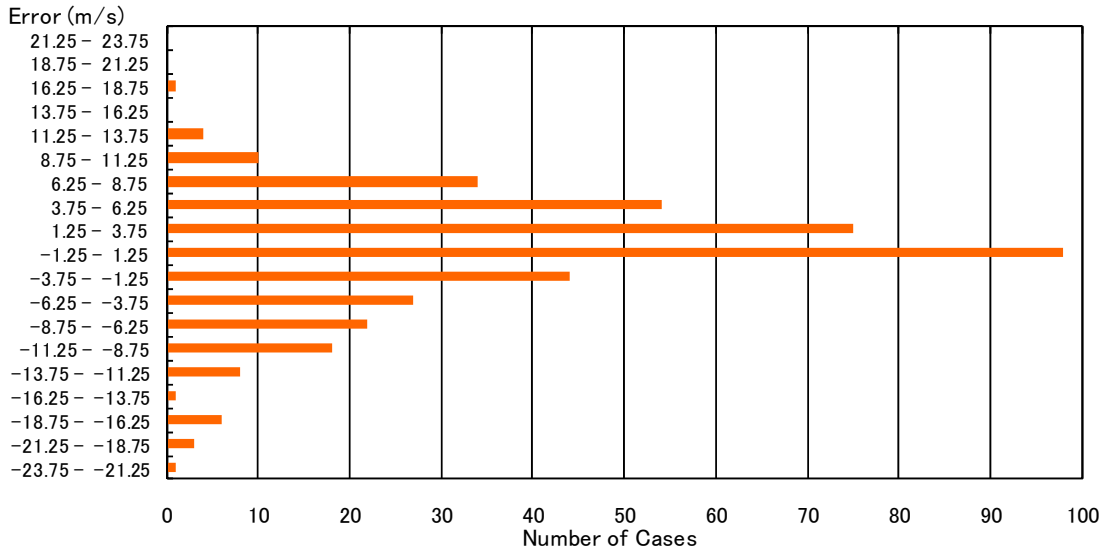


Figure 4.3 Histogram of 24-hour forecast maximum wind speed errors in 2009
(Those for 48- and 72-hour forecasts are shown on the attached DVD)

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 2009, the annual mean errors for 30-, 54- and 78-hour* predictions were 153 km (136 km in 2008), 254 km (220 km) and 388 km (346 km) respectively. The mean position errors of 18-, 30-, 42-, 54-, 66- and 78-hour predictions for each TC are given in Table 4.4.

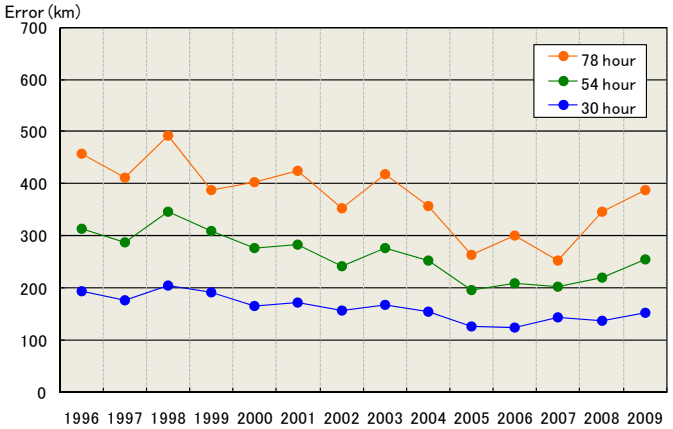


Figure 4.4 GSM annual mean position errors since 1996

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

Tropical Cyclone			T=18		T=30		T=42		T=54		T=66		T=78	
TY	0901	Kujira	118.2	(18)	160.0	(16)	213.0	(14)	244.4	(12)	320.7	(10)	366.9	(8)
TY	0902	Chan-hom	155.1	(18)	200.2	(16)	298.2	(15)	387.5	(13)	436.2	(11)	489.1	(10)
STS	0903	Linfa	94.6	(14)	140.6	(12)	167.4	(10)	237.8	(7)	200.1	(3)	-	(-)
TS	0904	Nangka	120.9	(14)	165.1	(12)	177.0	(6)	179.8	(1)	347.4	(1)	-	(-)
TS	0905	Soudelor	56.6	(3)	93.6	(1)	-	(-)	-	(-)	-	(-)	-	(-)
TY	0906	Molave	103.2	(14)	116.1	(12)	124.6	(9)	214.4	(8)	274.9	(4)	553.8	(1)
TS	0907	Goni	70.7	(17)	123.8	(16)	185.8	(14)	248.7	(12)	308.5	(10)	371.6	(8)
TY	0908	Morakot	79.5	(27)	103.1	(25)	144.3	(23)	189.1	(21)	259.3	(19)	300.0	(17)
TS	0909	Etau	115.9	(19)	180.9	(17)	230.7	(14)	313.4	(12)	383.5	(10)	451.2	(8)
TY	0910	Vamco	152.0	(33)	198.9	(31)	244.8	(29)	275.6	(27)	344.2	(25)	376.2	(23)
STS	0911	Krovanh	133.2	(15)	197.9	(13)	197.0	(10)	120.7	(7)	191.1	(5)	463.3	(3)
STS	0912	Dujuan	146.2	(26)	179.5	(24)	169.5	(22)	196.0	(20)	308.7	(18)	422.4	(16)
TS	0913	Mujigae	136.7	(9)	258.7	(7)	425.5	(5)	550.2	(3)	756.6	(1)	-	(-)
TY	0914	Choi-wan	111.2	(31)	128.8	(29)	163.2	(27)	206.7	(25)	249.5	(23)	317.1	(21)
TY	0915	Koppu	58.9	(8)	97.2	(6)	179.3	(4)	260.2	(2)	-	(-)	-	(-)
TY	0916	Ketsana	107.4	(18)	132.8	(16)	133.9	(14)	119.0	(12)	103.7	(10)	138.0	(8)
TY	0917	Parma	93.7	(62)	137.2	(60)	187.8	(58)	244.5	(56)	299.3	(54)	351.3	(52)
TY	0918	Melor	95.3	(37)	134.4	(35)	180.8	(33)	225.5	(31)	267.9	(29)	329.5	(27)
TS	0919	Nepartak	138.2	(19)	213.3	(17)	252.6	(15)	283.3	(13)	419.8	(11)	679.5	(9)
TY	0920	Lupit	102.5	(48)	166.5	(46)	268.0	(44)	377.5	(42)	501.6	(40)	590.1	(38)
TY	0921	Mirinae	83.7	(26)	111.4	(24)	162.8	(22)	173.4	(19)	191.8	(17)	214.6	(16)
TY	0922	Nida	87.0	(40)	141.8	(38)	211.9	(36)	266.3	(34)	309.2	(32)	352.7	(30)
	Annual	Mean	107.6	(516)	152.5	(473)	202.9	(424)	254.1	(377)	319.3	(333)	387.6	(295)

Table 4.4 Mean position errors (km) of GSM for each TC in 2009.
The number of samples is given in parentheses.

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 34% (36% in 2008), 48% (53%), 58% (59%) and 60% (59%) for 18-, 30-, 54- and 78-hour predictions respectively. These rates were in general higher for the *after* stage, in which the position errors of the PER methods were larger than those for the other two stages. However in 2009, the rates for the *during* were higher at longer forecast times due to the higher accuracy of GSM.

About 60% (70% in 2008) of 30-hour predictions had errors of less than 150 km, while 69% (74%) of 54-hour predictions had errors of less than 300 km, and 70% (73%) 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	95.4 (252)	117.7 (110)	120.4 (154)	107.6 (516)
	PER	144.6 (252)	151.1 (110)	200.5 (154)	162.7 (516)
	IMPROV	34.1 %	22.1 %	39.9 %	33.8 %
T=30	GSM	132.9 (226)	147.6 (99)	185.8 (148)	152.5 (473)
	PER	234.8 (226)	266.2 (99)	390.9 (148)	290.2 (473)
	IMPROV	43.4 %	44.6 %	52.5 %	47.5 %
T=42	GSM	183.6 (195)	169.6 (85)	248.7 (144)	202.9 (424)
	PER	348.7 (195)	377.5 (85)	598.5 (144)	439.3 (424)
	IMPROV	47.3 %	55.1 %	58.4 %	53.8 %
T=54	GSM	232.0 (171)	191.7 (71)	314.8 (135)	254.1 (377)
	PER	470.6 (171)	522.8 (71)	824.4 (135)	607.1 (377)
	IMPROV	50.7 %	63.3 %	61.8 %	58.2 %
T=66	GSM	281.9 (148)	229.7 (65)	413.9 (120)	319.3 (333)
	PER	620.1 (148)	686.2 (65)	1043.9 (120)	785.7 (333)
	IMPROV	54.5 %	66.5 %	60.4 %	59.4 %
T=78	GSM	334.4 (130)	294.3 (57)	500.9 (108)	387.6 (295)
	PER	751.0 (130)	852.8 (57)	1294.4 (108)	969.6 (295)
	IMPROV	55.5 %	65.5 %	61.3 %	60.0 %

Table 4.5 Mean position errors (km) of GSM and PER method predictions for the 22 TCs in 2009 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

The mean errors of 30-, 54-, 78-hour central pressure predictions by GSM in 2009 were +8.8 hPa (+10.4 hPa in 2008), +10.6 hPa (+12.5 hPa) and +10.8 hPa (+10.3 hPa) respectively. Their root mean square errors (RMSEs) were 22.0 hPa (18.9 hPa in 2008) for 30-hour predictions, 26.1 hPa (23.3 hPa) for 54-hour predictions and 28.1 hPa (24.7 hPa) for 78-hour predictions. The bias for 30-, 54-, and 78-hour maximum wind speed predictions were -5.1 m/s (-6.0 m/s in 2008) with RMSE of 11.3 m/s (10.5 m/s), -5.6 m/s (-6.7 m/s) with RMSE of 13.4 m/s (12.9 m/s) and -5.1 m/s (-5.9 m/s) with RMSE of 13.9 m/s (13.2 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). This underestimate results from the fact that the current horizontal resolution of GSM (about 20 km) is not fine enough to produce the TC core structure especially when it is intense and small.

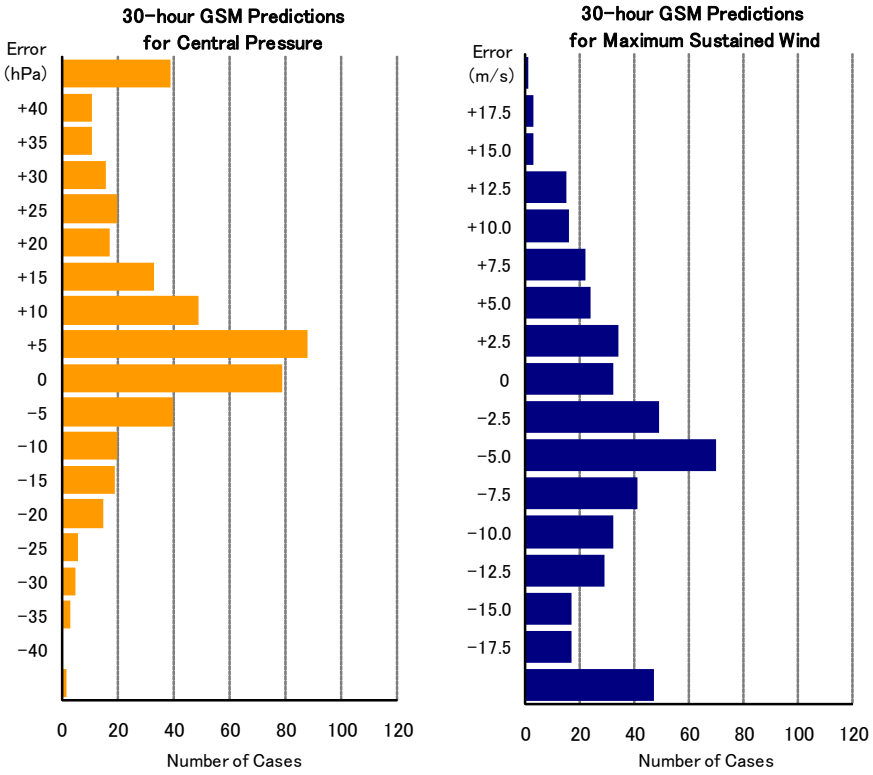


Figure 4.5 Error distributions of GSM 30-hour intensity predictions in 2009.
The figure on the left shows error distributions for central pressure, while the one on the right shows those for maximum wind speed (the error distributions of 54- and 78-hour predictions are included on the attached DVD).

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 means of ensemble mean position error at 30-, 54-, 78-, 102- and 126-hour predictions are 163 km (153 km in GSM), 269 km (254 km), 395 km (388 km), 509 km and 649 km, respectively.

Tropical Cyclone			T=30		T=54		T=78		T=102		T=126	
TY	0901	Kujira	174.2	(15)	300.4	(11)	454.6	(7)	744.6	(3)	-	(-)
TY	0902	Chan-hom	275.5	(19)	443.3	(15)	533.4	(11)	645.8	(7)	934.4	(3)
STS	0903	Linfa	139.5	(10)	180.8	(2)	-	(-)	-	(-)	-	(-)
TS	0904	Nangka	208.0	(11)	268.9	(3)	-	(-)	-	(-)	-	(-)
TS	0905	Soudelor	-	(-)	-	(-)	-	(-)	-	(-)	-	(-)
TY	0906	Molave	122.9	(10)	273.8	(4)	-	(-)	-	(-)	-	(-)
TS	0907	Goni	81.5	(11)	90.0	(6)	115.9	(2)	-	(-)	-	(-)
TY	0908	Morakot	118.7	(25)	209.4	(21)	329.4	(17)	401.1	(13)	455.4	(9)
TS	0909	Etau	130.7	(13)	281.0	(9)	442.3	(5)	351.7	(1)	-	(-)
TY	0910	Vamco	209.3	(31)	279.5	(26)	368.2	(22)	368.8	(18)	477.8	(14)
STS	0911	Krovanh	162.4	(11)	146.2	(7)	362.4	(3)	-	(-)	-	(-)
STS	0912	Dujuan	164.1	(23)	187.3	(19)	338.7	(15)	504.3	(11)	540.2	(7)
TS	0913	Mujigae	266.8	(7)	520.3	(3)	-	(-)	-	(-)	-	(-)
TY	0914	Choi-wan	124.9	(28)	195.4	(24)	275.5	(20)	366.8	(16)	477.3	(12)
TY	0915	Koppu	134.8	(6)	287.2	(2)	-	(-)	-	(-)	-	(-)
TY	0916	Ketsana	126.9	(13)	141.6	(9)	199.5	(5)	357.3	(1)	-	(-)
TY	0917	Parma	140.7	(57)	253.7	(53)	347.9	(49)	458.9	(45)	552.1	(41)
TY	0918	Melor	153.1	(35)	247.9	(31)	354.3	(27)	567.5	(23)	886.3	(19)
TS	0919	Nepartak	218.6	(17)	339.4	(13)	744.4	(9)	928.7	(4)	-	(-)
TY	0920	Lupit	178.1	(45)	353.6	(41)	532.9	(37)	687.3	(33)	938.0	(29)
TY	0921	Mirinae	141.6	(24)	206.1	(19)	271.2	(16)	297.8	(12)	282.9	(8)
TY	0922	Nida	168.5	(37)	323.9	(33)	451.6	(29)	538.6	(25)	650.9	(21)
All	Annual	Mean	162.8	(448)	268.6	(351)	395.4	(274)	508.8	(212)	648.5	(163)

Table 4.6 Mean position errors (km) of TEPS ensemble mean forecasts for each TC in 2009. The number of samples is given in parentheses.

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. In an ideal EPS with a large number of samples, large position error is found when the ensemble spread is large. However in 2009, large errors were found in the case of small ensemble spread.

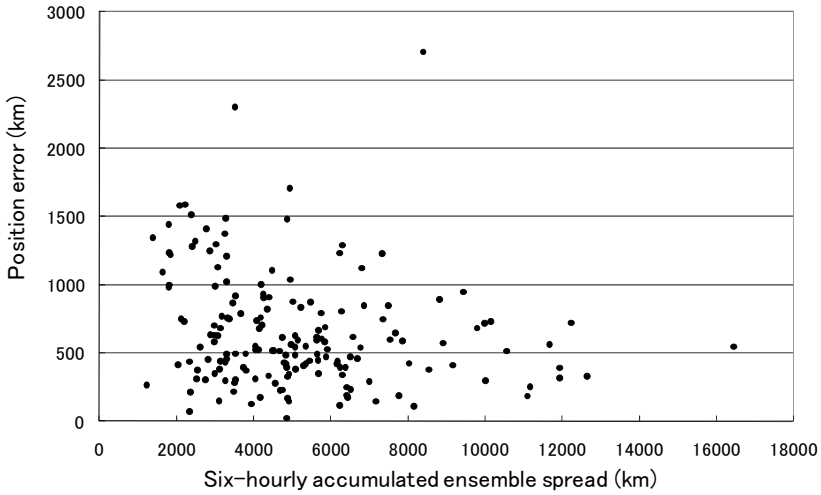


Figure 4.6 Relation between 6-hourly accumulated ensemble spread on the TC position forecast (km) and ensemble mean forecast position error (km) at 126-hour prediction in 2009.

To add reliability information to TC track forecasts, we have introduced a reliability index in which the categories A, B and C represent the highest, middle-level and lowest reliability, respectively. The index is determined by 6-hourly accumulated ensemble spread at each forecast time. The levels of the categories were set with the results from the pre-operational runs of TEPS so that the frequency of each category becomes 40%, 40% and 20%, respectively. Table 4.7 shows ensemble mean forecast errors classified with the reliability index. Theoretically, mean position errors of reliability A should be smaller than those of the reliability B and C throughout the forecast times with a sufficient number of samples in an ideal EPS. However, the A shows larger position errors compared to B and C. To improve the accuracy of forecasts, TEPS needs to be improved to give the better reliability information on the typhoon track forecast.

Table 4.7 Ensemble mean forecast position errors (km) in 2009 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	162.0 (150)	167.8 (263)	149.1 (56)
T=54	287.5 (130)	272.3 (190)	219.3 (51)
T=78	443.8 (102)	382.5 (144)	344.0 (44)
T=102	586.3 (84)	475.1 (103)	419.3 (33)
T=126	801.3 (59)	569.4 (86)	597.3 (26)

Appendices

RSMC Tropical Cyclone Best Track Data in 2009

Appendix 1

Kujira (0901)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
May 01/12	12.8	124.1	1006	-	0.0	TD
01/18	12.9	124.2	1004	-	0.5	TD
02/00	13.0	124.3	1004	-	1.0	TD
02/06	13.2	124.4	1002	-	1.0	TD
02/12	13.3	124.5	1002	-	1.5	TD
02/18	13.4	124.6	1000	35	2.0	TS
03/00	13.7	124.7	996	40	2.5	TS
03/06	14.1	125.0	985	45	3.0	TS
03/12	14.5	125.5	980	55	3.5	STS
03/18	15.0	126.2	975	60	4.0	STS
04/00	15.7	127.4	970	65	4.5	TY
04/06	16.4	128.5	965	70	5.0	TY
04/12	16.8	129.6	950	80	5.5	TY
04/18	17.1	131.0	940	85	6.0	TY
05/00	17.6	132.7	940	85	6.0	TY
05/06	18.3	134.0	940	85	6.0	TY
05/12	18.8	135.3	950	80	6.0	TY
05/18	19.5	136.9	950	80	6.0	TY
06/00	20.4	138.2	955	75	5.0	TY
06/06	21.6	139.8	955	75	5.0	TY
06/12	23.0	141.3	965	70	4.5	TY
06/18	24.4	142.9	970	65	4.0	TY
07/00	26.0	144.0	980	55	3.5	STS
07/06	28.4	145.5	985	45	3.0	TS
07/12	30.2	147.3	990	35	2.5	TS
07/18	32.3	149.3	998	-	2.0	L
08/00	34.4	151.1	1000	-	-	L
08/06	36.1	152.7	1000	-	-	L
08/12	37.8	154.6	1000	-	-	L
08/18	40.6	156.4	998	-	-	L
09/00	41.9	159.3	998	-	-	L
09/06	43.0	161.8	998	-	-	L
09/12	43.8	163.6	1000	-	-	L
09/18	44.4	164.8	1000	-	-	L
10/00	45.1	165.9	1002	-	-	L
10/06	45.4	166.6	1002	-	-	L
10/12	45.8	167.4	1002	-	-	L
10/18	45.9	168.5	1002	-	-	L
11/00	46.6	169.3	1006	-	-	L
11/06	47.2	170.2	1008	-	-	L
11/12	48.3	171.0	1008	-	-	L
11/18	49.5	171.4	1008	-	-	L
12/00	50.7	171.5	1010	-	-	L
12/06	52.2	170.5	1010	-	-	L
12/12	53.3	168.6	1010	-	-	L
12/18	53.9	167.4	1010	-	-	L
13/00	54.2	166.0	1012	-	-	L
13/06	55.0	164.3	1014	-	-	L
13/12						Dissip.

Nangka (0904)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Jun. 22/12	10.8	129.0	1002	-	1.0	TD
22/18	10.9	128.0	1002	-	1.5	TD
23/00	11.6	126.5	1000	-	2.0	TD
23/06	11.8	125.3	996	35	2.5	TS
23/12	12.3	124.2	994	40	2.5	TS
23/18	12.5	123.2	994	40	2.5	TS
24/00	12.8	122.3	994	40	2.5	TS
24/06	13.3	121.2	994	40	2.5	TS
24/12	13.9	120.3	994	40	2.5	TS
24/18	14.5	119.3	996	40	2.5	TS
25/00	15.5	118.6	996	40	2.5	TS
25/06	16.3	118.3	996	40	2.5	TS
25/12	17.4	117.5	996	35	2.5	TS
25/18	18.4	116.8	996	35	2.5	TS
26/00	19.2	116.3	996	35	2.5	TS
26/06	20.8	115.7	996	35	2.5	TS
26/12	22.1	114.9	996	35	2.0	TS
26/18	23.0	114.2	1000	-	2.0	TD
27/00						Dissip.

Chan-hom (0902)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
May 02/18	9.7	111.1	1006	-	0.5	TD
03/00	9.7	111.5	1004	-	1.0	TD
03/06	9.7	111.5	1004	-	1.5	TD
03/12	9.9	111.6	1000	35	2.0	TS
03/18	10.2	111.9	998	35	2.0	TS
04/00	10.5	112.2	996	35	2.5	TS
04/06	10.9	112.0	992	40	3.0	TS
04/12	11.2	111.7	990	45	3.0	TS
04/18	11.3	111.6	985	50	3.5	STS
05/00	11.5	111.7	980	55	3.5	STS
05/06	12.1	111.8	980	55	3.5	STS
05/12	12.7	112.1	980	55	3.5	STS
05/18	13.3	112.6	980	55	3.5	STS
06/00	13.6	113.1	980	55	3.5	STS
06/06	14.1	113.9	980	55	3.5	STS
06/12	14.4	114.6	975	60	4.0	STS
06/18	14.8	115.9	975	65	4.0	TY
07/00	15.3	117.3	975	65	4.0	TY
07/06	15.8	118.7	975	65	4.0	TY
07/12	16.4	120.2	985	55	4.0	STS
07/18	16.6	121.5	990	50	3.5	STS
08/00	16.5	123.4	990	50	3.5	STS
08/06	16.4	124.9	990	45	3.0	TS
08/12	16.7	126.3	992	40	3.0	TS
08/18	17.0	127.0	994	35	2.5	TS
09/00	17.2	127.5	998	-	2.5	TD
09/06	17.4	128.0	1000	-	-	TD
09/12	17.8	128.7	1002	-	-	TD
09/18	18.5	128.5	1004	-	-	TD
10/00	19.0	127.9	1006	-	-	TD
10/06	19.7	128.2	1006	-	-	TD
10/12	20.5	127.7	1006	-	-	TD
10/18	20.9	127.6	1006	-	-	TD
11/00	21.7	127.2	1006	-	-	TD
11/06	21.7	126.7	1006	-	-	TD
11/12	22.1	127.4	1008	-	-	TD
11/18	23.0	127.2	1008	-	-	TD
12/00	23.8	126.9	1010	-	-	TD
12/06	24.3	127.2	1008	-	-	TD
12/12	24.8	127.9	1008	-	-	TD
12/18	25.3	128.5	1008	-	-	TD
13/00	25.7	128.8	1008	-	-	TD
13/06						Dissip.

Soudelor (0905)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Jul. 09/18	18.7	121.7	1002	-	0.5	TD
10/00	18.7	120.6	1000	-	1.0	TD
10/06	19.3	119.9	1000	-	0.5	TD
10/12	19.3	118.4	998	-	0.5	TD
10/18	19.5	116.7	996	-	1.0	TD
11/00	19.8	115.4	994	35	1.0	TS
11/06	19.8	114.0	992	35	1.5	TS
11/12	19.9	112.8	992	35	1.5	TS
11/18	20.1	111.6	994	35	2.0	TS
12/00	20.5	110.4	996	-	2.0	TD
12/06	20.8	108.5	996	-	2.0	TD
12/12	21.0	107.0	998	-	2.0	TD
12/18	20.8	105.0	1000	-	1.5	TD
13/00						Dissip.

Linfa (0903)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Jun. 17/06	17.4	116.7	1004	-	0.0	TD
17/12	17.6	116.6	1004	-	0.5	TD
17/18	17.7	116.3	1002	-	1.0	TD
18/00	17.6	116.1	1000	35	1.5	TS
18/06	17.3	116.3	998	35	1.5	TS
18/12	17.2	116.5	994	35	2.0	TS
18/18	17.4	116.9	994	35	2.0	TS
19/00	17.6	117.2	992	40	2.5	TS
19/06	18.4	117.3	990	45	2.5	TS
19/12	19.3	117.1	985	50	3.0	STS
19/18	19.8	116.9	985	50	3.0	STS
20/00	20.1	117.1	980	55	3.5	STS
20/06	20.5	117.3	975	60	4.0	STS
20/12	21.2	117.8	975	60	4.0	STS
20/18	21.9	118.1	975	60	4.0	STS
21/00	22.7	118.3	975	60	4.0	STS
21/06	23.4	118.3	980	55	3.5	STS
21/12	24.1	118.3	980	50	3.5	STS
21/18	25.1	119.0	992	40	3.0	TS
22/00	26.0	119.7	996	35	2.5	TS
22/06	27.4	120.7	998	-	2.0	TD
22/12	28.7	121.8	1000	-	-	TD
22/18	29.2	122.7	1000	-	-	TD
23/00	29.7	124.2	1000	-	-	TD
23/06	30.0	125.4	1000	-	-	L
23/12	31.7	129.1	998	-	-	L
23/18	33.2	133.4	998	-	-	L
24/00	33.9	137.2	998	-	-	L
24/06	35.7	142.0	1000	-	-	L
24/12	37.5	146.0	1000	-	-	L
24/18	39.0	149.1	1002	-	-	L
25/00	40.1	152.3	1002	-	-	L
25/06	41.1	155.8	1002	-	-	L
25/12	41.9	157.6	1002	-	-	L
25/18	42.6	159.6	1002	-	-	L
26/00	42.9	160.6	1004	-	-	L
26/06	43.5	161.8	1004	-	-	L
26/12	43.9	163.1	1004	-	-	L
26/18	44.6	164.0	1006	-	-	L
27/00	45.6	165.4	1006	-	-	L
27/06	46.8	166.6	1004	-	-	L
27/12	47.9	168.0	1004	-	-	L
27/18	49.3	168.8	1004	-	-	L
28/00	50.6	169.9	1004	-	-	L
28/06	52.1	171.2	1004	-	-	L
28/12	53.8	172.7	1004	-	-	L
28/18	55.3	173.4	1004	-	-	L
29/00	56.4	173.8	1006	-	-	L
29/06	57.4	174.3	1006	-	-	L
29/12	58.1	174.4	1008	-	-	L
29/18	58.5	173.5	1008	-	-	L
30/00	58.4	172.7	1008	-	-	L
30/06	58.2	172.0	1006	-	-	L
30/12	57.8	171.9	1006	-	-	L
30/18						Dissip.

Molave (0906)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Jul. 15/00	14.1	128.6	1004	-	0.5	TD
15/06	14.4	127.8	1002	-	1.0	TD
15/12	14.9	127.1	1002	-	1.0	TD
15/18	15.6	126.4	1000	-	1.5	TD
16/00	16.1	125.8	1000	-	1.5	TD
16/06	16.6	125.1	998	35	2.0	TS
16/12	17.3	124.6	996	35	2.0	TS
16/18	18.0	123.9	994	40	2.5	TS
17/00	18.7	123.4	992	45	3.0	TS
17/06	19.5	122.6	985	55	3.5	STS
17/12	20.7	121.3	980	60	4.0	STS
17/18	21.0	119.6	975	65	4.0	TY
18/00	21.4	118.3	975	65	4.0	TY
18/06	21.8	117.1	975	65	4.0	TY
18/12	22.3	116.0	975	65	4.0	TY
18/18	22.6	114.5	980	60	3.5	STS
19/00	22.9	112.8	992	40	3.0	TS
19/06	23.3	111.1	996	-	2.5	TD
19/12						Dissip.

Goni (0907)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Aug. 01/06	16.6	123.2	992	-	0.5	TD
01/12	16.9	121.9	994	-	0.5	TD
01/18	17.0	120.2	994	-	0.5	TD
02/00	17.2	118.5	994	-	0.5	TD
02/06	17.3	117.4	992	-	0.5	TD
02/12	17.4	116.6	992	-	0.5	TD
02/18	17.8	116.3	992	-	0.5	TD
03/00	18.5	116.2	994	-	0.5	TD
03/06	19.3	115.7	994	-	0.5	TD
03/12	19.7	115.3	992	35	1.0	TS
03/18	20.1	114.6	992	35	1.5	TS
04/00	20.7	114.3	992	35	1.5	TS
04/06	21.3	114.0	990	40	2.0	TS
04/12	21.5	113.5	990	40	2.0	TS
04/18	21.6	113.1	990	40	2.0	TS
05/00	21.8	112.6	990	40	2.5	TS
05/06	22.0	112.4	990	40	2.5	TS
05/12	22.0	112.1	990	40	2.5	TS
05/18	22.0	111.8	990	35	2.5	TS
06/00	22.0	111.4	990	35	2.5	TS
06/06	21.9	111.1	990	-	2.0	TD
06/12	21.4	110.5	990	-	1.5	TD
06/18	21.0	110.3	990	-	2.0	TD
07/00	20.6	109.6	990	-	2.0	TD
07/06	20.2	109.2	990	35	2.0	TS
07/12	19.9	108.9	990	35	1.5	TS
07/18	19.5	108.4	990	35	1.0	TS
08/00	19.1	108.3	990	35	0.5	TS
08/06	18.4	108.2	992	-	0.5	TD
08/12	17.8	108.7	992	-	0.5	TD
08/18	17.7	110.0	994	-	0.0	TD
09/00	18.0	111.2	994	-	-	TD
09/06	18.8	112.6	994	-	-	TD
09/12	19.3	113.3	994	-	-	TD
09/18	19.9	113.8	994	-	-	TD
10/00	20.4	114.3	996	-	-	TD
10/06						Dissip.

Morakot (0908)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Aug. 02/18	20.1	133.4	994	-	0.0	TD
03/00	20.3	133.8	992	35	0.5	TS
03/06	20.4	134.4	992	35	0.5	TS
03/12	20.6	134.9	990	40	1.0	TS
03/18	21.2	135.5	985	45	1.5	TS
04/00	21.7	135.9	985	45	2.0	TS
04/06	22.2	135.4	985	45	2.5	TS
04/12	22.3	134.6	980	50	3.0	STS
04/18	22.5	134.1	975	55	3.5	STS
05/00	22.6	133.3	975	60	3.5	STS
05/06	22.8	132.1	970	60	4.0	STS
05/12	22.9	130.8	970	60	4.0	STS
05/18	23.1	129.3	965	65	4.0	TY
06/00	23.0	127.8	965	65	4.0	TY
06/03	23.1	127.2	960	65	-	TY
06/06	23.1	126.6	960	65	4.0	TY
06/09	23.2	126.1	955	70	-	TY
06/12	23.4	125.4	950	70	4.5	TY
06/15	23.4	124.6	945	75	-	TY
06/18	23.4	124.0	945	75	4.5	TY
06/21	23.4	123.7	945	75	-	TY
07/00	23.5	123.1	945	75	4.5	TY
07/03	23.4	122.7	950	70	-	TY
07/06	23.4	122.3	950	70	4.5	TY
07/09	23.4	122.1	950	70	-	TY
07/12	23.5	121.9	950	70	4.5	TY
07/18	23.8	121.2	960	65	4.0	TY
08/00	24.5	120.7	970	60	3.5	STS
08/06	24.6	120.5	970	60	3.0	STS
08/12	24.7	120.3	970	60	3.0	STS
08/18	24.9	120.1	975	60	3.0	STS
09/00	25.7	120.3	975	60	3.0	STS
09/06	26.2	120.1	975	60	3.0	STS
09/12	26.7	119.8	980	50	2.5	STS
09/18	27.2	119.5	985	45	2.0	TS
10/00	28.2	119.6	990	40	2.0	TS
10/06	29.0	119.7	992	35	2.0	TS
10/12	30.3	120.3	994	35	1.5	TS
10/18	31.0	120.5	996	-	1.5	TD
11/00	31.9	120.8	998	-	-	TD
11/06	32.8	121.4	998	-	-	TD
11/12	34.0	122.7	998	-	-	TD
11/18	35.5	124.3	998	-	-	L
12/00	36.7	126.1	998	-	-	L
12/06						Dissip.

Etau (0909)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Aug. 08/00	22.7	139.7	998	-	1.0	TD
08/06	23.5	139.0	996	-	1.0	TD
08/12	24.2	138.2	996	-	0.5	TD
08/18	25.3	136.9	996	-	1.0	TD
09/00	26.0	136.3	996	-	1.0	TD
09/06	27.0	135.2	994	35	1.5	TS
09/12	27.9	134.8	994	35	1.5	TS
09/18	28.9	134.3	994	35	1.5	TS
09/21	29.4	134.3	994	35	-	TS
10/00	30.0	134.4	992	40	2.0	TS
10/03	30.6	134.6	992	40	-	TS
10/06	31.1	135.2	992	40	2.0	TS
10/09	31.6	135.6	992	40	-	TS
10/12	32.0	135.9	992	40	2.0	TS
10/15	32.3	136.4	992	40	-	TS
10/18	32.7	136.9	992	40	2.0	TS
10/21	32.9	137.9	992	40	-	TS
11/00	33.2	138.6	992	40	2.0	TS
11/03	33.3	139.7	992	40	-	TS
11/06	33.4	140.8	992	40	2.0	TS
11/09	33.2	141.8	992	40	-	TS
11/12	33.1	143.0	992	40	2.0	TS
11/18	32.7	145.2	992	40	2.0	TS
12/00	32.5	148.3	992	40	2.0	TS
12/06	32.3	150.6	992	40	2.0	TS
12/12	33.2	151.8	992	35	1.5	TS
12/18	33.5	151.8	992	35	1.5	TS
13/00	33.8	151.7	994	-	1.0	TD
13/06	34.4	151.6	994	-	1.0	TD
13/12	34.9	151.9	996	-	-	TD
13/18	35.6	152.0	998	-	-	TD
14/00	36.4	152.9	1000	-	-	TD
14/06	37.4	154.2	1002	-	-	TD
14/12	39.1	155.9	1004	-	-	L
14/18	40.3	158.9	1002	-	-	L
15/00	41.0	163.1	1002	-	-	L
15/06	41.3	167.9	1002	-	-	L
15/12	41.8	173.5	1002	-	-	L
15/18	42.3	179.1	1000	-	-	L
16/00	43.0	184.7	998	-	-	Out

Vamco (0910)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Aug. 16/12	11.6	160.7	1006	-	1.0	TD
16/18	11.5	160.0	1006	-	1.0	TD
17/00	12.6	159.0	1006	-	1.5	TD
17/06	13.2	158.8	1006	-	2.0	TD
17/12	13.9	158.5	1004	-	2.0	TD
17/18	14.5	158.3	1000	35	2.5	TS
18/00	15.6	157.8	998	35	3.0	TS
18/06	16.2	157.5	996	40	3.0	TS
18/12	16.6	157.3	985	50	3.5	STS
18/18	17.0	157.3	980	55	4.0	STS
19/00	17.3	157.5	975	65	4.5	TY
19/06	17.7	157.7	970	70	5.0	TY
19/12	18.0	157.6	965	75	5.5	TY
19/18	18.2	157.4	950	85	5.5	TY
20/00	18.6	157.4	945	90	6.0	TY
20/06	18.8	157.1	945	90	6.0	TY
20/12	19.0	157.1	945	90	6.0	TY
20/18	19.3	157.0	945	90	6.0	TY
21/00	19.8	156.7	945	90	6.0	TY
21/06	20.5	156.8	945	90	6.0	TY
21/12	21.1	156.7	945	90	6.0	TY
21/18	22.2	156.9	945	90	6.0	TY
22/00	23.5	156.7	955	80	5.5	TY
22/06	24.7	156.3	955	80	5.5	TY
22/12	25.6	155.9	955	80	5.5	TY
22/18	26.5	155.5	955	80	5.5	TY
23/00	27.5	155.0	955	80	5.5	TY
23/06	28.5	154.9	955	80	5.0	TY
23/12	29.3	154.6	955	80	5.0	TY
23/18	30.0	154.4	955	80	5.0	TY
24/00	31.1	154.8	955	80	4.5	TY
24/06	32.2	154.9	960	75	4.5	TY
24/12	33.6	155.3	960	75	4.5	TY
24/18	35.5	155.9	960	75	4.5	TY
25/00	38.1	156.8	965	70	4.5	TY
25/06	41.4	158.6	970	65	4.0	TY
25/12	45.2	161.6	980	60	3.5	STS
25/18	48.5	164.7	985	55	3.0	STS
26/00	51.4	169.3	988	-	3.0	L
26/06	53.3	173.9	988	-	-	L
26/12	54.3	178.6	988	-	-	L
26/18	54.7	183.5	988	-	-	Out

Krovanh (0911)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Aug. 28/00	21.4	149.1	1002	-	1.0	TD
28/06	22.6	149.1	1002	-	1.5	TD
28/12	23.8	149.0	998	35	2.0	TS
28/18	25.0	148.7	996	35	2.0	TS
29/00	26.3	147.8	994	40	2.5	TS
29/06	27.4	146.9	992	40	2.5	TS
29/12	28.6	146.0	990	45	3.0	TS
29/18	29.9	144.5	985	50	3.0	STS
30/00	30.6	142.5	985	50	3.0	STS
30/06	31.1	141.0	980	55	3.5	STS
30/09	31.4	140.8	980	55	-	STS
30/12	31.8	140.6	980	55	3.5	STS
30/15	32.1	140.3	980	55	-	STS
30/18	32.7	140.0	975	60	3.5	STS
30/21	33.1	139.9	975	60	-	STS
31/00	33.5	139.9	975	60	3.5	STS
31/03	34.0	139.9	980	55	-	STS
31/06	34.6	140.5	980	55	3.5	STS
31/09	35.4	141.0	980	55	-	STS
31/12	36.4	141.5	985	50	3.5	STS
31/15	37.2	142.1	985	50	-	STS
31/18	38.3	142.9	985	50	3.0	STS
31/21	39.4	143.8	990	45	-	TS
Sep. 01/00	40.3	144.6	992	45	2.5	TS
01/06	42.2	146.3	994	45	2.0	TS
01/12	42.9	148.2	996	-	1.5	L
01/18	43.3	150.3	1000	-	-	L
02/00	43.5	152.8	1000	-	-	L
02/06	43.4	155.6	1004	-	-	L
02/12						Dissip.

Dujuan (0912)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Sep. 02/18	17.5	130.1	996	-	0.5	TD
03/00	17.8	128.9	996	-	1.0	TD
03/06	17.4	127.7	996	-	1.5	TD
03/12	16.9	127.5	994	-	1.5	TD
03/18	17.1	128.2	992	35	2.0	TS
04/00	17.3	128.9	990	40	2.0	TS
04/06	17.7	129.5	990	40	2.0	TS
04/12	18.6	131.2	990	40	2.0	TS
04/18	19.1	131.8	985	45	2.5	TS
05/00	20.0	132.4	980	50	2.5	STS
05/06	21.3	133.6	980	50	3.0	STS
05/12	22.6	134.8	980	50	3.0	STS
05/18	23.4	135.2	980	50	3.0	STS
06/00	24.6	135.3	980	50	3.0	STS
06/06	25.4	135.8	980	50	3.0	STS
06/12	26.0	135.9	980	50	3.0	STS
06/18	26.8	135.9	980	50	3.0	STS
07/00	27.2	135.8	980	50	3.0	STS
07/06	27.9	136.2	980	50	3.0	STS
07/12	28.6	136.5	980	50	3.0	STS
07/18	29.4	137.3	980	50	2.5	STS
08/00	30.4	138.7	980	50	2.5	STS
08/06	31.1	140.4	980	50	2.5	STS
08/12	31.6	142.4	980	50	3.0	STS
08/18	32.3	145.1	980	50	3.0	STS
09/00	33.6	148.6	980	50	3.0	STS
09/06	35.1	152.2	980	50	3.0	STS
09/12	37.0	155.7	980	50	3.0	STS
09/18	39.6	159.8	980	50	2.5	STS
10/00	42.9	163.8	980	50	2.5	STS
10/06	45.5	167.4	980	-	2.0	L
10/12	47.8	170.7	980	-	-	L
10/18	49.5	174.5	984	-	-	L
11/00	51.2	177.5	986	-	-	L
11/06	53.0	180.0	990	-	-	L
11/12	54.4	181.2	992	-	-	Out

Mujigae (0913)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Sep. 09/00	16.9	119.1	1002	-	0.5	TD
09/06	17.7	118.3	1000	-	1.0	TD
09/12	18.1	117.4	1000	-	1.5	TD
09/18	18.7	116.2	1000	-	2.0	TD
10/00	19.0	114.9	998	35	2.0	TS
10/06	19.3	113.7	998	35	2.0	TS
10/12	19.6	112.5	996	35	2.0	TS
10/18	19.7	111.4	996	35	2.0	TS
11/00	19.8	109.0	994	40	2.5	TS
11/06	19.8	108.2	994	40	2.5	TS
11/12	19.6	107.4	996	35	2.0	TS
11/18	19.7	106.7	998	35	1.5	TS
12/00	20.0	106.0	1000	-	1.5	TD
12/06	20.3	104.5	1004	-	2.0	TD
12/12	20.6	102.8	1006	-	1.5	TD
12/18						Dissip.

Choi-wan (0914)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Sep. 12/00	14.3	153.5	1008	-	0.5	TD
12/06	14.9	152.6	1006	-	1.0	TD
12/12	15.0	152.0	1004	-	1.5	TD
12/18	15.4	150.9	1002	35	2.0	TS
13/00	16.0	150.0	998	45	2.5	TS
13/06	15.8	149.3	994	50	3.0	STS
13/12	15.7	148.7	990	55	3.5	STS
13/18	15.6	148.7	980	60	4.0	STS
14/00	15.6	148.3	965	70	4.5	TY
14/06	15.7	147.8	955	80	5.0	TY
14/12	16.3	147.5	945	85	5.5	TY
14/18	16.6	147.0	935	95	6.0	TY
15/00	17.1	146.6	935	95	6.0	TY
15/06	17.6	145.7	925	100	6.5	TY
15/12	17.9	145.0	915	105	7.0	TY
15/18	18.2	144.2	915	105	7.0	TY
16/00	18.6	143.4	915	105	7.0	TY
16/06	19.0	142.6	915	105	7.0	TY
16/12	19.2	141.9	915	105	7.0	TY
16/18	19.6	141.4	915	105	7.0	TY
17/00	20.3	140.9	925	100	6.5	TY
17/06	21.0	140.3	935	95	6.0	TY
17/12	21.6	139.8	935	95	6.0	TY
17/18	22.5	139.3	945	85	5.5	TY
18/00	23.2	138.9	945	85	5.5	TY
18/06	24.1	138.8	950	80	5.0	TY
18/12	25.2	139.1	955	75	4.5	TY
18/18	26.4	139.6	960	70	4.5	TY
18/21	27.0	139.7	960	70	-	TY
19/00	27.7	140.4	960	70	4.5	TY
19/03	28.4	141.0	960	70	-	TY
19/06	29.1	141.6	960	70	4.5	TY
19/09	29.8	142.4	960	70	-	TY
19/12	30.5	143.3	965	70	4.0	TY
19/18	32.7	145.1	970	70	4.0	TY
20/00	34.1	146.8	975	65	3.5	TY
20/06	35.1	149.1	980	60	3.0	STS
20/12	36.8	152.3	986	-	2.5	L
20/18	38.8	156.1	990	-	-	L
21/00						Dissip.

Koppu (0915)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Sep. 13/00	19.5	120.3	1000	-	1.0	TD
13/06	19.3	118.9	1000	-	1.5	TD
13/12	19.2	117.9	1000	-	2.0	TD
13/18	19.7	116.6	994	35	2.5	TS
14/00	20.0	115.9	990	45	3.0	TS
14/06	20.3	115.1	985	55	3.5	STS
14/12	20.9	114.2	980	60	4.0	STS
14/18	21.5	113.1	975	65	4.0	TY
15/00	22.0	112.0	980	55	3.5	STS
15/06	22.5	110.6	990	40	3.0	TS
15/12	23.3	109.5	996	-	2.5	TD
15/18	23.2	108.5	1000	-	2.0	TD
16/00						Dissip.

Ketsana (0916)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Sep. 25/00	14.2	127.9	1000	-	1.0	TD
25/06	14.3	126.8	998	-	1.0	TD
25/12	14.7	125.3	998	-	1.5	TD
25/18	14.9	123.7	996	-	2.0	TD
26/00	15.1	122.4	994	35	2.0	TS
26/06	15.1	121.2	990	40	2.5	TS
26/12	15.4	119.5	990	40	2.5	TS
26/18	15.3	117.7	990	45	2.5	TS
27/00	15.2	116.5	985	50	3.0	STS
27/06	15.2	115.5	985	50	3.0	STS
27/12	15.6	114.5	980	55	3.5	STS
27/18	15.7	113.7	975	60	3.5	STS
28/00	15.8	112.8	970	60	4.0	STS
28/06	15.8	111.9	960	70	4.5	TY
28/12	16.0	111.1	960	70	4.5	TY
28/18	16.0	110.2	960	70	4.5	TY
29/00	15.5	109.5	960	70	4.5	TY
29/06	15.4	108.9	965	70	4.5	TY
29/12	15.3	108.4	980	60	4.0	STS
29/18	15.3	107.9	990	45	3.5	TS
30/00	15.3	107.6	994	35	3.0	TS
30/06	15.3	107.1	998	-	2.5	TD
30/12	15.2	105.9	1000	-	-	TD
30/18	15.1	105.0	1002	-	-	TD
Oct. 01/00						Dissip.

Melor (0918)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Sep. 29/06	9.6	160.4	1002	-	1.0	TD
29/12	10.6	157.4	998	-	1.5	TD
29/18	10.9	156.8	998	-	2.0	TD
30/00	11.5	156.2	996	35	2.5	TS
30/06	12.6	154.8	992	40	2.5	TS
30/12	12.9	154.0	990	45	3.0	TS
30/18	13.0	153.5	980	55	3.5	STS
Oct. 01/00	13.6	153.2	975	65	4.0	TY
01/06	13.9	152.5	955	75	5.0	TY
01/12	14.1	152.0	950	80	5.0	TY
01/18	14.0	151.4	940	90	6.0	TY
02/00	14.2	151.1	935	95	6.0	TY
02/06	14.5	150.6	935	95	6.0	TY
02/12	15.0	149.9	935	95	6.0	TY
02/18	15.4	148.8	935	95	6.0	TY
03/00	15.6	147.9	935	95	6.0	TY
03/06	16.2	146.8	940	90	5.5	TY
03/12	16.5	145.3	935	95	6.0	TY
03/18	16.5	143.7	925	100	6.5	TY
04/00	16.6	142.3	920	105	6.5	TY
04/06	17.0	140.9	910	110	7.5	TY
04/12	17.5	139.4	910	110	7.5	TY
04/18	17.9	137.7	910	110	7.5	TY
05/00	18.5	136.3	915	105	7.0	TY
05/06	19.2	134.8	915	105	7.0	TY
05/12	20.0	133.6	930	95	6.0	TY
05/18	21.2	132.5	935	90	6.0	TY
06/00	22.5	131.7	935	90	6.0	TY
06/06	23.9	130.9	940	85	6.0	TY
06/09	24.5	130.8	940	85	-	TY
06/12	25.1	130.7	940	85	6.0	TY
06/15	25.7	130.5	940	85	-	TY
06/18	26.5	130.8	940	85	6.0	TY
06/21	27.3	131.0	940	85	-	TY
07/00	28.2	131.5	940	85	5.5	TY
07/03	29.0	131.8	945	80	-	TY
07/06	29.9	132.5	945	80	5.0	TY
07/09	30.8	133.2	945	80	-	TY
07/12	31.6	134.3	945	80	5.0	TY
07/15	32.9	135.6	950	75	-	TY
07/18	34.0	136.6	955	75	5.0	TY
07/19	34.2	136.9	955	75	-	TY
07/20	34.6	136.9	955	75	-	TY
07/21	35.1	137.2	965	65	-	TY
08/00	36.1	138.8	975	60	4.0	STS
08/03	37.1	139.7	975	60	-	STS
08/06	38.4	141.2	984	55	4.0	STS
08/09	39.0	142.3	980	55	-	STS
08/12	40.0	143.6	980	-	3.5	L
08/18	41.3	145.6	980	-	3.5	L
09/00	42.2	147.7	984	-	3.0	L
09/06	43.2	150.0	984	-	3.0	L
09/12	44.2	152.4	984	-	-	L
09/18	45.1	156.0	982	-	-	L
10/00	46.0	159.2	982	-	-	L
10/06	46.7	163.5	982	-	-	L
10/12	46.7	167.4	984	-	-	L
10/18	47.0	171.9	988	-	-	L
11/00	47.2	177.1	988	-	-	L
11/06						Dissip.

Parma (0917)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Sep. 27/18	9.4	145.5	1004	-	1.0	TD
28/00	9.4	144.6	1002	-	1.0	TD
28/06	9.2	143.3	1000	-	1.5	TD
28/12	9.0	142.1	1000	-	1.5	TD
28/18	8.6	140.8	998	-	1.5	TD
29/00	8.0	139.7	996	-	2.0	TD
29/06	7.8	138.9	994	35	2.5	TS
29/12	8.0	138.0	992	40	3.0	TS
29/18	8.4	137.5	990	50	3.5	STS
30/00	9.1	136.8	980	60	4.5	STS
30/06	9.9	135.4	970	70	5.0	TY
30/12	10.5	134.0	960	80	5.5	TY
30/18	11.3	132.5	945	90	6.0	TY
Oct. 01/00	11.8	131.1	930	100	7.0	TY
01/06	12.5	129.7	930	100	7.0	TY
01/12	13.1	128.5	930	100	7.0	TY
01/18	13.7	127.6	940	90	6.0	TY
02/00	14.5	126.3	940	90	6.0	TY
02/06	15.0	125.4	955	80	6.0	TY
02/12	15.8	124.7	955	80	5.0	TY
02/18	16.4	123.7	965	75	5.0	TY
03/00	17.1	122.9	965	75	5.0	TY
03/06	17.8	122.2	965	75	5.0	TY
03/12	18.3	121.5	970	65	4.5	TY
03/18	18.6	120.7	975	60	4.5	STS
04/00	18.8	120.1	980	60	4.0	STS
04/06	19.3	119.9	980	60	4.0	STS
04/12	19.6	119.8	985	55	3.5	STS
04/18	19.9	119.7	990	50	3.0	STS
05/00	20.1	119.6	990	50	3.0	STS
05/06	20.1	119.8	990	50	3.0	STS
05/12	20.0	119.9	985	55	3.5	STS
05/18	19.8	120.0	985	55	3.5	STS
06/00	19.3	120.2	985	55	3.5	STS
06/06	18.9	120.6	985	55	3.5	STS
06/12	18.4	121.0	990	50	3.0	STS
06/18	17.9	121.4	994	40	2.5	TS
07/00	17.6	122.4	996	35	2.5	TS
07/06	17.7	122.7	996	35	2.5	TS
07/12	18.1	122.7	994	40	3.0	TS
07/18	17.8	122.9	994	40	3.0	TS
08/00	17.4	122.5	994	40	3.0	TS
08/06	17.4	122.0	994	40	3.0	TS
08/12	17.5	121.4	994	40	3.0	TS
08/18	17.7	120.8	996	35	2.5	TS
09/00	18.2	119.8	998	35	2.5	TS
09/06	18.1	119.7	998	35	2.0	TS
09/12	17.5	119.2	998	35	2.0	TS
09/18	17.3	118.7	998	35	1.5	TS
10/00	17.1	118.6	1000	-	1.5	TD
10/06	18.0	118.2	1000	-	1.0	TD
10/12	18.3	116.9	1000	-	1.0	TD
10/18	17.9	115.6	1000	-	1.5	TD
11/00	17.3	114.0	998	35	2.0	TS
11/06	17.5	113.0	998	35	2.0	TS
11/12	18.0	112.6	998	35	2.0	TS
11/18	18.6	111.7	998	35	2.0	TS
12/00	19.1	111.0	996	35	2.5	TS
12/06	19.3	110.1	996	35	2.5	TS
12/12	19.8	109.6	996	40	3.0	TS
12/18	19.8	109.0	994	40	3.0	TS
13/00	19.9	108.6	992	45	3.0	TS
13/06	20.2	108.1	990	50	3.5	STS
13/12	20.4	107.7	994	40	3.5	TS
13/18	20.4	107.4	1000	35	3.5	TS
14/00	20.3	107.1	1008	-	3.5	TD
14/06	20.0	107.0	1010	-	3.5	TD
14/12	19.5	106.9	1012	-	3.0	TD
14/18						Dissip.

Nepartak (0919)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Oct. 08/00	15.2	143.8	1004	-	0.0	TD
08/06	16.0	143.6	1004	-	0.0	TD
08/12	16.8	143.4	1004	-	0.5	TD
08/18	17.8	143.2	1002	-	1.0	TD
09/00	18.5	143.1	1002	-	1.0	TD
09/06	19.4	142.7	1000	35	1.5	TS
09/12	19.8	142.5	998	35	1.5	TS
09/18	20.3	142.3	998	35	2.0	TS
10/00	20.7	142.2	998	35	2.0	TS
10/06	21.3	141.9	998	35	2.0	TS
10/12	21.8	141.8	998	35	2.0	TS
10/18	22.1	142.0	998	35	2.0	TS
11/00	22.3	142.3	996	40	2.5	TS
11/06	22.7	142.7	996	40	2.5	TS
11/12	22.9	143.3	996	40	2.5	TS
11/18	23.2	143.8	994	45	3.0	TS
12/00	23.5	144.3	992	45	3.0	TS
12/06	24.3	145.1	992	45	3.0	TS
12/12	25.5	146.2	992	45	3.0	TS
12/18	26.9	147.8	992	45	3.0	TS
13/00	28.6	150.1	992	45	3.0	TS
13/06	30.5	152.8	992	45	3.0	TS
13/12	31.4	155.1	994	45	3.0	TS
13/18	32.6	157.6	996	40	2.5	TS
14/00	34.0	160.0	998	-	2.5	L
14/06	35.4	163.1	1000	-	-	L
14/12	36.4	166.1	1000	-	-	L
14/18	37.5	169.2	1000	-	-	L
15/00	38.5	172.2	1000	-	-	L
15/06	39.2	175.2	998	-	-	L
15/12	40.0	178.1	998	-	-	L
15/18	41.1	180.7	998	-	-	Out

Mirinae (0921)

Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Oct. 25/18	11.8	152.5	1002	-	0.5	TD
26/00	12.3	151.5	1004	-	0.5	TD
26/06	12.9	149.9	1002	-	1.0	TD
26/12	13.5	148.6	1004	-	1.0	TD
26/18	13.8	146.8	1002	-	1.5	TD
27/00	14.3	145.3	1002	-	2.0	TD
27/06	14.9	143.7	998	35	2.5	TS
27/12	15.7	142.0	992	45	3.0	TS
27/18	15.9	140.3	980	55	3.5	STS
28/00	16.1	138.5	965	70	4.5	TY
28/06	16.2	137.0	960	75	5.0	TY
28/12	16.2	135.5	955	80	5.0	TY
28/18	16.2	133.8	955	80	5.0	TY
29/00	15.9	132.2	955	80	5.0	TY
29/06	16.0	130.6	960	75	5.0	TY
29/12	16.0	128.9	965	75	5.0	TY
29/18	15.7	127.3	965	75	5.0	TY
30/00	15.3	125.7	970	70	4.5	TY
30/06	14.9	124.6	975	65	4.0	TY
30/12	14.7	123.2	980	60	4.0	STS
30/18	14.2	121.7	985	55	3.5	STS
31/00	14.1	120.2	990	50	3.0	STS
31/06	14.0	118.9	990	50	3.0	STS
31/12	14.0	117.8	994	45	2.5	TS
31/18	14.0	116.6	994	45	2.5	TS
Nov. 01/00	13.9	115.3	994	45	2.5	TS
01/06	13.8	114.5	994	45	2.5	TS
01/12	13.8	113.5	994	45	2.5	TS
01/18	13.6	112.1	994	45	2.5	TS
02/00	13.2	110.9	994	45	2.5	TS
02/06	12.9	109.7	994	45	2.5	TS
02/12	12.7	108.5	998	35	2.0	TS
02/18	13.0	106.7	1004	-	1.5	TD
03/00						Dissip.

Lupit (0920)

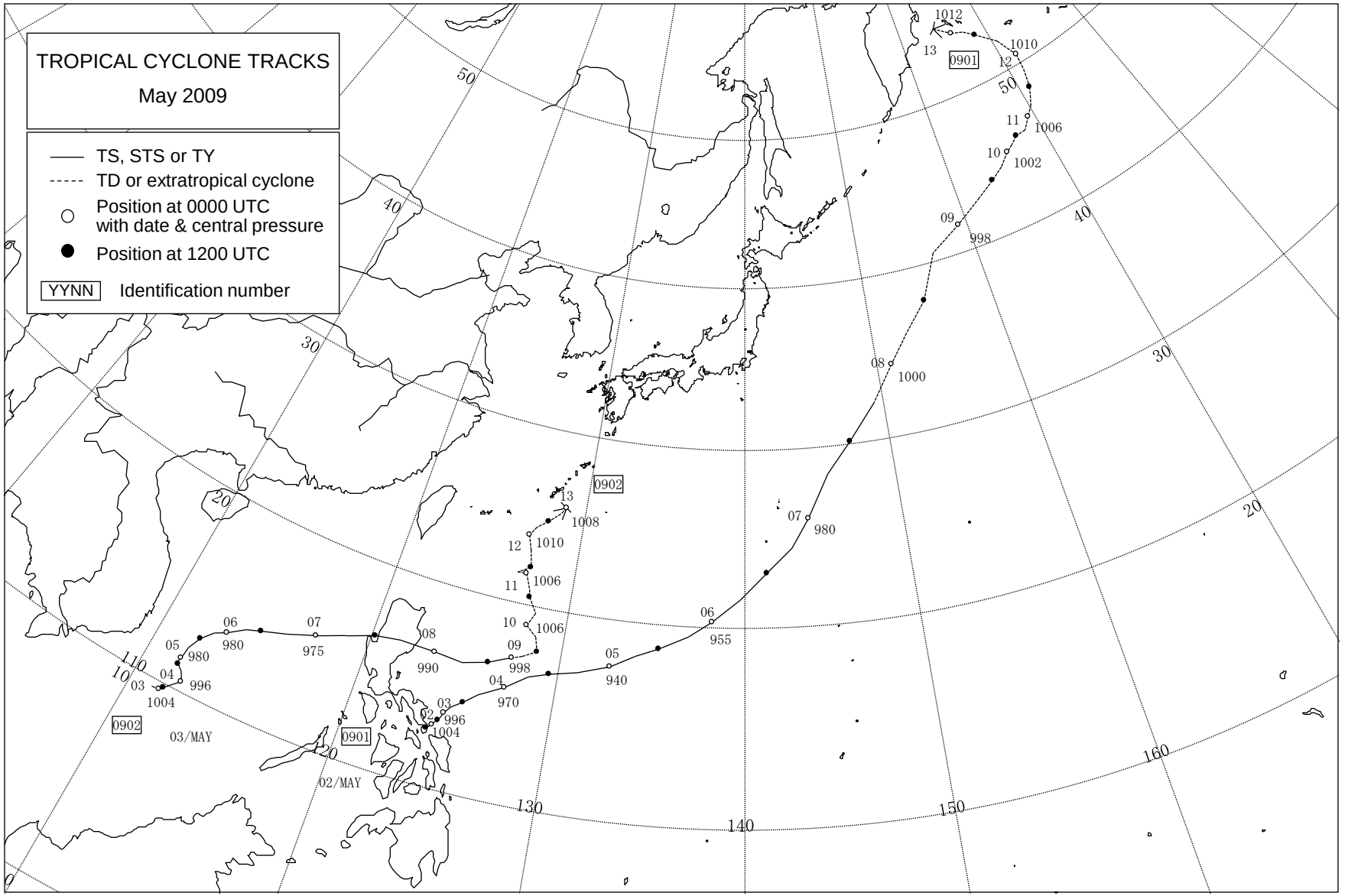
Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Oct. 14/12	10.9	148.8	1006	-	0.5	TD
14/18	11.2	146.8	1004	-	1.0	TD
15/00	11.4	144.3	1004	-	1.5	TD
15/06	11.8	142.1	1004	-	2.0	TD
15/12	12.1	140.2	1002	35	2.5	TS
15/18	12.4	139.1	1000	40	3.0	TS
16/00	13.2	137.4	992	45	3.0	TS
16/06	13.9	136.0	980	55	3.5	STS
16/12	14.1	134.3	975	60	4.0	STS
16/18	14.5	133.2	970	65	4.0	TY
17/00	15.1	132.7	965	70	4.5	TY
17/06	15.7	132.3	955	80	5.0	TY
17/12	16.1	132.3	950	85	5.5	TY
17/18	16.7	132.5	950	85	5.5	TY
18/00	17.1	132.9	940	90	6.0	TY
18/06	17.3	133.6	940	90	6.0	TY
18/12	17.6	134.0	940	90	6.0	TY
18/18	18.0	134.2	930	95	6.5	TY
19/00	18.5	134.1	930	95	6.5	TY
19/06	19.0	133.2	930	95	6.5	TY
19/12	19.3	132.4	940	90	5.5	TY
19/18	19.8	131.5	945	85	5.5	TY
20/00	20.1	130.6	950	80	4.5	TY
20/06	20.5	129.7	950	80	4.5	TY
20/12	20.6	128.9	960	75	4.5	TY
20/18	20.5	127.9	960	75	4.5	TY
21/00	20.2	127.1	965	70	4.5	TY
21/06	19.8	126.3	965	70	4.5	TY
21/12	19.3	125.7	965	70	4.5	TY
21/18	19.1	125.4	965	70	4.5	TY
22/00	18.9	124.8	965	70	4.5	TY
22/06	18.9	124.4	965	70	4.5	TY
22/12	18.9	124.0	970	65	4.0	TY
22/18	19.0	123.8	970	65	4.0	TY
23/00	19.1	123.6	970	65	4.0	TY
23/06	19.4	123.7	975	60	3.5	STS
23/12	19.8	124.1	980	55	3.5	STS
23/18	20.4	124.6	980	55	3.5	STS
24/00	21.4	124.9	980	55	3.0	STS
24/06	22.3	125.4	980	55	3.0	STS
24/12	23.1	125.8	980	55	3.5	STS
24/18	23.4	126.6	980	55	3.5	STS
25/00	24.3	127.3	980	55	3.5	STS
25/03	24.6	127.9	980	55	-	STS
25/06	24.9	128.6	980	55	3.0	STS
25/09	25.2	129.4	980	55	-	STS
25/12	25.7	130.1	980	55	3.0	STS
25/15	26.2	130.8	980	55	-	STS
25/18	26.5	131.7	980	55	2.5	STS
25/21	27.0	132.7	980	55	-	STS
26/00	27.5	133.4	980	55	2.0	STS
26/06	29.1	135.8	980	55	2.0	STS
26/09	30.2	137.4	980	55	-	STS
26/12	31.3	139.1	980	55	2.0	STS
26/15	32.4	140.7	980	55	-	STS
26/18	34.0	142.8	980	55	2.0	STS
26/21	35.9	144.6	980	55	-	STS
27/00	38.3	146.1	972	-	2.0	L
27/06	41.8	149.0	964	-	2.0	L
27/12	44.3	151.6	956	-	-	L
27/18	46.2	155.5	956	-	-	L
28/00	47.9	159.3	956	-	-	L
28/06	49.5	162.7	956	-	-	L
28/12	50.5	164.8	956	-	-	L
28/18	51.1	166.7	960	-	-	L
29/00	51.3	168.5	968	-	-	L
29/06	51.6	170.5	974	-	-	L
29/12	52.3	172.1	980	-	-	L
29/18	53.3	172.8	984	-	-	L
30/00	54.1	173.5	990	-	-	L
30/06	55.2	173.8	992	-	-	L
30/12	56.1	173.8	994	-	-	L
30/18	56.9	173.6	996	-	-	L
31/00						Dissip.

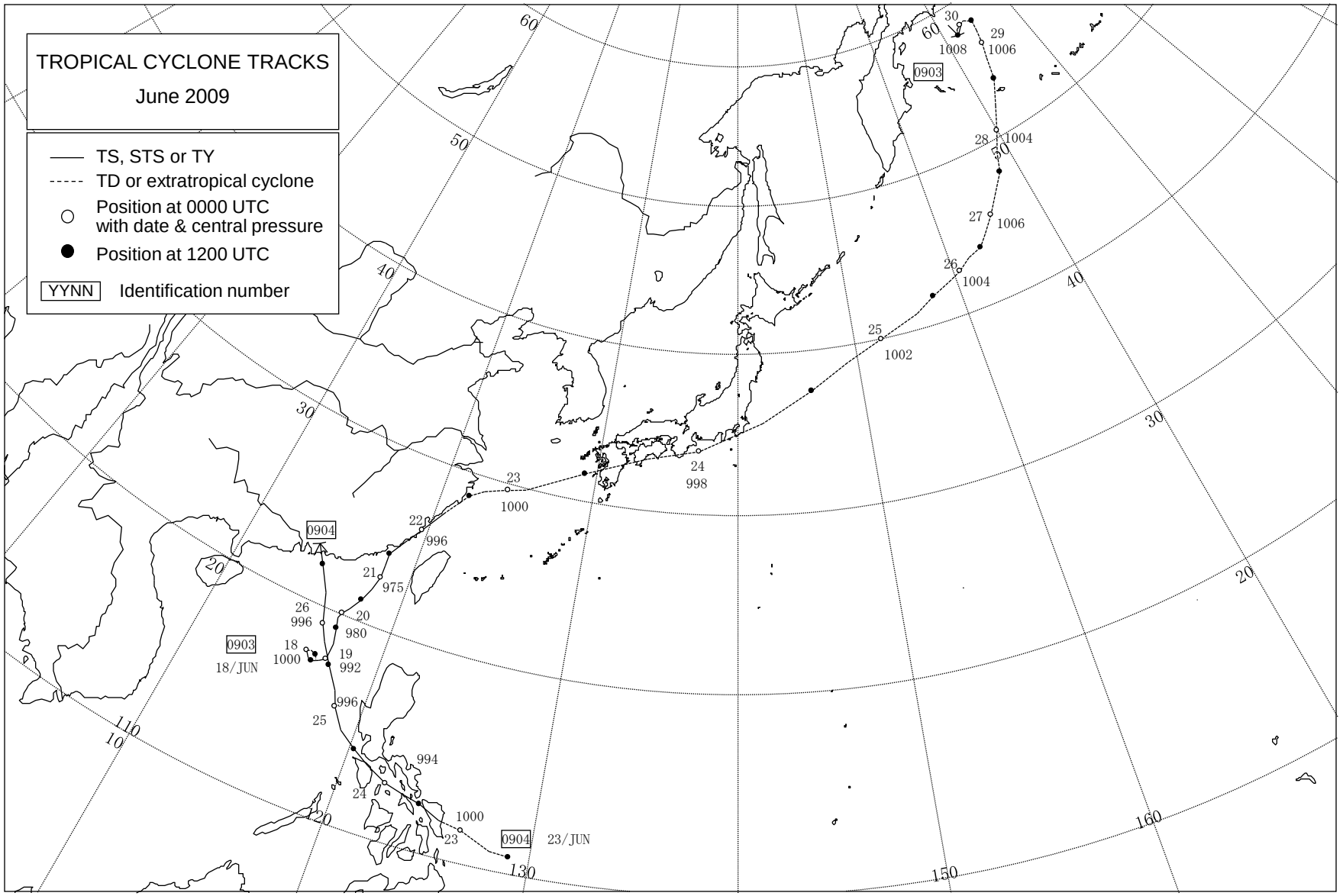
Nida (0922)

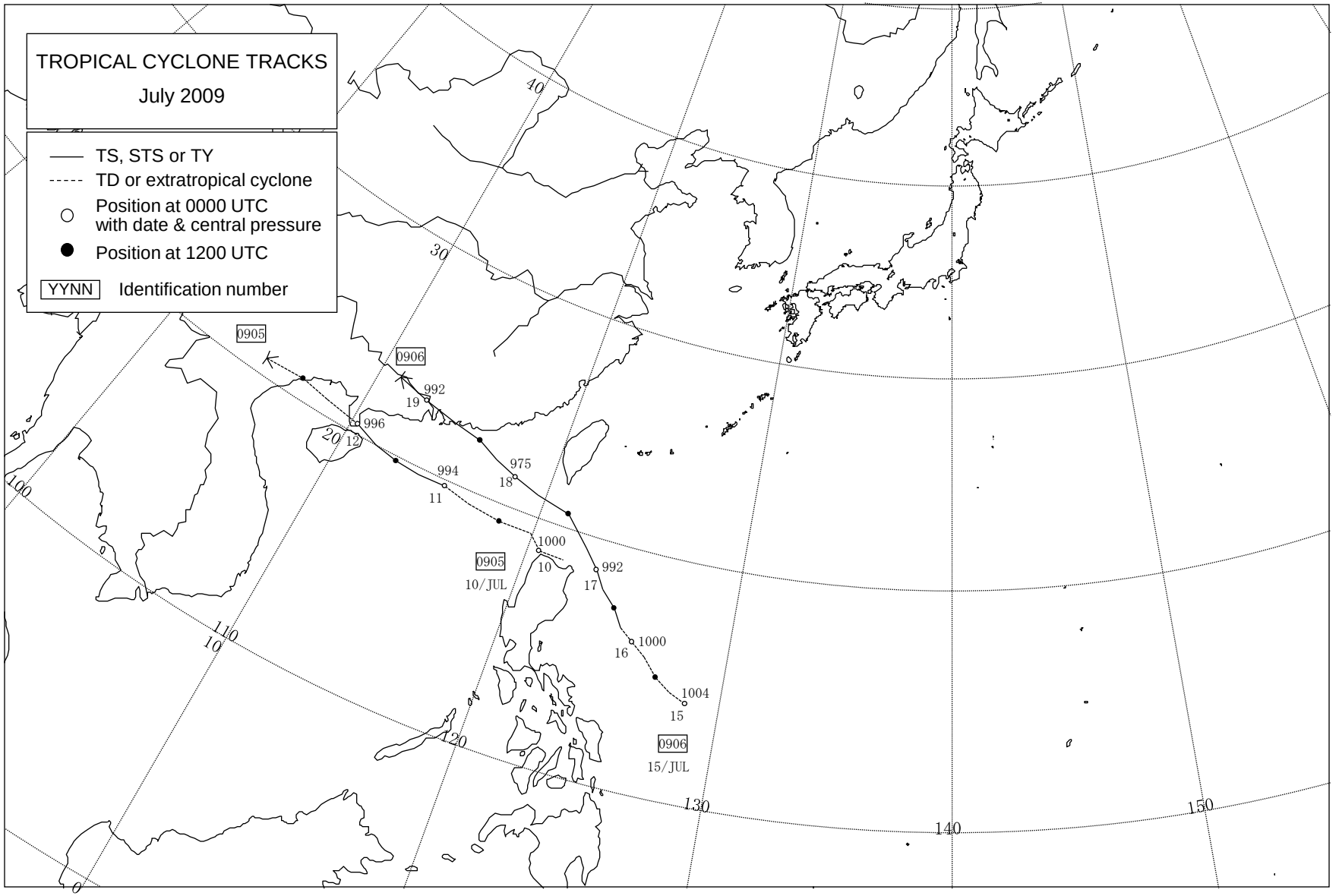
Date/Time (UTC)	Center position Lat (N)	Lon (E)	Central pressure (hPa)	Max wind (kt)	CI num.	Grade
Nov. 21/18	6.7	148.3	1002	-	1.0	TD
22/00	6.9	148.2	1004	-	1.0	TD
22/06	7.2	148.1	1000	-	1.0	TD
22/12	7.4	148.0	1002	-	1.0	TD
22/18	7.6	148.0	1002	-	1.0	TD
23/00	7.8	148.0	1002	-	1.5	TD
23/06	8.2	147.6	1002	-	1.5	TD
23/12	8.5	147.1	1000	35	2.0	TS
23/18	8.7	146.3	996	45	2.5	TS
24/00	8.8	145.8	992	50	3.0	STS
24/06	8.9	145.5	980	65	4.0	TY
24/12	9.3	145.0	975	70	4.0	TY
24/18	9.9	144.3	960	80	5.0	TY
25/00	10.7	143.8	950	85	5.5	TY
25/06	11.6	143.0	940	95	6.0	TY
25/12	12.6	142.2	925	105	6.5	TY
25/18	13.6	141.4	905	115	7.5	TY
26/00	14.5	140.7	905	115	7.5	TY
26/06	15.2	140.0	905	110	7.5	TY
26/12	15.8	139.7	915	105	7.0	TY
26/18	16.3	139.3	915	105	7.0	TY
27/00	16.9	139.2	925	100	6.5	TY
27/06	17.8	139.2	925	100	6.5	TY
27/12	18.3	139.0	925	100	6.5	TY
27/18	18.7	139.0	925	100	6.5	TY
28/00	19.0	139.0	925	100	6.5	TY
28/06	19.1	139.2	925	100	6.5	TY
28/12	19.1	139.3	930	95	6.5	TY
28/18	19.1	139.5	930	95	6.5	TY
29/00	19.3	139.4	945	85	5.5	TY
29/06	19.5	139.4	945	85	5.5	TY
29/12	19.5	139.2	945	85	5.5	TY
29/18	19.6	139.5	945	85	5.5	TY
30/00	19.6	139.3	945	85	5.5	TY
30/06	19.8	139.1	945	85	5.5	TY
30/12	20.0	138.8	955	80	5.0	TY
30/18	20.1	138.5	955	80	5.0	TY
Dec. 01/00	20.3	138.2	955	80	5.0	TY
01/06	20.6	137.7	965	70	4.5	TY
01/12	20.6	137.3	970	65	4.0	TY
01/18	20.7	136.9	980	60	3.5	STS
02/00	20.8	136.1	980	60	3.5	STS
02/06	20.9	135.6	985	50	3.0	STS
02/12	21.1	135.1	990	45	3.0	TS
02/18	21.5	134.6	994	40	2.5	TS
03/00	21.7	134.2	1000	-	2.0	TD
03/06	22.4	134.5	1002	-	-	TD
03/12	22.6	135.6	1002	-	-	TD
03/18						Dissip.

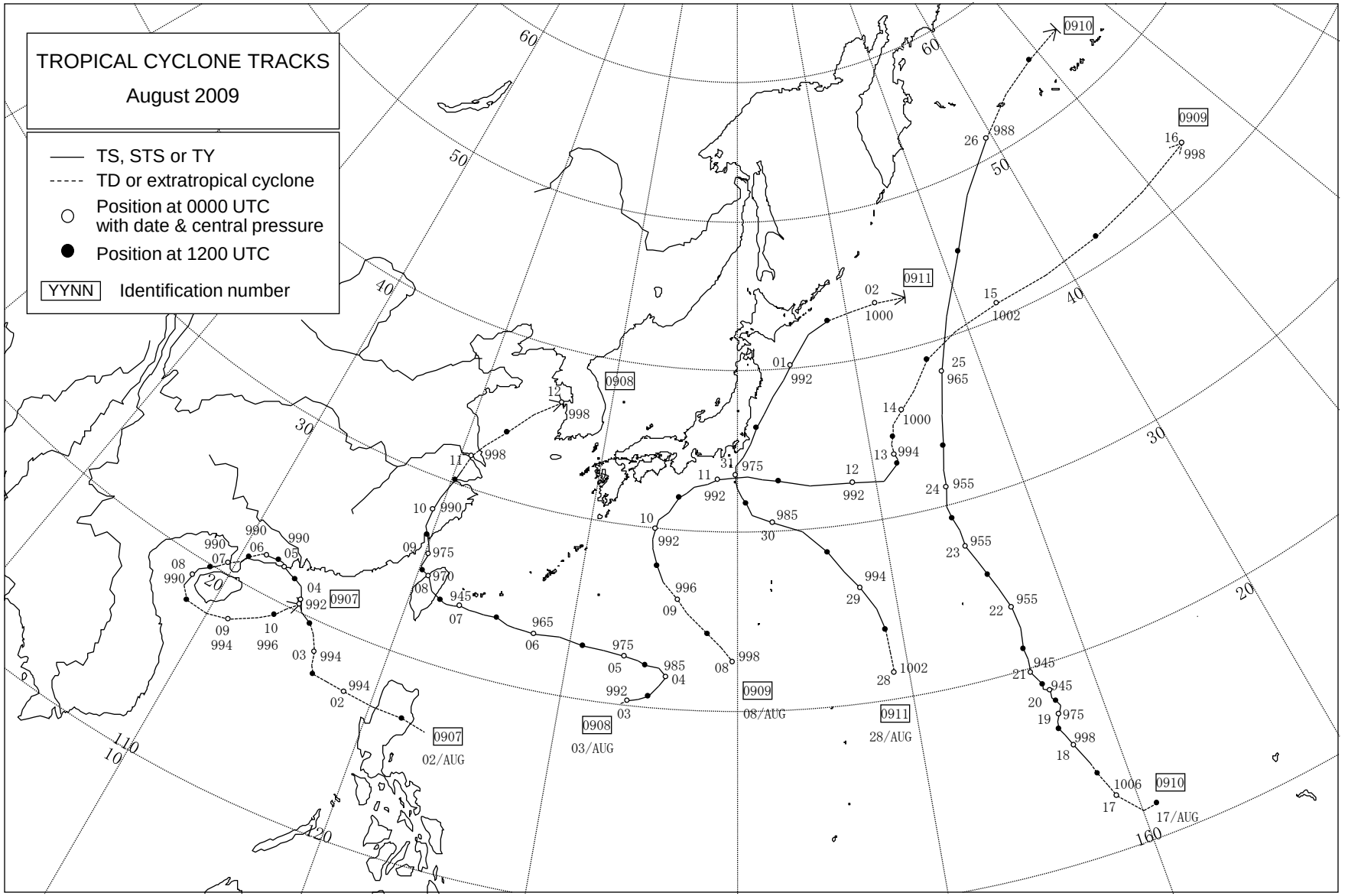
Appendix 2

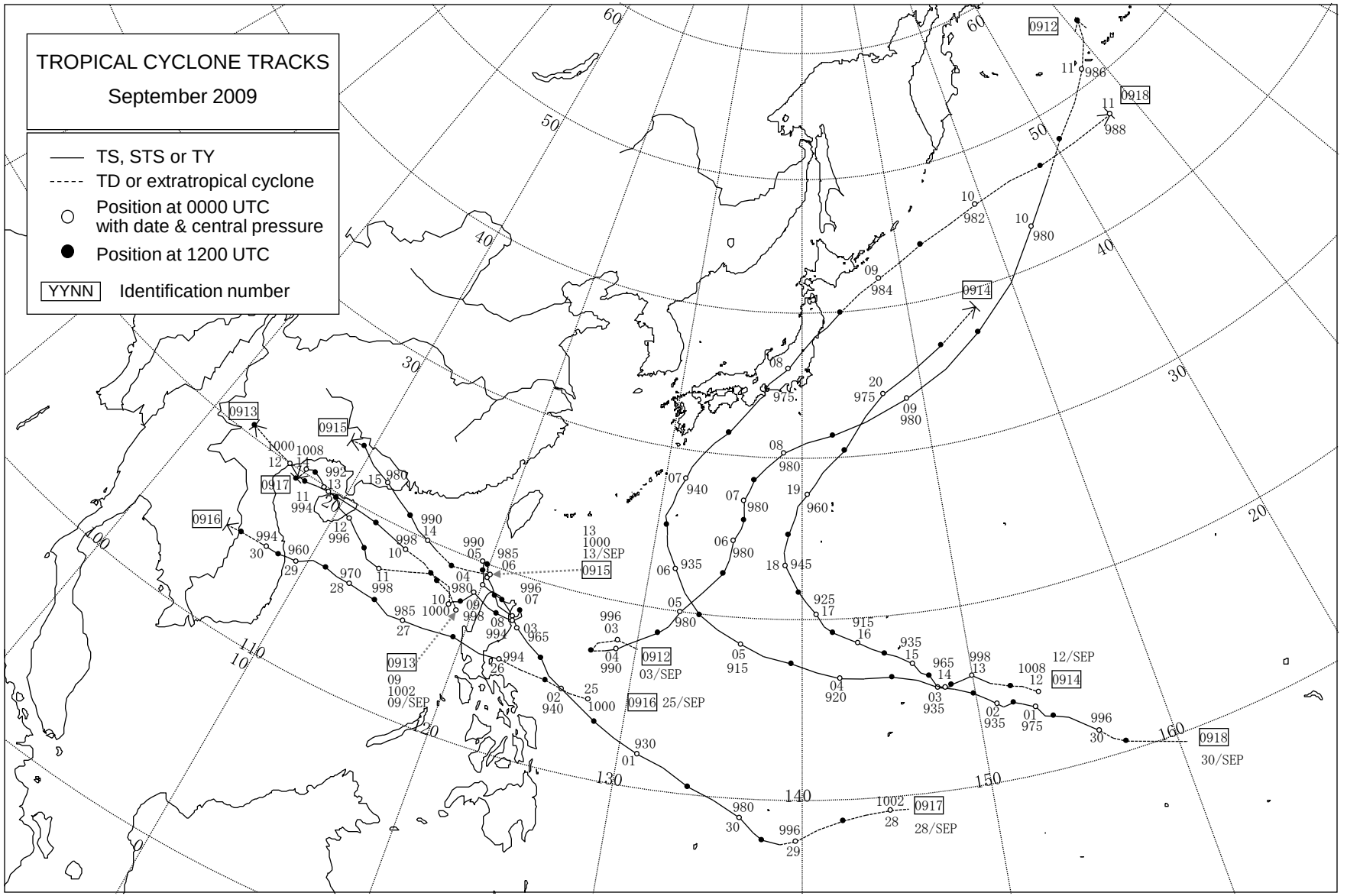
Monthly Tracks of Tropical Cyclones in 2009

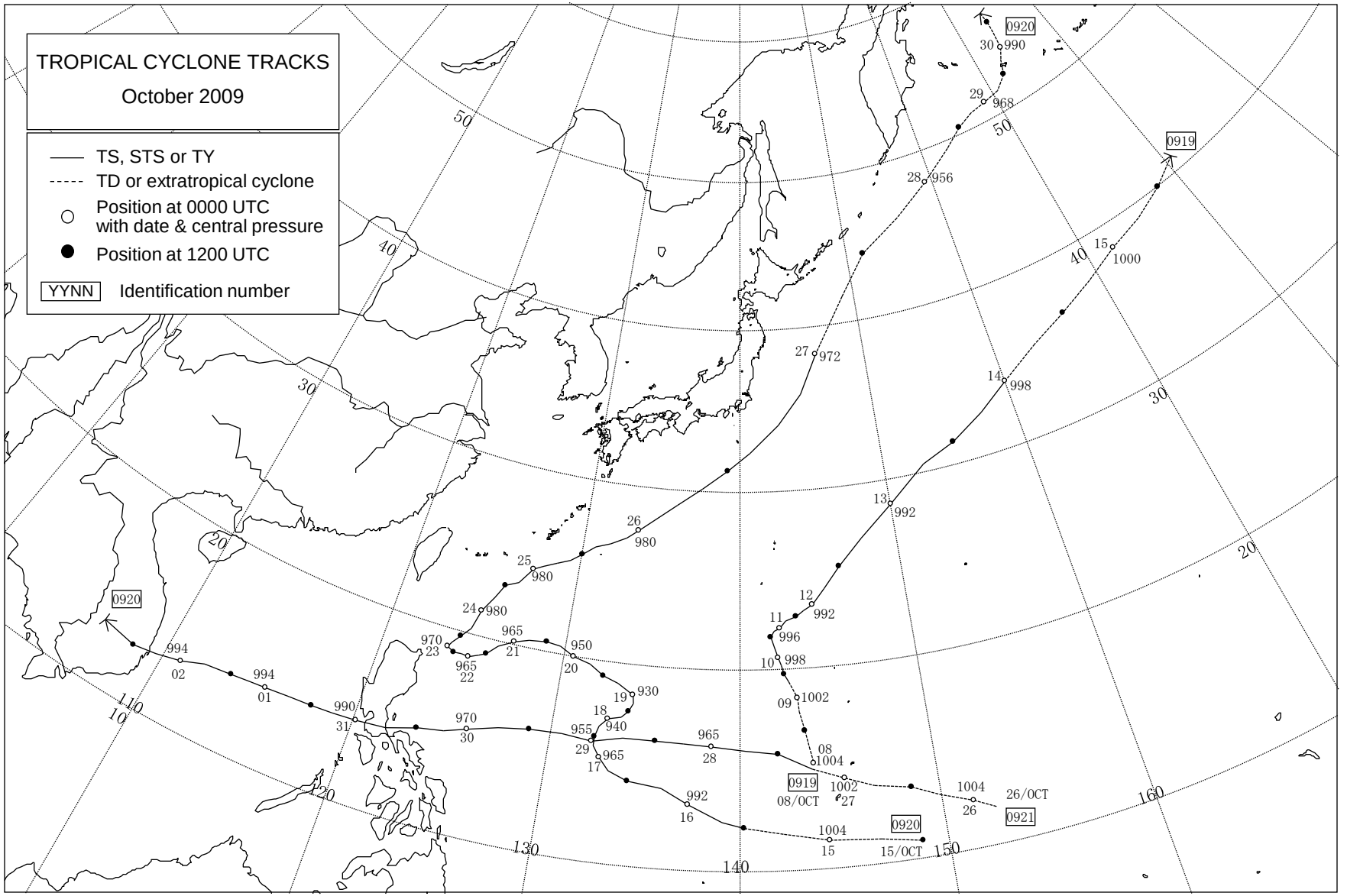

TROPICAL CYCLONE TRACKS
May 2009
TS, STS or TY
TD or extratropical cyclone
Position at 0000 UTC
with date & central pressure
Position at 1200 UTC
YYNN Identification number
0901
0902
03/MAY
02/MAY
1012
1010
1006
1002
998
1000
980
955
940
970
1004
996
990
975
1008
0
10
20
30
40
50
110
120
130
140
150
160

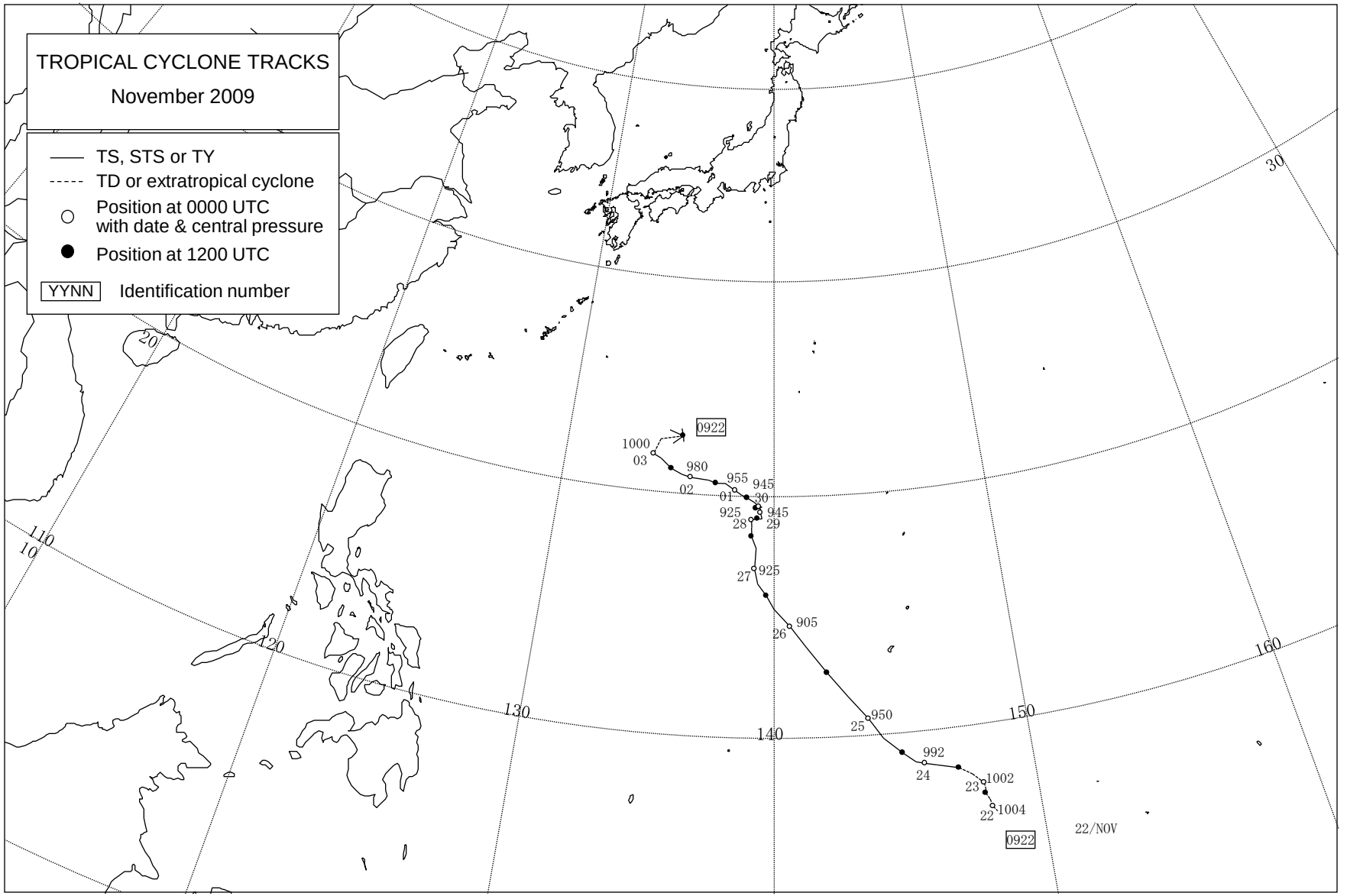

TROPICAL CYCLONE TRACKS
June 2009
TS, STS or TY
TD or extratropical cyclone
Position at 0000 UTC
with date & central pressure
Position at 1200 UTC
YYNN Identification number
0903
0904
18/JUN
23/JUN
60
50
40
30
20
10
110
120
130
150
160


TROPICAL CYCLONE TRACKS
July 2009
TS, STS or TY
TD or extratropical cyclone
Position at 0000 UTC
with date & central pressure
Position at 1200 UTC
YYNN Identification number
0905
0906
992
19
996
12
994
11
975
18
1000
10
0905
10/JUL
992
17
1000
16
1004
15
0906
15/JUL
40
30
20
100
110
10
120
130
140
150
0


TROPICAL CYCLONE TRACKS
August 2009
TS, STS or TY
TD or extratropical cyclone
Position at 0000 UTC
with date & central pressure
Position at 1200 UTC
YYNN Identification number
0907
0908
0909
0910
0911
02/AUG
03/AUG
08/AUG
17/AUG
28/AUG


TROPICAL CYCLONE TRACKS
September 2009
TS, STS or TY
TD or extratropical cyclone
Position at 0000 UTC
with date & central pressure
Position at 1200 UTC
YYNN Identification number
0912
0913
0914
0915
0916
0917
0918
03/SEP
09/SEP
12/SEP
25/SEP
28/SEP
30/SEP


TROPICAL CYCLONE TRACKS
October 2009
TS, STS or TY
TD or extratropical cyclone
Position at 0000 UTC
with date & central pressure
Position at 1200 UTC
YYNN Identification number
0920
30 990
29 968
0919
28 956
15 1000
27 972
14 998
13 992
26 980
25 980
12 992
24 980
11 996
970
23
965
21
950
20
965
22
10 998
994
02
994
01
09 1002
19 930
990
31
18
970
30
955
940
29
965
28
08 1004
965
17
0919
08/0CT
1002
27
1004
26
26/0CT
0921
992
16
1004
15
0920
15/0CT
10
110
120
130
140
150
160
50
40
30
20


TROPICAL CYCLONE TRACKS
November 2009
TS, STS or TY
TD or extratropical cyclone
Position at 0000 UTC
with date & central pressure
Position at 1200 UTC
YYNN Identification number
0922
1000
03
980
02
955
945
01
30
925
945
28
29
27
925
905
26
950
25
992
24
1002
23
1004
22
0922
22/NOV
10
110
120
130
140
150
160
20
30

Appendix 3

Errors of Track and Intensity Forecasts for Each Tropical Cyclone in 2009

Date/Time		Center Position (km)						Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	=24	=48	=72	=90	=120	T=24	=48	=72	T=24	=48	=72
TY Kujira (0901)													
May	02/18	49	113					25			-25		
	03/00	39	102	186	244	470		20	40	20	-20	-30	-15
	03/06	22	156	335	614	908		15	30	5	-15	-20	0
	03/12	22	145	301	538	833		20	10	-15	-15	-5	10
	03/18	21	123	300	393			30	10	-20	-20	-5	15
	04/00	0	149	355	367			25	-5	-30	-15	5	25
	04/06	0	222	469	634			20	-5	-35	-10	5	35
	04/12	0	139	235	227			0	-15	-20	0	10	30
	04/18	0	133	215				-5	-5		0	5	
	05/00	0	53	189				0	-5		0	5	
	05/06	0	46	63				10	5		-5	0	
	05/12	22	65	167				5	0		-5	10	
	05/18	0	191					0			0		
	06/00	0	113					0			0		
	06/06	0	44					0			5		
	06/12	44	106					0			10		
	06/18	0											
	07/00	30											
	07/06	74											
	07/12	44											
	mean	18	119	256	431	737		10	5	-14	-7	-2	14
	sample	20	16	11	7	3		16	11	7	16	11	7

Date/Time		Center Position (km)						Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	=24	=48	=72	=90	=120	T=24	=48	=72	T=24	=48	=72
TY Chan-hom (0902)													
May	03/12	0	122	259	289	510	943	0	5	5	0	-5	-5
	03/18	25	133	224	162	415	820	5	5	5	-5	-5	-10
	04/00	22	195	228	135	441		10	5	5	-10	-5	-10
	04/06	44	200	174	151	559		5	-5	-5	-5	5	0
	04/12	55	148	87	273	719		0	0	-15	0	0	10
	04/18	55	49	99	371	863		0	0	-15	0	-5	10
	05/00	33	55	55	427			-5	0	-10	5	-5	5
	05/06	0	34	238	631			-5	0	-5	5	-5	5
	05/12	43	107	405	780			0	-10	-7	0	5	10
	05/18	32	213	547	865			-5	-15	-19	0	10	25
	06/00	16	204	619				-5	-15		0	10	
	06/06	11	217	630				-5	-15		0	15	
	06/12	11	237	757				-15	-12		10	15	
	06/18	21	290	769				-20	-9		15	15	
	07/00	0	288					-5			0		
	07/06	0	303					0			0		
	07/12	0	395					-2			5		
	07/18	78	211					-4			10		
	08/00	105											
	08/06	147											
	08/12	135											
	08/18	132											
	mean	44	189	364	408	585	882	-3	-5	-6	2	3	4
	sampl	22	18	14	10	6	2	18	14	10	18	14	10

Date/Time		Center Position (km)						Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	=24	=48	=72	=90	=120	T=24	=48	=72	T=24	=48	=72
STS Linfa (0903)													
June	18/00	21											
	18/06	33	116	223	379			0	15	14	0	-15	-15
	18/12	49	105	156	334			5	10	5	-5	-10	0
	18/18	65	85	124	334			5	10	-7	-5	-10	10
	19/00	32	129	192	379			10	15	-6	-10	-15	10
	19/06	22	33	147				10	5		-10	-5	
	19/12	0	62	128				5	5		-5	0	
	19/18	0	124	254				5	4		-5	-5	
	20/00	21	173	277				0	0		0	0	
	20/06	21	123					-5			5		
	20/12	24	67					0			5		
	20/18	11	67					-2			5		
	21/00	15	10					-2			5		
	21/06	10											
	21/12	10											
	21/18	60											
	22/00	46											
	mean	26	91	188	356			3	8	2	-2	-8	1
	sample	17	12	8	4			12	8	4	12	8	4

Date/Time		Center Position (km)						Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	=24	=48	=72	=90	=120	T=24	=48	=72	T=24	=48	=72
TS Nangka (0904)													
June	23/06	47	113	207	432			4	2	2	-5	-5	0
	23/12	31	104	255	479			0	-6	-6	0	10	10
	23/18	11	112	289				-2	-6		0	10	
	24/00	25	126	276				-4	-6		0	10	
	24/06	11	130	219				-4	-11		5	15	
	24/12	22	167	284				-6	-11		10	15	
	24/18	22	170					-6			10		
	25/00	70	79					-6			10		
	25/06	55	112					-2			5		
	25/12	24	208					2			0		
	25/18	0											
	26/00	15											
	26/06	0											
	26/12	0											
	mean	24	132	255	456			-2	-6	-2	4	9	5
	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	=24	=48	=72	=90	=120	T=24	=48	=72	T=24	=48	=72
TS Soudelor (0905)													
July	11/00	0											
	11/06	44											
	11/12	64											
	11/18	47											
	mean	39											
	sampl	4											

Date/Time		Center Position (km)						Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	=24	=48	=72	=90	=120	T=24	=48	=72	T=24	=48	=72
TY Molave (0906)													
July	16/06	0	42					9			-15		
	16/12	21	47	128				10	10		-15	-15	
	16/18	11	93	200				15	5		-20	-10	
	17/00	0	179	295				10	-2		-15	5	
	17/06	0	128					5			-10		
	17/12	0	122					5			-10		
	17/18	0	185					16			-60		
	18/00	0	15					4			-40		
	18/06	0											
	18/12	0											
	18/18	31											
	19/00	0											
mean		5	102	208				9	4		-23	-7	
sampl		12	8	3				8	3		8	3	

Date/Time		Center Position (km)						Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	=24	=48	=72	=90	=120	T=24	=48	=72	T=24	=48	=72
TS Goni (0907)													
Aug.	03/12	46	165	247				0	2		0	-5	
	03/18	33	167	207	608			0	2	4	0	0	-35
	04/00	62	78	67				0	2		-5	0	
	04/06	54	46					2			-5		
	04/12	15	25					4			-5		
	04/18	38	85					6			-35		
	05/00	33	72					6			-35		
	05/06	23											
	05/12	0											
	05/18	10	456					6			-35		
	06/00	15											
	06/06												
	06/12												
	08/00	11											
mean		28	137	174	608			3	2	4	-15	-2	-35
sampl		12	8	3	1			8	3	1	8	3	1

Date/Time		Center Position (km)						Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	=24	=48	=72	=90	=120	T=24	=48	=72	T=24	=48	=72
TY Morakot (0908)													
Aug.	03/00	293											
	03/06	173	279					7			-10		
	03/12	211	230	82				12	15		-15	-15	
	03/18	0	23	255	493	667	887	15	20	35	-15	-15	-20
	04/00	0	75	302	424	395	356	10	15	25	-15	-10	-10
	04/06	0	112	336	419	384	391	10	15	15	-10	-10	-10
	04/12	22	137	351	362	320	282	5	20	15	-5	-10	-5
	04/18	51	121	333	361	335	219	10	25	5	-10	-15	0
	05/00	0	158	264	224	167	88	0	5	-20	0	0	15
	05/06	22	78	239	302	202	220	-20	-25	10	20	20	-10
	05/12	31	60	171	167	56	270	-10	-25	-5	15	20	10
	05/18	0	90	171	167	60		-20	-10	-5	15	15	5
	06/00	68	99	142	107	82		-20	-20	-5	15	20	5
	06/06	30	191	156	220	169		-20	-20	-5	20	20	5
	06/12	0	102	164	128	178		-15	-10	0	15	10	5
	06/18	0	102	211	204			-5	5	5	10	-5	0
	07/00	22	60	114	214			0	5	0	5	-5	5
	07/06	31	56	130	293			5	10	-2	0	-10	10
	07/12	39	102	149	396			10	10	0	-5	-5	5
	07/18	69	169	158				5	7		-5	-5	
	08/00	97	78	96				5	4		-10	-5	
	08/06	38	70	97				10	2		-15	-35	
	08/12	0	10	120				5	0		-5	-35	
	08/18	0	68					0			0		
	09/00	54	206					-10			15		
	09/06	60	195					-12			20		
	09/12	30	15					-2			5		
	09/18	0											
	10/00	0											
	10/06	30											
	10/12	66											
mean		46	111	192	280	251	339	-1	2	4	1	-4	1
sampl		31	26	21	16	12	8	26	21	16	26	21	16

Date/Time		Center Position (km)						Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	=24	=48	=72	=90	=120	T=24	=48	=72	T=24	=48	=72
TS Etau (0909)													
Aug.	09/06	37	94					0			-5		
	09/12	59	107	213	460			0	0	-2	0	0	10
	09/18	59	102	372	521			-2	-2	-2	5	5	10
	10/00	29	67	490				-2	-2		5	5	
	10/06	0	89	457				-7	-7		10	10	
	10/12	0	188	448				-7	-7		10	15	
	10/18	0	225	290				-7	-7		10	15	
	11/00	33	261					-7			10		
	11/06	0	239					-7			10		
	11/12	52	128					0			10		
	11/18	0	48					0			10		
	12/00	58											
	12/06	65											
	12/12	0											
	12/18	22											
mean		28	141	379	491			-4	-4	-2	7	8	10
sampl		15	11	6	2			11	6	2	11	6	2

Date/Time		Center Position (km)						Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	=24	=48	=72	=90	=120	T=24	=48	=72	T=24	=48	=72
TY Vamco (0910)													
Aug.	17/18	0	125	314	456	452	390	12	30	30	-10	-30	-30
	18/00	0	199	347	441	412	326	15	35	30	-20	-35	-30
	18/06	0	196	240	270	303	279	20	35	25	-25	-35	-25
	18/12	11	172	213	174	164	203	5	15	5	-15	-25	-20
	18/18	31	152	190	166	178	112	15	5	5	-20	-20	-20
	19/00	0	85	124	269	339	245	15	5	-5	-15	-10	0
	19/06	0	54	59	281	250	143	15	5	-5	-15	-10	0
	19/12	0	74	80	42	156	220	10	5	-5	0	5	15
	19/18	11	39	53	132	68	167	5	5	-5	5	5	15
	20/00	0	42	137	175	145	348	-15	-25	-20	10	20	15
	20/06	11	76	180	158	69	468	-15	-25	-20	10	20	15
	20/12	0	53	210	205	145	792	-15	-25	-20	10	20	15
	20/18	0	79	201	159	144	567	-10	-20	-15	5	15	10
	21/00	10	114	146	197	321		-20	-20	-15	15	15	10
	21/06	0	190	229	316	720		-20	-20	-20	15	15	15
	21/12	0	190	235	301	969		-20	-20	-20	15	15	15
	21/18	11	91	133	132	738		-10	-10	-5	10	10	10
	22/00	0	102	232	435			10	15	10	-5	-10	-5
	22/06	15	33	93	161			10	10	5	-5	-5	0
	22/12	0	135	307	202			15	20	10	-15	-20	-15
	22/18	0	145	350	281			15	20	5	-15	-20	-15
	23/00	0	61	164				0	5		0	0	
	23/06	0	38	209				5	5		0	0	
	23/12	0	91	226				5	-5		0	5	
	23/18	0	92	147				5	-5		0	5	
	24/00	15	147					0			5		
	24/06	0	248					0			0		
	24/12	0	173					5			-10		
	24/18	0	328					5			-10		
	25/00	0											
	25/06	0											
	25/12	8											
	25/18	0											
mean		4	121	193	236	328	328	2	2	-1	-3	-3	-1
sampl		33	29	25	21	17	13	29	25	21	29	25	21

Date/Time		Center Position (km)						Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	=24	=48	=72	=90	=120	T=24	=48	=72	T=24	=48	=72
STS Krovanh (0911)													
Aug.	28/12	91	367	472	643			4	10	0	-5	-10	0
	28/18	78	373	460	820			5	10	-5	-5	-10	5
	29/00	46	211	36	227			0	5	-12	0	-5	10
	29/06	10	80	189	142			0	0	-4	0	0	0
	29/12	0	73	42				0	0		0	0	
	29/18	0	37	62				5	0		-5	0	
	30/00	10	67	96				5	-2		-5	0	
	30/06	0	67	82				0	-4		0	5	
	30/12	0	77					-5			5		
	30/18	0	106					-5			5		
	31/00	0	163					-12			10		
	31/06	9	208					-14			10		
	31/12	0											
	31/18	0											
Sept.	01/00	0											
	01/06	11											
mean		16	152	180	458			-1	2	-5	1	-2	4
sampl		16	12	8	4			12	8	4	12	8	4

Date/Time		Center Position (km)						Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	=24	=48	=72	=90	=120	T=24	=48	=72	T=24	=48	=72
STS Dujuan (0912)													
Sept.	03/18	0	46	235	169	191	58	5	5	0	-5	-5	0
	04/00	24	62	255	174	129	148	5	-5	-5	-5	5	5
	04/06	145	238	262	89	286	892	0	-10	-10	0	10	10
	04/12	101	325	351	289	443	849	0	-10	-10	0	10	10
	04/18	54	309	316	290	510	912	-5	-10	-10	5	10	10
	05/00	0	255	218	315	572		-5	-10	-10	5	10	10
	05/06	15	118	113	277	790		-5	-10	-15	5	10	15
	05/12	15	83	125	48	288		-5	-10	-15	5	10	15
	05/18	49	171	295	400	303		-5	-10	-15	5	10	15
	06/00	0	162	147	227			-5	-10	-15	5	10	15
	06/06	0	140	109	291			-5	-10	-15	5	10	15
	06/12	15	89	117	300			-5	-10	-15	5	10	15
	06/18	0	31	117	314			-5	-10	-10	5	10	10
	07/00	23	31	142				0	0		0	0	
	07/06	0	68	475				0	-10		0	10	
	07/12	0	142	212				0	-10		0	10	
	07/18	0	115	226				0	-10		0	10	
	08/00	0	77					0			0		
	08/06	15	110					0			0		
	08/12	11	109					0			0		
	08/18	0	186					-8			10		
	09/00	0											
	09/06	0											
	09/12	0											
	09/18	0											
mean		19	136	219	245	390	572	-2	-8	-11	2	8	11
sampl		25	21	17	13	9	5	21	17	13	21	17	13

Date/Time		Center Position (km)						Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	=24	=48	=72	=90	=120	T=24	=48	=72	T=24	=48	=72
TS Mujigae (0913)													
Sept.	10/00	0	361					2			0		
	10/06	0	326					4			-5		
	10/12	21	221					2			0		
	10/18	31	183					0			0		
	11/00	73											
	11/06	42											
	11/12	21											
	11/18	0											
mean		23	273					2			-1		
sampl		8	4					4			4		

Date/Time		Center Position (km)						Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	=24	=48	=72	=90	=120	T=24	=48	=72	T=24	=48	=72
TY Choi-wan (0914)													
Sept.	12/18	0	72	139	178	348	523	14	50	65	-20	-45	-50
	13/00	0	179	215	199	244	386	20	40	50	-20	-35	-35
	13/06	0	183	177	176	301	482	25	40	45	-25	-30	-30
	13/12	0	117	207	281	342	427	30	45	40	-25	-30	-30
	13/18	0	94	161	233	259	378	25	25	25	-20	-20	-20
	14/00	0	46	118	179	133	145	5	25	15	-10	-20	-15
	14/06	0	67	43	157	173	361	15	25	5	-15	-20	-10
	14/12	0	74	92	63	269	566	25	25	5	-20	-20	-10
	14/18	0	39	59	56	164	376	20	20	-10	-15	-15	5
	15/00	0	63	24	126	292	719	10	0	-20	-10	-5	10
	15/06	0	76	46	10	156	477	0	-20	-35	-5	5	20
	15/12	0	56	46	35	65		0	-20	-40	-5	5	25
	15/18	0	46	23	78	240		0	-30	-45	-5	15	30
	16/00	0	94	75	76	169		-10	-30	-35	0	15	20
	16/06	0	86	20	11	352		-20	-25	-25	5	10	15
	16/12	0	23	30	77			-20	-30	-30	5	15	15
	16/18	0	35	22	153			-30	-35	-30	15	20	10
	17/00	0	47	104	180			-20	-35	-35	15	30	20
	17/06	0	0	22	169			-15	-25	-35	15	25	25
	17/12	0	30	63				-20	-20		20	15	
	17/18	0	89	196				-15	-20		15	10	
	18/00	0	59	229				-15	-25		15	15	
	18/06	0	95	347				-10	-20		10	15	
	18/12	0	65					-5			5		
	18/18	0	111					-5			5		
	19/00	22	181					-10			10		
	19/06	15	199					-15			15		
	19/12	0											
	19/18	0											
	20/00	0											
	20/06	21											
mean		2	82	107	128	234	440	-1	-2	-5	-2	-2	0
sampl		31	27	23	19	15	11	27	23	19	27	23	19

Date/Time		Center Position (km)						Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	=24	=48	=72	=90	=120	T=24	=48	=72	T=24	=48	=72
TY Koppu (0915)													
Sept.	13/18	10	90					15			-20		
	14/00	21	152					0			0		
	14/06	10	131					-5			10		
	14/12	11											
	14/18	0											
	15/00	0											
	15/06	0											
mean		8	124					3			-3		
sampl		7	3					3			3		

Date/Time		Center Position (km)						Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	=24	=48	=72	=90	=120	T=24	=48	=72	T=24	=48	=72
TY Ketsana (0916)													
Sept.	26/00	70	101	54	174	345		5	5	0	-15	-5	-5
	26/06	62	77	32	90			-5	10	-5	0	-10	-5
	26/12	11	78	88	105			-10	0	-20	10	5	15
	26/18	55	24	102	200			-10	0	-20	10	5	20
	27/00	46	44	123	203			-5	0	0	10	5	5
	27/06	11	65	148				5	-5		0	5	
	27/12	25	39	123				0	-20		5	15	
	27/18	54	78	123				0	-5		5	5	
	28/00	22	143	159				0	-9		5	15	
	28/06	0	140					-5			5		
	28/12	0	109					-10			5		
	28/18	0	123					-5			5		
	29/00	25	70					-4			10		
	29/06	0											
	29/12	75											
	29/18	129											
	30/00	141											
mean		43	84	106	154	345		-3	-3	-9	4	4	6
sampl		17	13	9	5	1		13	9	5	13	9	5

Date/Time		Center Position (km)						Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	=24	=48	=72	=90	=120	T=24	=48	=72	T=24	=48	=72
TY Parma (0917)													
Sept.	29/06	22	189	309	360	488	576	20	50	15	-25	-45	-15
	29/12	33	143	351	369	492	536	20	40	10	-25	-35	-10
	29/18	33	142	360	463	622	627	35	30	-5	-35	-25	0
	30/00	0	239	441	510	705	679	45	25	-5	-40	-20	0
	30/06	0	213	371	508	640	650	20	-15	-25	-20	5	10
	30/12	0	210	350	513	725	876	0	-25	-40	-10	10	25
	30/18	0	147	332	473	590	747	-20	-45	-55	5	20	35
Oct.	01/00	0	142	270	389	439	442	-30	-55	-60	25	40	45
	01/06	0	133	266	325	334	313	-45	-55	-60	35	40	45
	01/12	22	118	249	291	253	290	-35	-40	-45	25	35	40
	01/18	22	139	202	228	178	302	-25	-25	-30	15	25	25
	02/00	0	128	232	227	163	331	-25	-30	-30	15	25	25
	02/06	0	120	197	195	199	400	-15	-30	-30	5	20	25
	02/12	0	118	181	136	253	428	-20	-35	-25	15	25	20
	02/18	0	116	194	105	303	419	-20	-30	-25	15	25	20
	03/00	22	143	146	152	420	523	-20	-35	-30	15	25	20
	03/06	0	138	115	203	447	534	-15	-30	-30	10	25	20
	03/12	0	105	97	179	295	280	-20	-25	-35	15	20	25
	03/18	0	57	70	216	366	229	-20	-20	-29	15	15	30
	04/00	0	81	64	348	392	149	-20	-20	-31	15	15	35
	04/06	0	39	128	396	464	402	-20	-20	-31	15	15	35
	04/12	33	38	205	403	399	356	-20	-25	-29	15	20	30
	04/18	15	84	301	483	383	327	-15	-29	-29	10	30	30
	05/00	21	119	400	440	291		-15	-31	-29	10	35	30
	05/06	43	148	399	382	283		-15	-31	-29	10	35	30
	05/12	31	131	266	127	70		-20	-29	-29	15	30	30
	05/18	21	158	287	78	78		-24	-24	-26	25	25	30
	06/00	0	235	245	123		414	-16	-14	-13	20	15	15
	06/06	22	250	182	116		424	-16	-14	-13	20	15	15
	06/12	39	96	65	138		456	0	2	0	0	0	0
	06/18	48	100	101	88			2	2	2	0	0	-35
	07/00	67	32	167		402	477	2	-2		-5	0	
	07/06	39	11	134		439	573	2	-2		-5	0	
	07/12	32	59	140		424	602	2	-2		-5	0	
	07/18	74	64	167		475	613	0	-2		0	0	
	08/00	32	181		401	571	687	-2		-2	0		0
	08/06	32	171		439	538	557	-2		-2	0		0
	08/12	33	65		223	339	340	-2		-2	0		0
	08/18	44	64		299	332	314	-2		-2	0		0
	09/00	201		329	334	448			-2	0		0	0
	09/06	22		142	177	357			0	2		0	0
	09/12	21		32	113				2	6		0	-40
	09/18	15											
	10/00												
	10/06												
	10/12												
	10/18												
	11/00	79	74	113				4	10		0	-45	
	11/06	22	109	181				4	12		0	-50	
	11/12	31	189	200				4	6		-5	-5	
	11/18	39	146	189				6	0		-5	0	
	12/00	0	61					8			-10		
	12/06	0	88					10			-15		
	12/12	0	76					6			-5		
	12/18	0	94					0			0		
	13/00	0											
	13/06	0											
	13/12	0											
	13/18	0											
mean		22	121	218	288	394	467	-7	-13	-21	3	9	16
sampl		55	47	42	38	37	34	47	42	38	47	42	38

Date/Time		Center Position (km)						Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	=24	=48	=72	=90	=120	T=24	=48	=72	T=24	=48	=72
TY Melor (0918)													
Sept.	30/00	0	179	233	343	440	517	10	35	30	-15	-30	-25
	30/06	0	140	163	201	171	284	25	30	20	-20	-25	-15
	30/12	0	70	81	116	125	450	25	25	15	-20	-20	-15
	30/18	0	49	91	68	134	403	25	15	15	-20	-15	-15
Oct.	01/00	0	15	74	107	254	339	25	5	20	-20	-10	-20
	01/06	0	56	68	222	418	571	-5	-10	20	-5	0	-20
	01/12	0	54	100	225	440	612	-5	-5	20	0	0	-15
	01/18	0	22	172	245	342	468	-5	5	30	0	-5	-20
	02/00	0	54	139	143	376	656	-5	10	25	5	-5	-15
	02/06	0	85	152	221	348	424	-10	20	15	10	-10	-5
	02/12	0	48	162	194	320	426	-5	20	0	5	-10	5
	02/18	0	85	107	71	281	276	5	20	-5	0	-10	10
	03/00	0	78	77	83	172	360	10	15	-5	-5	-5	10
	03/06	0	99	123	135	218	545	20	15	-5	-10	-5	10
	03/12	0	61	92	98	293		20	0	-5	-10	5	10
	03/18	0	39	38	124	459		20	-5	-5	-10	10	10
	04/00	0	24	59	282	860		0	-10	-5	0	10	10
	04/06	0	21	80	343	916		0	-15	-10	0	15	15
	04/12	0	22	90	308			-20	-20	-15	15	20	20
	04/18	0	30	145	460			-25	-20	-20	20	20	15
	05/00	0	39	202	504			-25	-20	-35	20	15	25
	05/06	0	35	239	617			-30	-20	-34	25	20	25
	05/12	0	73	308				-25	-15		20	20	
	05/18	0	122	424				-15	-20		15	20	
	06/00	0	184	452				-5	-30		5	25	
	06/06	0	132	488				-5	-24		5	20	
	06/12	0	159					0			0		
	06/18	0	229					-10			5		
	07/00	0	252					-15			15		
	07/06	0	195					-14			10		
	07/12	0											
	07/18	0											
	08/00	0											
	08/06	52											
mean		2	88	168	232	365	452	-1	0	3	1	2	0
sampl		34	30	26	22	18	14	30	26	22	30	26	22

Date/Time		Center Position (km)						Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	=24	=48	=72	=90	=120	T=24	=48	=72	T=24	=48	=72
TS Nepartak (0919)													
Oct.	09/06	0	11	144	482	1482		0	-4	-7	0	5	5
	09/12	22	39	145	502	1541		-6	-6	-7	10	5	5
	09/18	24	47	127	629	1689		-6	-4	-7	10	0	5
	10/00	57	79	294	994			-4	-2	-7	5	0	5
	10/06	73	127	404	1332			-4	-2	-7	5	0	5
	10/12	66	112	427	1172			-6	-7	-14	5	5	10
	10/18	104	91	53	385			-4	-12	-16	0	10	15
	11/00	41	73	147				-7	-12		5	10	
	11/06	0	70	261				-7	-12		5	10	
	11/12	0	60	450				-7	-9		5	5	
	11/18	20	188	464				-7	-11		5	10	
	12/00	0	305					-7			5		
	12/06	0	441					-7			5		
	12/12	0	481					-9			5		
	12/18	15	264					-6			5		
	13/00	0											
	13/06	19											
	13/12	58											
	13/18	19											
mean		27	159	265	785	1571		-6	-7	-9	5	5	7
sampl		19	15	11	7	3		15	11	7	15	11	7

Date/Time		Center Position (km)						Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	=24	=48	=72	=90	=120	T=24	=48	=72	T=24	=48	=72
TY Lupit (0920)													
Oct.	15/12	0	90	194				21	35		-20	-35	
	15/18	0	186	222	420	474	467	22	30	35	-20	-30	-25
	16/00	39	201	259	447	438	338	15	30	35	-15	-25	-25
	16/06	15	100	238	400	453	390	10	10	10	-10	-10	-10
	16/12	0	102	365	398	453	392	5	0	0	-10	-5	-5
	16/18	0	189	427	444	382	356	0	0	-15	-5	-5	5
	17/00	11	180	356	369	338	537	0	0	-20	-5	-5	10
	17/06	0	217	347	366	194	515	-5	-5	-25	0	0	15
	17/12	0	226	269	294	294	569	-10	-20	-40	5	10	25
	17/18	0	206	241	251	336	630	0	-25	-40	0	15	25
	18/00	0	146	203	214	347	675	-5	-30	-45	0	20	30
	18/06	0	119	207	186	422	735	-5	-30	-45	0	20	30
	18/12	0	124	227	254	422	786	0	-20	-25	0	15	20
	18/18	0	146	185	355	607	1121	-15	-30	-25	10	20	15
	19/00	0	112	152	359	593	1192	-20	-35	-20	15	25	10
	19/06	0	108	178	440	692	1290	-15	-25	10	10	15	-10
	19/12	0	122	234	487	888	1491	-25	-30	5	15	20	-5
	19/18	0	94	219	482	880	1365	-25	-30	5	15	20	-5
	20/00	0	98	176	482	942	1468	-15	-10	5	10	5	-5
	20/06	0	56	129	422	762	1192	-15	-10	0	10	5	0
	20/12	11	39	67	257	685	1183	-5	-10	-10	5	10	10
	20/18	0	78	124	180	473	1008	-5	-10	-10	5	10	10
	21/00	0	79	39	347	750	1390	0	-5	-10	0	5	10
	21/06	10	25	76	478	807	1510	0	-5	-10	0	5	10
	21/12	0	39	183	635	1111	2110	-5	-10	0	5	10	0
	21/18	0	70	306	715	1294	2576	-5	-10	0	5	10	0
	22/00	0	39	302	660	1251		-5	-15	-15	5	15	15
	22/06	25	70	401	777	1409		-10	-15	-15	10	15	15
	22/12	25	99	376	729	1472		-10	-10	-10	10	10	10
	22/18	62	162	356	778	1702		-10	-10	-10	10	10	10
	23/00	69	313	596	1145			-10	-10	-10	10	10	10
	23/06	77	384	731	1435			-5	-5	-5	5	5	5
	23/12	86	362	744	1684			0	5	5	0	-5	-5
	23/18	100	373	863	2094			0	5	5	0	-5	-5
	24/00	0	173	794				5	5		-5	-5	
	24/06	0	208	838				5	5		-5	-5	
	24/12	0	233	1028				-5	-5		5	5	
	24/18	0	278	1300				0	0		0	0	
	25/00	10	304					0			0		
	25/06	0	346					5			-5		
	25/12	0	317					0			0		
	25/18	11	207					-5			5		
	26/00	0											
	26/06	0											
	26/12	0											
	26/18	0											
mean		12	167	367	575	720	1012	-4	-8	-9	2	5	6
sampl		46	42	38	33	29	25	42	38	33	42	38	33

Date/Time		Center Position (km)						Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	=24	=48	=72	=90	=120	T=24	=48	=72	T=24	=48	=72
TY Mirinae (0921)													
Oct.	27/06	0	53	143	286	763	930	30	20	-10	-30	-20	5
	27/12	32	85	193	280	593	802	25	0	-30	-25	-5	20
	27/18	0	76	195	305	519	722	15	-15	-45	-15	5	30
	28/00	11	64	227	380	548	577	-5	-30	-55	0	15	35
	28/06	0	139	306	490	479	563	-15	-40	-55	5	20	35
	28/12	0	150	256	333	314	408	-20	-45	-44	5	25	35
	28/18	21	185	307	317	311		-20	-45	-44	5	30	35
	29/00	0	167	257	235	287		-25	-40	-44	10	30	35
	29/06	22	100	264	186	137		-15	-10	-14	10	5	10
	29/12	22	123	204	145	45		-20	-14	-14	15	10	10
	29/18	43	145	121	62			-25	-14	-14	20	10	10
	30/00	0	109	103	39			-10	-14	-14	5	10	10
	30/06	0	95	56	77			-10	-14	-4	5	10	0
	30/12	32	73	15	114			-14	-14	2	10	10	-35
	30/18	0	24	95				-14	-14		10	10	
	31/00	22	24	140				-14	-14		10	10	
	31/06	22	45	67				-14	-9		10	5	
	31/12	22	76	187				-9	4		5	-35	
	31/18	0	101					-4			0		
Nov.	01/00	0	149					2			-10		
	01/06	22	119					2			-10		
	01/12	25	84					-2			0		
	01/18	55											
	02/00	22											
	02/06	0											
	02/12	0											
mean		14	99	174	232	400	667	-7	-17	-28	2	8	17
sampl		26	22	18	14	10	6	22	18	14	22	18	14

Date/Time		Center Position (km)						Central Pressure (hPa)			Max. Wind (kt)		
	(UTC)	T=00	=24	=48	=72	=90	=120	T=24	=48	=72	T=24	=48	=72
TY Nida (0922)													
Nov.	23/12	35	101	162	267	334	295	17	60	65	-25	-55	-50
	23/18	33	144	197	190	281	478	30	75	60	-35	-60	-45
	24/00	22	146	168	154	246	362	35	75	50	-35	-60	-40
	24/06	11	86	165	189	242	363	35	55	30	-35	-35	-25
	24/12	35	135	163	137	161	291	45	40	30	-40	-30	-25
	24/18	22	93	78	57	87	130	60	40	30	-45	-30	-25
	25/00	0	86	62	67	73	86	20	0	0	-20	-5	-5
	25/06	0	58	68	74	77	57	5	-15	0	-5	5	0
	25/12	0	21	68	77	57	21	-10	-15	0	10	10	0
	25/18	0	24	78	86	90	15	-10	-15	0	10	10	0
	26/00	0	25	116	101	100	46	-20	-15	-20	15	5	10
	26/06	0	104	143	131	104	84	-5	15	-5	0	-15	0
	26/12	0	119	130	101	64	156	-5	10	-5	0	-10	0
	26/18	0	103	118	115	11	177	0	10	-5	-10	-10	0
	27/00	0	54	84	74	42	270	0	-5	-5	-10	0	0
	27/06	0	0	70	167	288	589	0	-5	-5	-10	0	0
	27/12	0	74	84	138	57	203	-5	-5	-5	0	0	0
	27/18	0	95	138	150	79	190	-5	-5	-5	0	0	0
	28/00	0	63	126	143	78		-5	5	10	0	-5	-10
	28/06	0	73	126	139	122		-5	5	0	0	-5	0
	28/12	11	57	95	105	189		-10	-10	-10	0	0	10
	28/18	11	57	49	126	260		-10	-10	-25	0	0	15
	29/00	0	38	68	176			-10	-10	-25	0	0	15
	29/06	10	33	102	193			-10	-20	-30	0	10	25
	29/12	0	25	113	237			-15	-20	-30	5	15	30
	29/18	10	31	137	297			0	-15	-24	0	15	25
	30/00	24	85	215				5	-15		-5	10	
	30/06	11	94	183				-5	-20		5	20	
	30/12	10	77	218				0	-15		0	15	
	30/18	15	69	220				-10	-14		5	15	
Dec.	01/00	11	74					-5			0		
	01/06	15	49					-5			5		
	01/12	33	109					-10			10		
	01/18	66	160					-9			10		
	02/00	129											
	02/06	24											
	02/12	31											
	02/18	64											
mean		17	75	125	142	138	212	2	5	3	-6	-6	-4
sampl		38	34	30	26	22	18	34	30	26	34	30	26

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 - 2009

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
2009					2	2	2	5	7	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 Tropical Cyclone Advisory for Five-day Track Forecast (WTPQ50-55 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 $YYGGgg_F$ UTC $LaLa.La_F$ N $LoLoLo.Lo_F$ E (or W) FrFrFr NM 70%
MOVE direction SpSpSp KT
PRES PPPP HPA
MXWD VmVmVm KT
GUST VgVgVg KT
48HF $YYGGgg_F$ UTC $LaLa.La_F$ N $LoLoLo.Lo_F$ E (or W) FrFrFr NM 70%
MOVE direction SpSpSp KT
PRES PPPP HPA
GUST VgVgVg KT
MXWD VmVmVm KT

72HF 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
96HF YYGGggF UTC LaLa.LaF N LoLoLo.LoF E (or W) FrFrFr NM 70%
MOVE direction SpSpSp KT
120HF YYGGggF UTC LaLa.LaF N LoLoLo.LoF E (or W) FrFrFr NM 70%
MOVE direction SpSpSp KT=

Notes:

a. Underlined parts are fixed.

b. Abbreviations and symbolic letters are the same as those used in RSMC Tropical Cyclone Advisory (WTPQ20-25 RJTD).

Example:

WTPQ50 RJTD 060000
RSMC TROPICAL CYCLONE ADVISORY
NAME TY 0908 MORAKOT (0908)
ANALYSIS
PSTN 060000UTC 23.4N 128.3E FAIR
MOVE WNW 09KT
PRES 960HPA
MXWD 075KT
GUST 105KT
50KT 80NM
30KT 350NM SOUTH 300NM NORTH
FORECAST
24HF 070000UTC 24.0N 123.9E 70NM 70%
MOVE W 10KT
PRES 925HPA
MXWD 090KT
GUST 130KT
48HF 080000UTC 25.3N 121.8E 110NM 70%
MOVE WNW 06KT
PRES 950HPA
MXWD 080KT
GUST 115KT
72HF 090000UTC 26.5N 119.7E 160NM 70%
MOVE WNW 06KT
PRES 970HPA
MXWD 065KT
GUST 095KT
96HF 100000UTC 28.0N 118.8E 240NM 70%
MOVE NNW SLOWLY
120HF 110000UTC 29.6N 118.2E 375NM 70%
MOVE NNW SLOWLY =

(3) 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 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=

(4) 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=

(5) 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.=

(6) 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 =

(7) 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 TEPS and the Global Data Assimilation System]

TEPS:

- Implementation of the Reduced Gaussian grid model on TEPS (June 2009)

Global Data Assimilation Systems:

- Improvement on the position of TC bogus data (March 2009, October 2009)
- Upgrade of the linear radiative transfer model (RTTOV 8 to RTTOV 9: March 2009)
- Assimilation of surface wind data from Metop-A/ASCAT (July 2009)
- Assimilation of the infrared sounding observations from DMSP-F16/SSMIS (July 2009)
- Assimilation of aircraft temperature observations (November 2009)
- Assimilation of refractive index data from GPS radio occultation (November 2009)
- Assimilation of the radiance data from NOAA-19/AMSU-A and MHS (December 2009)

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 MELOR (TY0918). In this case, the control member forecast TC track was entering into the Sea of Japan, which turned to be false, while the ensemble mean and some 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.

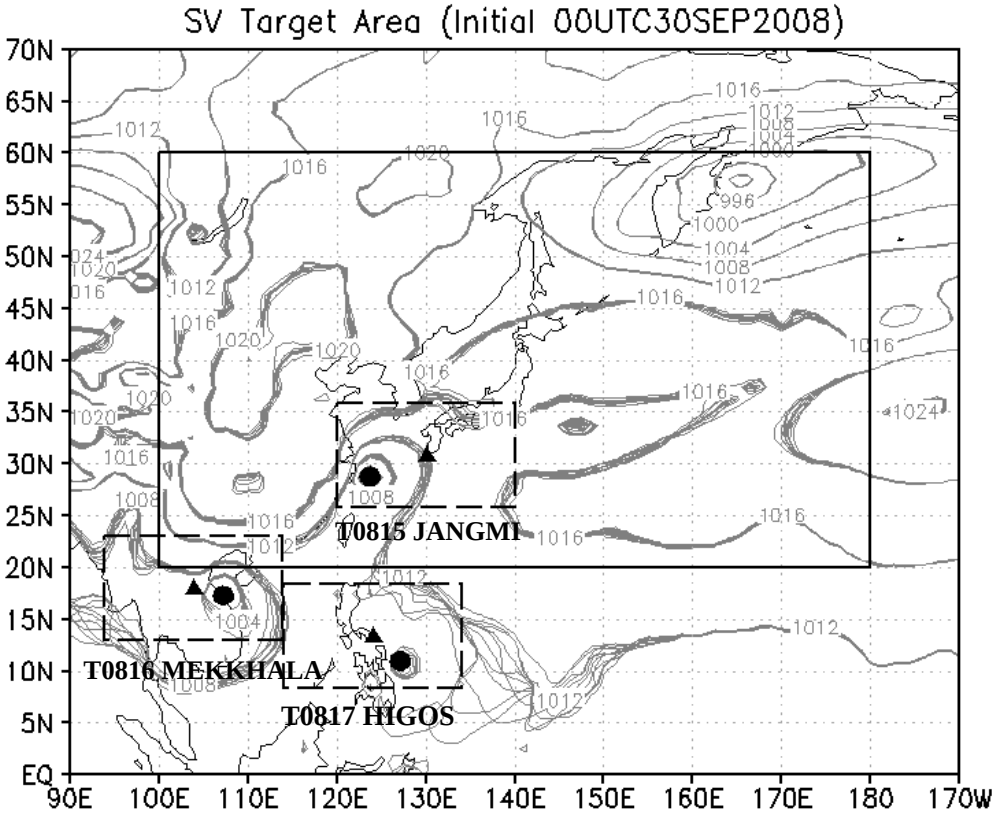


Figure 6.1 Example of SV target area of TEPS (Initial time: 00UTC 30 September 2008). Black circles and triangles show TC central positions and operational 24-hour forecast positions. Gray contours show the initial sea level pressure of each member. Large thick rectangular shows fixed SV target area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

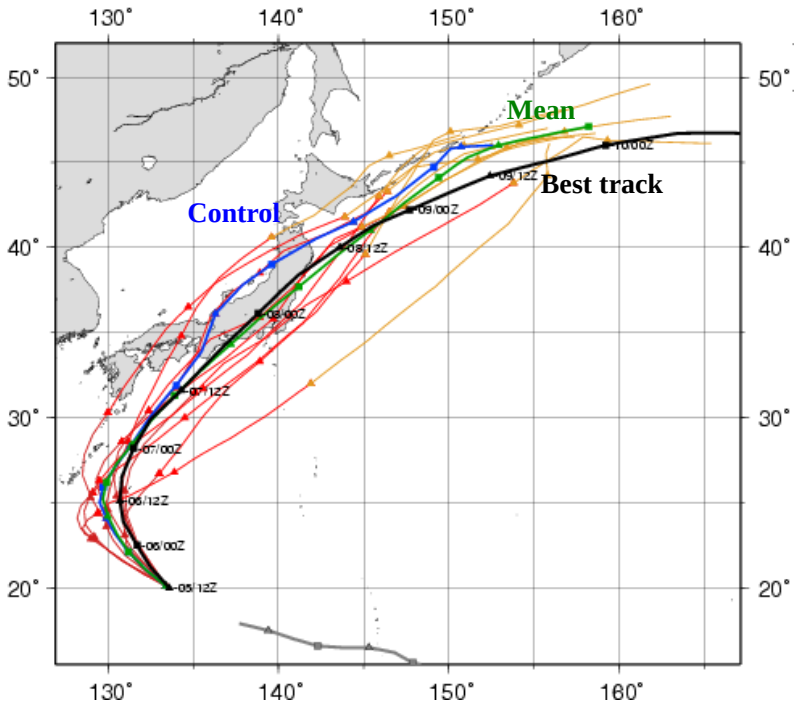


Figure 6.2 Example of TEPS forecast track (Initial time: 12UTC 5 October 2009). Black, blue, green lines denote TC best track, forecast track of control member and ensemble mean respectively. Red (up to 96-hour) and yellow (up to 120-hour) lines show TC forecast tracks of each perturbed members.

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 2009 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 2009. This document is a brief user's guide to the DVD, which was mastered in ISO-9660 format.

Directory and File layout

```
[Root]
|------AdbeRdr1000_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 2009 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
        |---T0901 (hourly satellite image data)
        |---T0902 (hourly satellite image data)
                :
        |---T0922 (hourly satellite image data)
|------Andata
        |--Besttrack
            |--E_BST_2009.txt (best track data for 2009)
            |--E_BST_200905.txt (best track data for TCs generated in May 2009)
                    :
            |--E_BST_200911.txt (best track data for TCs generated in November 2009)
```

How to use the DVD

When the DVD runs, a start menu automatically appears displaying a panel with buttons marked *Annual Report 2009*, *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 2009 >

Annual Report 2009 is provided in two formats as PDF files and MS Word/Excel/PowerPoint files.

- PDF files:

Click the *Annual Report 2009* button to open the text in PDF. If you cannot open the PDF file, install Adobe Acrobat Reader using the installer (AdbeRdr1000_en_US.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 2009 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 TD formation to the time weakened to TD or Low

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:

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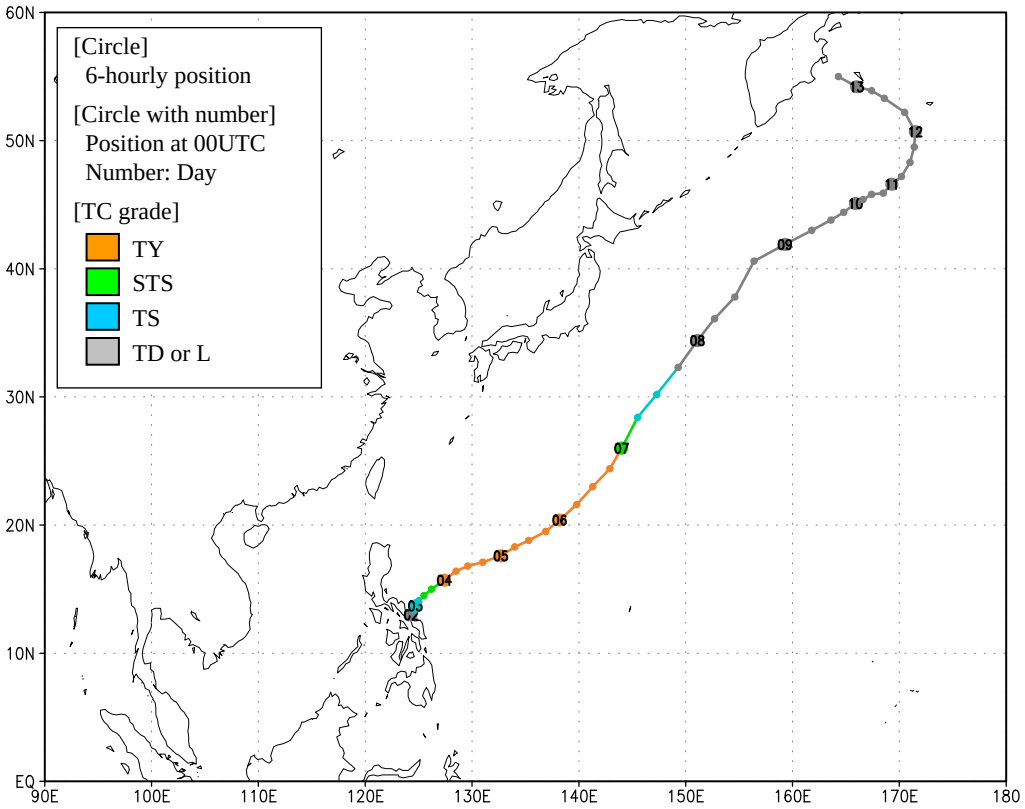
FAX: +81-3-3211-8303
E-mail: rsmc-tokyo@met.kishou.go.jp

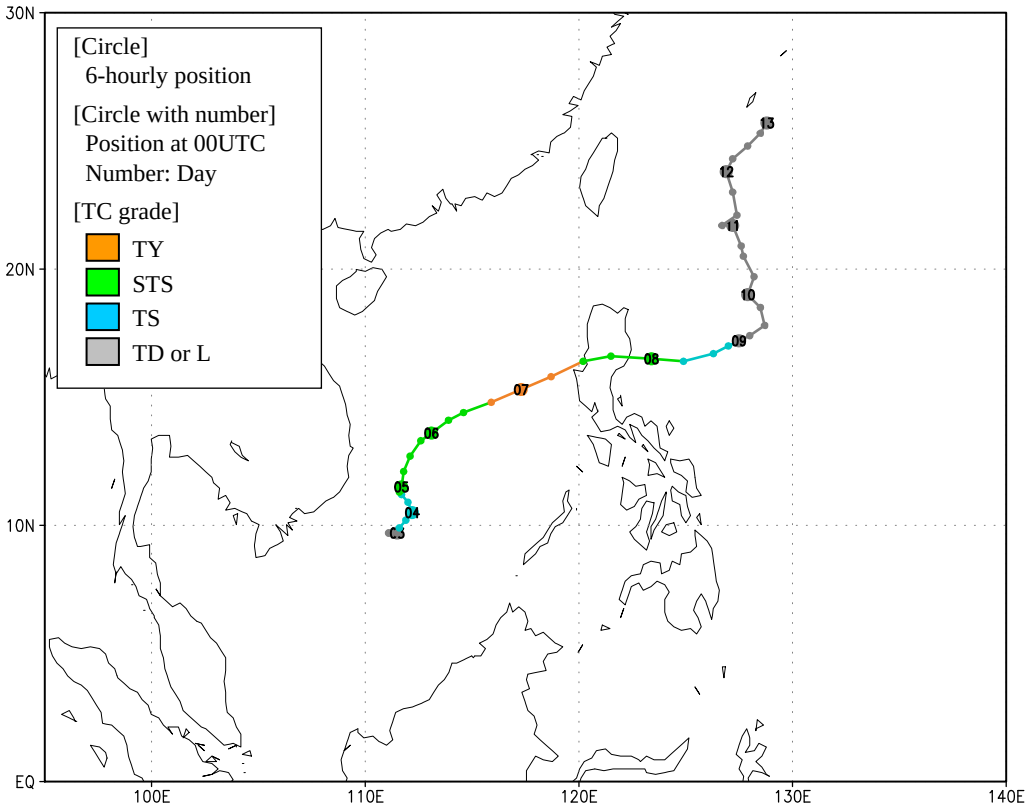
Kujira (0901)

Kujira formed as a tropical depression (TD) near the south-eastern coast of Luzon Island at 12 UTC on 1 May 2009. Moving slowly northeastward, it was upgraded to tropical storm (TS) intensity over the same waters at 18 UTC the next day. Keeping its northeastward track, it was upgraded to typhoon (TY) intensity and reached its peak intensity with maximum sustained winds of 85 kt and a central pressure of 940 hPa over the sea east of the Philippines at 18 UTC on 4 May. Weakening in intensity, it was downgraded to severe tropical storm (STS) intensity over the sea east of the Ogasawara Islands at 00 UTC on 7 May. Keeping its northeastward track, Kujira transformed into an extratropical cyclone east of Japan at 18 UTC that day before dissipating east of the Kamchatka Peninsula at 12 UTC on 13 May.



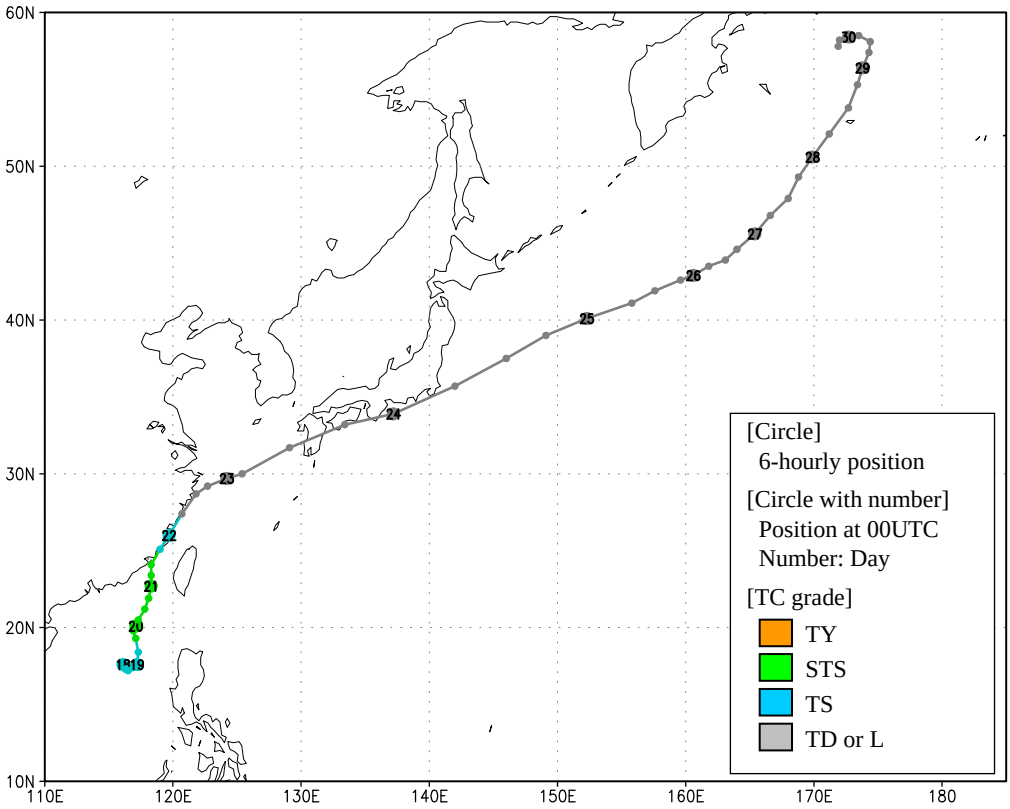
Chan-hom (0902)

Chan-hom formed as a tropical depression (TD) over the South China Sea at 18 UTC on 2 May 2009. It remained almost stationary until 12 UTC on 3 May, when it was upgraded to tropical storm (TS) intensity. Moving east-northeastward over the South China Sea, it reached its peak intensity with maximum sustained winds of 65 kt and a central pressure of 975 hPa when it was upgraded to typhoon (TY) intensity at 18 UTC on 6 May. Soon after being downgraded to severe tropical storm (STS) intensity at 12 UTC the next day, it hit Luzon Island. Chan-hom crossed the Island eastward and was then downgraded to TD intensity over the sea east of the Philippines at 00 UTC on 9 May. It turned sharply to the north at 12 UTC that day. Keeping its northward track, it dissipated south of Okinawa at 06 UTC on 13 May.



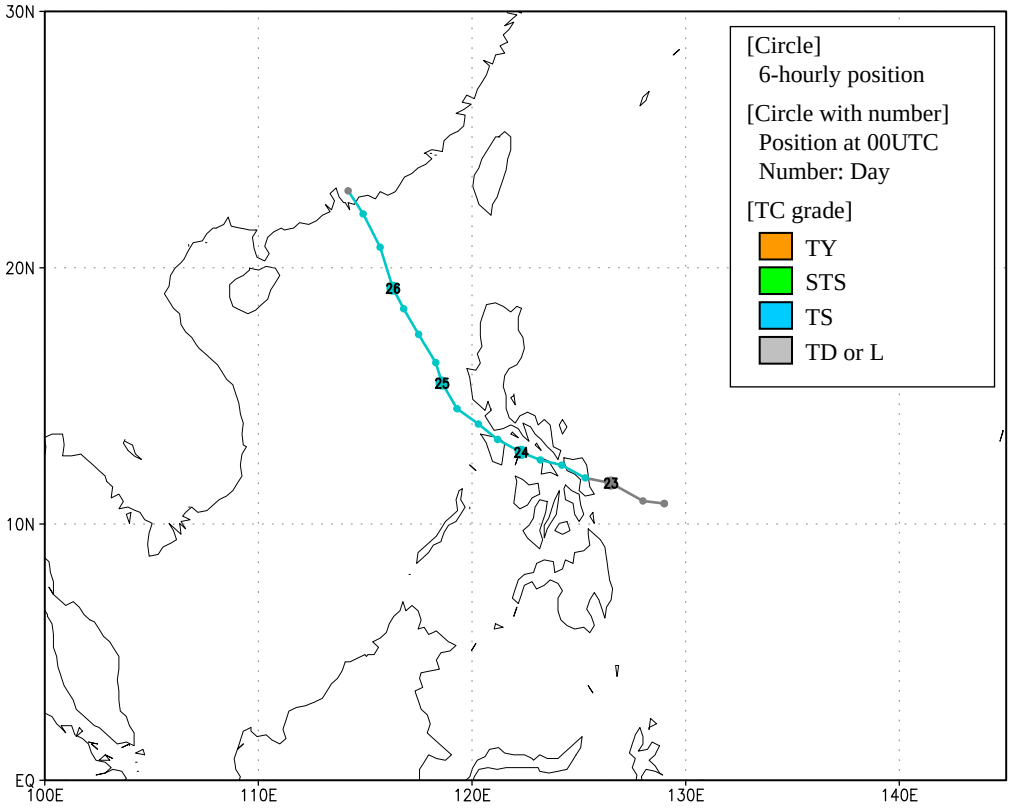
Linfa (0903)

Linfa formed as a tropical depression (TD) over the South China Sea at 06 UTC on 17 June 2009. Remaining almost stationary, it was upgraded to tropical storm (TS) intensity at 00 UTC the next day. It started moving northward and was upgraded to severe tropical storm (STS) intensity over the same waters at 12 UTC on 19 June. Linfa reached its peak intensity with maximum sustained winds of 60 kt and a central pressure of 975 hPa over the same waters at 06 UTC the next day. Moving northeastward along the coast of southern China, it was downgraded to TD intensity at 06 UTC on 22 June. Crossing the East China Sea east-northeastward, it transformed into an extratropical cyclone at 06 UTC on 23 June. Keeping the same direction, it passed along the southern coast of the Japanese islands. Gradually turning its direction to the north, it dissipated east of the Kamchatka Peninsula at 18 UTC on 30 June.



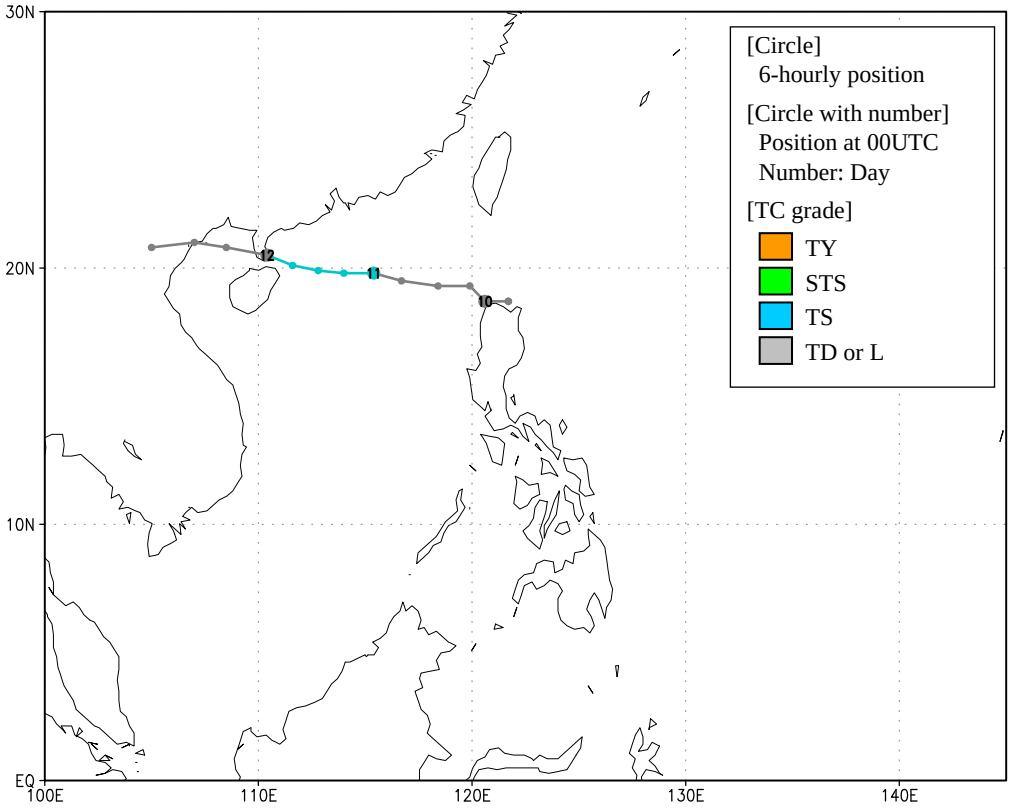
Nangka (0904)

Nangka formed as a tropical depression (TD) over the sea east of the Philippines at 12 UTC on 22 June 2009. Moving west-northwestward, it was upgraded to tropical storm (TS) intensity around Samar Island at 06 UTC the next day, and reached its peak intensity with maximum sustained winds of 40 kt and a central pressure of 994 hPa over the west of the island six hours later. Passing over the Philippines, it kept its west-northwestward track before turning northwestward when it entered the South China Sea late on 24 June. Soon after Nangka hit east of Hong Kong, it was downgraded to TD intensity at 18 UTC on 26 June and dissipated over southern China six hours later.



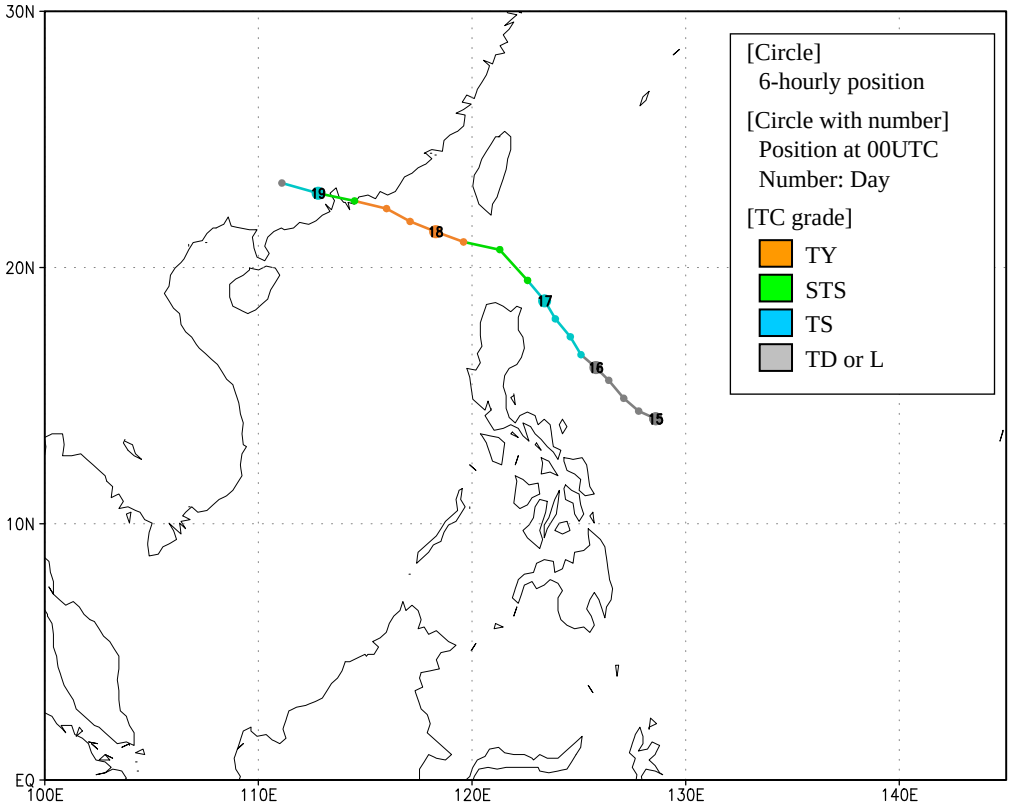
Soudelor (0905)

Soudelor formed as a tropical depression (TD) off the northern coast of Luzon Island at 18 UTC on 9 July 2009. Moving west-northwestward, it was upgraded to tropical storm (TS) intensity over the sea south of Hong Kong at 00 UTC on 11 July and reached its peak intensity with maximum sustained winds of 35 kt and a central pressure of 992 hPa six hours later. Keeping its west-northwestward track, Soudelor was downgraded to TD intensity when it hit the Leizhou Peninsula at 00 UTC on 12 July before dissipating over northern Viet Nam at 00 UTC the next day.



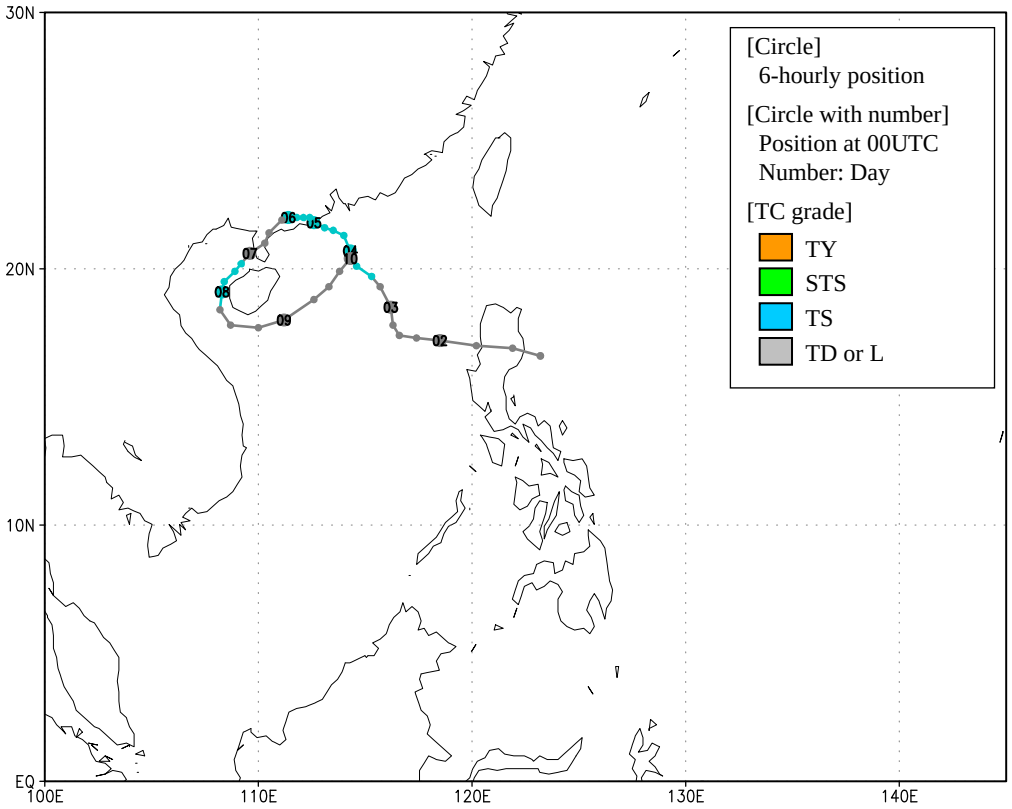
Molave (0906)

Molave formed as a tropical depression (TD) east of the Philippines at 00 UTC on 15 July 2009. Moving northwestward, it was upgraded to tropical storm (TS) intensity east of Luzon Island at 06 UTC the next day. Soon after turning to the west-northwest over Luzon Island, it was upgraded to typhoon (TY) intensity, reaching its peak intensity with maximum sustained winds of 65 kt and a central pressure of 975 hPa at 18 UTC on 17 July. It moved over the South China Sea holding its west-northwestward track and TY intensity before hitting the north of Hong Kong late the next day. Molave weakened rapidly and was downgraded to TD intensity at 06 UTC on 19 July, then dissipated over southern China six hours later.



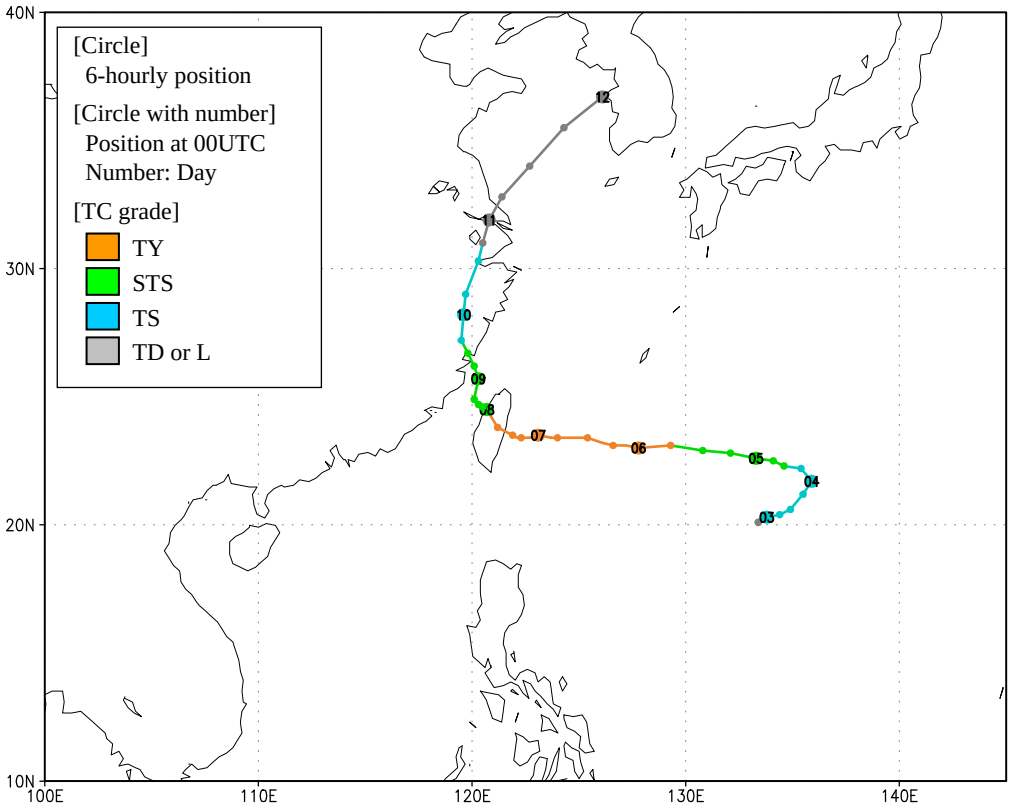
Goni (0907)

Goni formed as a tropical depression (TD) over the sea east of the Philippines at 06 UTC on 1 August 2009. Moving westward, it crossed Luzon Island and turned northwestward 24 hours before being upgraded to tropical storm (TS) intensity over the South China Sea at 12 UTC on 3 August. It reached its peak intensity with maximum sustained winds of 40 kt and a central pressure of 990 hPa off the coast of Hong Kong at 06 UTC the next day. Goni hit the coast west of Macao early on 5 August, and was downgraded to TD intensity at 06 UTC the next day. After crossing the Leizhou Peninsula in southern China, it turned in a counterclockwise direction to circle around Hainan Island, where it was re-upgraded to TS intensity at 06 UTC on 7 August before being re-downgraded to TD intensity over the Gulf of Tonkin 24 hours later. Moving northeastward over the South China Sea, it dissipated south of Hong Kong at 06 UTC on 10 August.



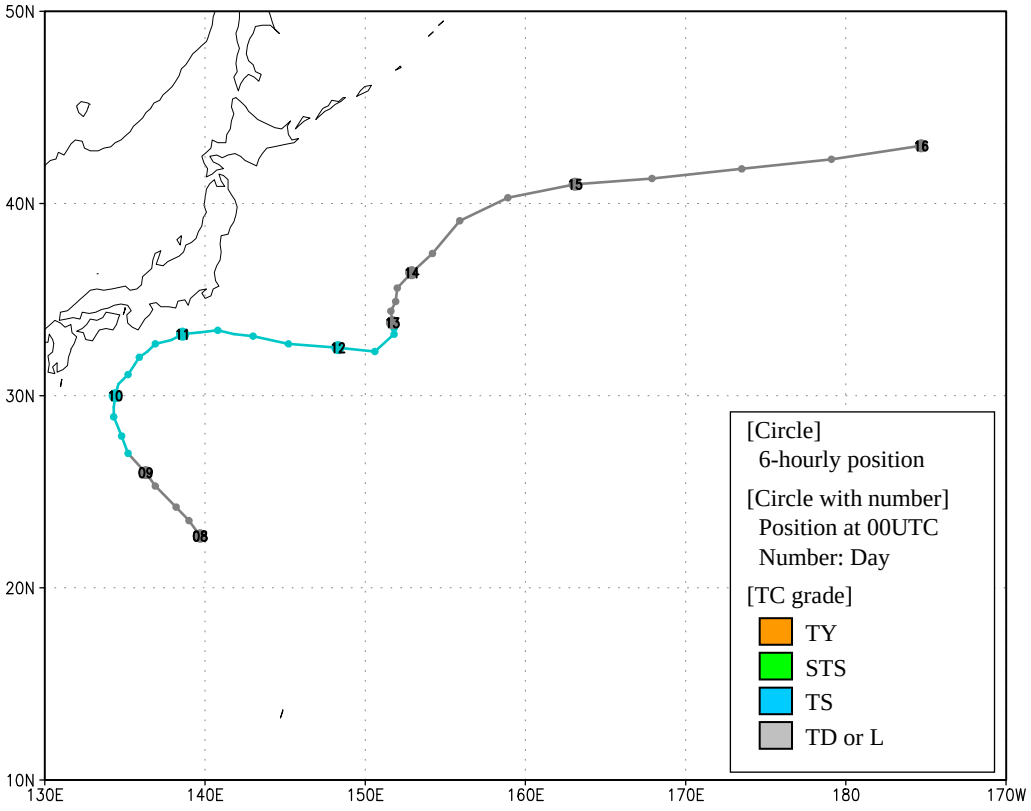
Morakot (0908)

Morakot formed as a tropical depression (TD) southeast of Minamidaitojima Island at 18 UTC on 2 August 2009 and was upgraded to tropical storm (TS) intensity six hours later. After changing from eastward to westward movement on 4 August, it was upgraded to typhoon (TY) intensity southeast of Okinawa Island at 18 UTC the next day before reaching its peak intensity with maximum sustained winds of 75 kt and a central pressure of 945 hPa south of Ishigakijima Island at 15 UTC on 6 August. Maintaining its westward track and TY intensity, Morakot hit Taiwan Island late the next day. Turning gradually to the north, it hit Fujian Province on 9 August. After moving northward with diminishing intensity, it was downgraded to TD intensity southwest of Shanghai at 18 UTC on 10 August. Turning to the northeast and passing over the Yellow Sea, it transformed into an extratropical cyclone at 18 UTC on 11 August and dissipated around the Korean Peninsula 12 hours later.



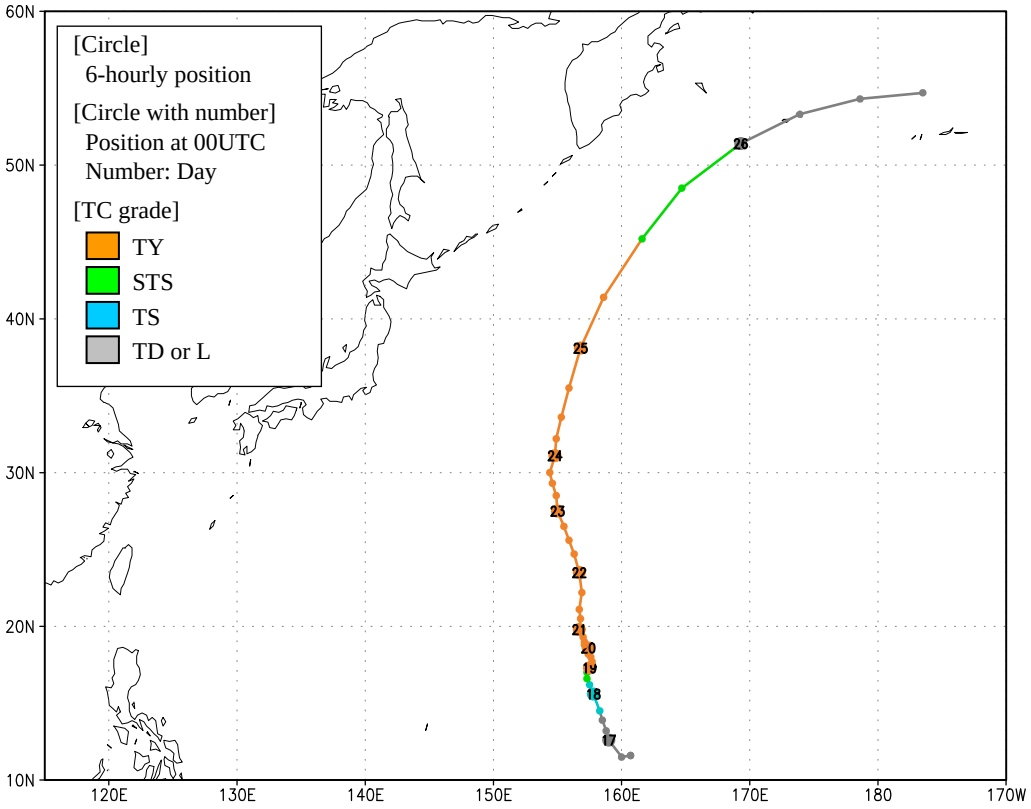
Etau (0909)

Etau formed as a tropical depression (TD) over the sea southwest of Iwoto Island at 00 UTC on 8 August 2009. Moving northwestward, it was upgraded to tropical storm (TS) intensity over the sea south of Japan at 06 UTC the next day and reached its peak intensity with maximum sustained winds of 40 kt and a central pressure of 992 hPa at 00 UTC on 10 August. After recurving south of Honshu Island, Etau moved eastward and was downgraded to TD intensity over the sea east of Japan at 00 UTC on 13 August just after turning northward. Moving gradually eastward again, it transformed into an extratropical cyclone far east of Japan at 12 UTC the next day and crossed longitude 180 degrees east over the sea south of the Aleutian Islands before 00 UTC on 16 August.



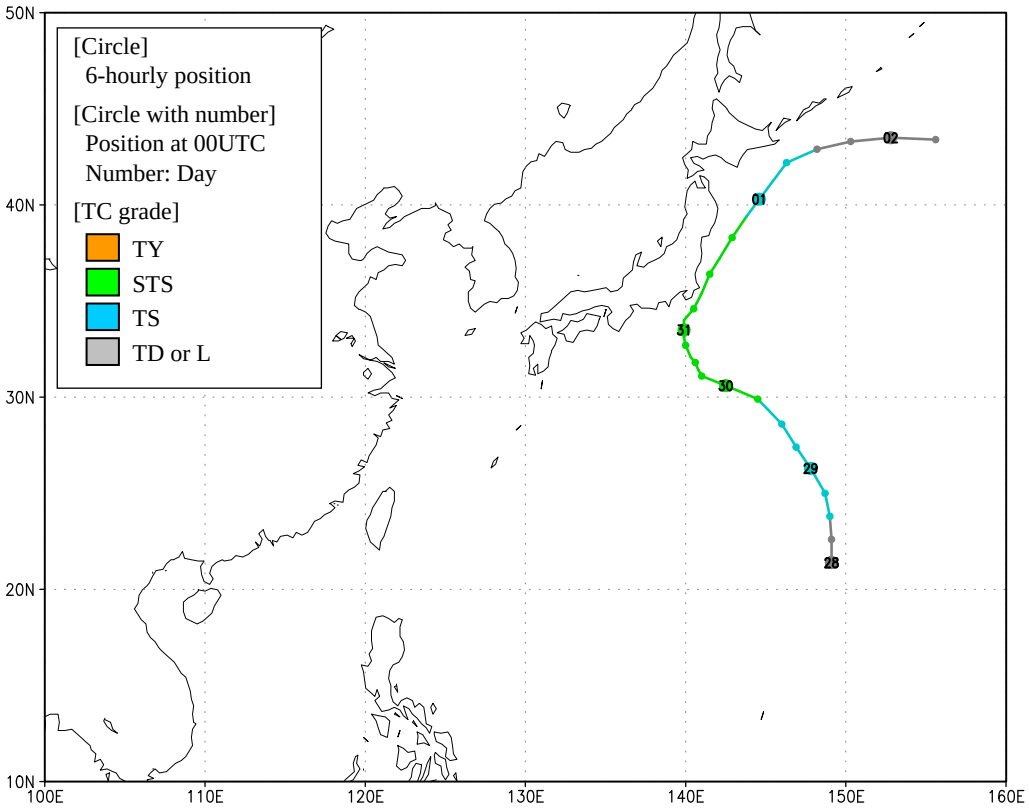
Vamco (0910)

Vamco formed as a tropical depression (TD) over the sea west of the Marshall Islands at 12 UTC on 16 August 2009. Moving northwestward, it was upgraded to tropical storm (TS) intensity far east of the Mariana Islands at 18 UTC the next day. Moving slowly northward, it was upgraded to typhoon (TY) intensity at 00 UTC on 19 August and reached its peak intensity 24 hours later with maximum sustained winds of 90 kt and a central pressure of 945 hPa. Vamco kept its northward track and TY intensity until 12 UTC on 25 August. Gradually accelerating northeastward, it transformed into an extratropical cyclone east of the Kamchatka Peninsula at 00 UTC on 26 August and crossed longitude 180 degrees east before 18 UTC on the same day.



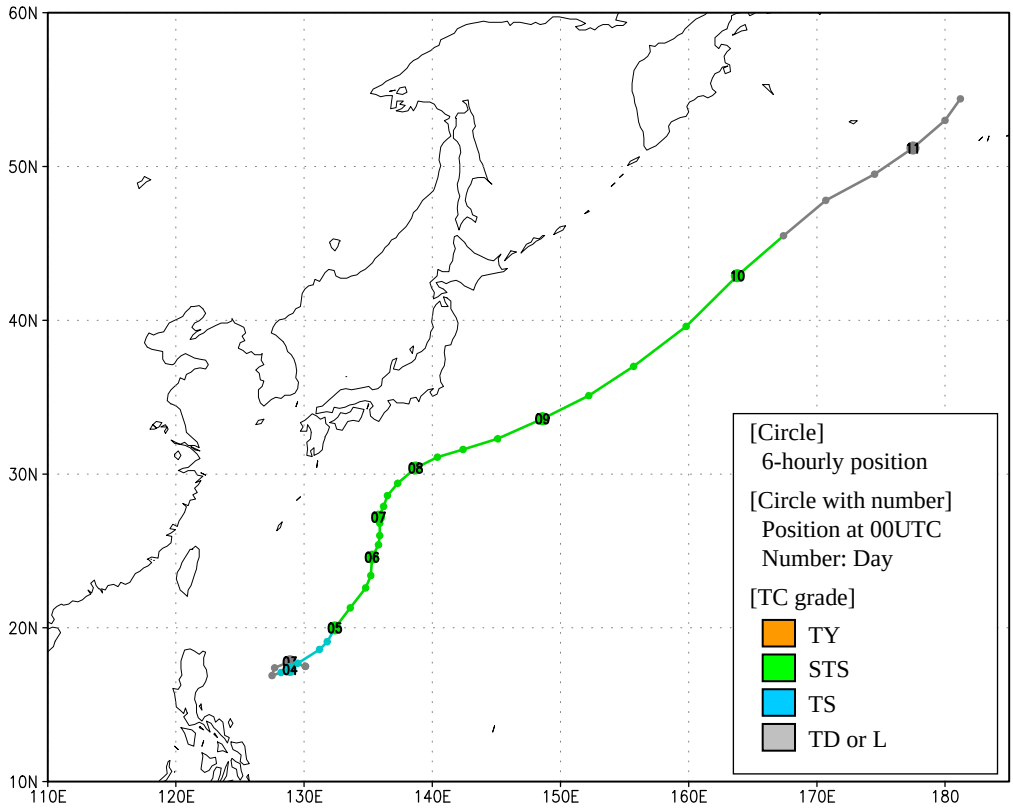
Krovanh (0911)

Krovanh formed as a tropical depression (TD) east of the Northern Mariana Islands at 00 UTC on 28 August 2009. It moved northward and was upgraded to tropical storm (TS) intensity southeast of the Ogasawara Islands 12 hours later. Turning to the northwest, it was upgraded to severe tropical storm (STS) intensity at 18 UTC the next day before reaching its peak intensity with maximum sustained winds of 60 kt and a central pressure of 975 hPa 24 hours later. It turned to the north again and passed east of Hachijojima Island early on 31 August. Krovanh accelerated northeastward along the eastern coast of Honshu and transformed into an extratropical cyclone east of Hokkaido at 12 UTC on 1 September. Moving eastward, it dissipated over the sea south of the Kuril Islands at 12 UTC the next day.



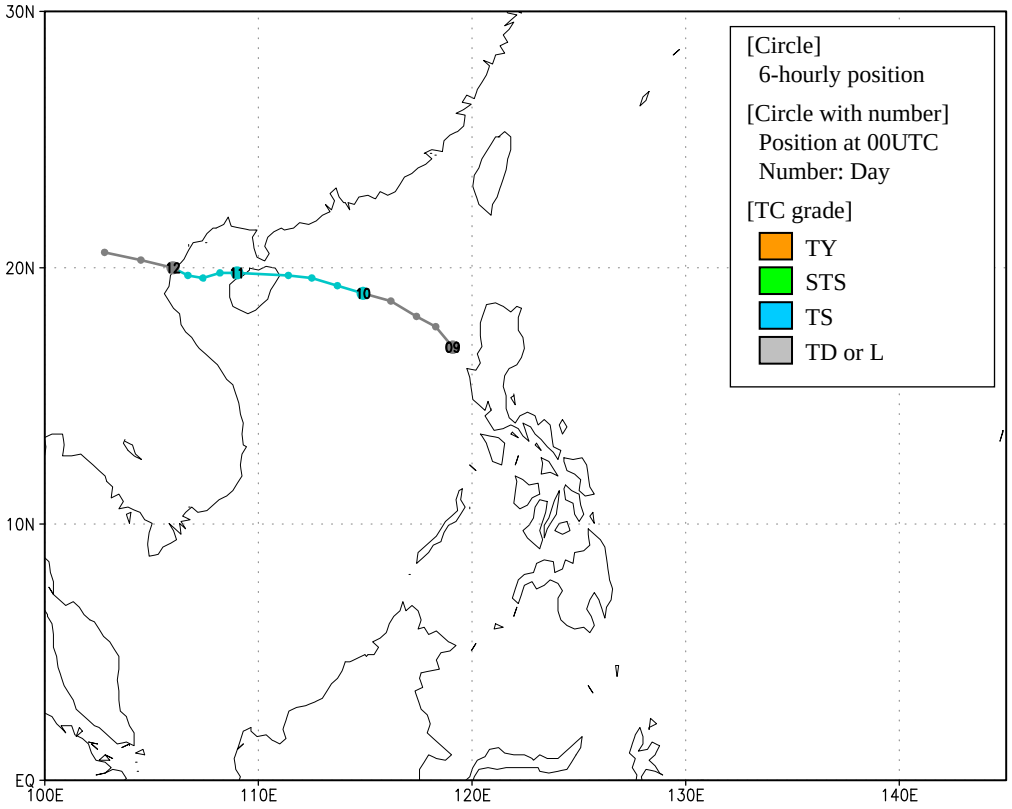
Dujuan (0912)

Dujuan formed as a tropical depression (TD) over the sea east of Luzon Island at 18 UTC on 2 September 2009. It moved slightly westward and was upgraded to tropical storm (TS) intensity at 18 UTC the next day soon after taking on an eastward direction. Turning northeastward over the same waters, it was upgraded to severe tropical storm (STS) intensity at 00 UTC on 5 September, reaching its peak intensity with maximum sustained winds of 50 kt and a central pressure of 980 hPa. Maintaining its intensity, Dujuan turned gradually northward, moved over the sea south of Japan and accelerated as it turned east-northeastward then northeastward over the sea east of Japan. It transformed into an extratropical cyclone south of the Aleutian Islands at 06 UTC on 10 September and crossed longitude 180 degrees east before 12 UTC the next day.



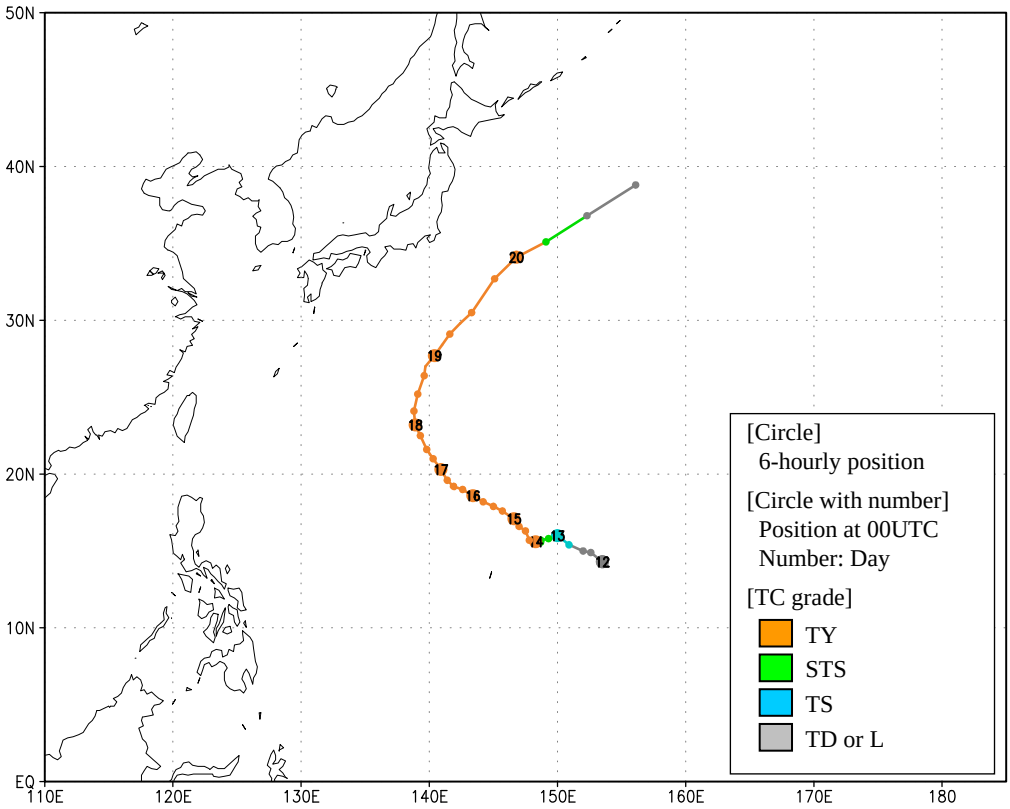
Mujigae (0913)

Mujigae formed as a tropical depression (TD) off the western coast of Luzon Island at 00 UTC on 9 September 2009. Moving west-northwestward, it was upgraded to tropical storm (TS) intensity over the sea south of Hong Kong at 00 UTC on 10 September and reached its peak intensity with maximum sustained winds of 40 kt and a central pressure of 994 hPa over the Gulf of Tonkin at 00 UTC the next day, just after crossing Hainan Island. Keeping its westward track, Mujigae was downgraded to TD intensity at 00 UTC on 12 September soon after hitting northern Viet Nam, then dissipated over northern Laos 18 hours later.



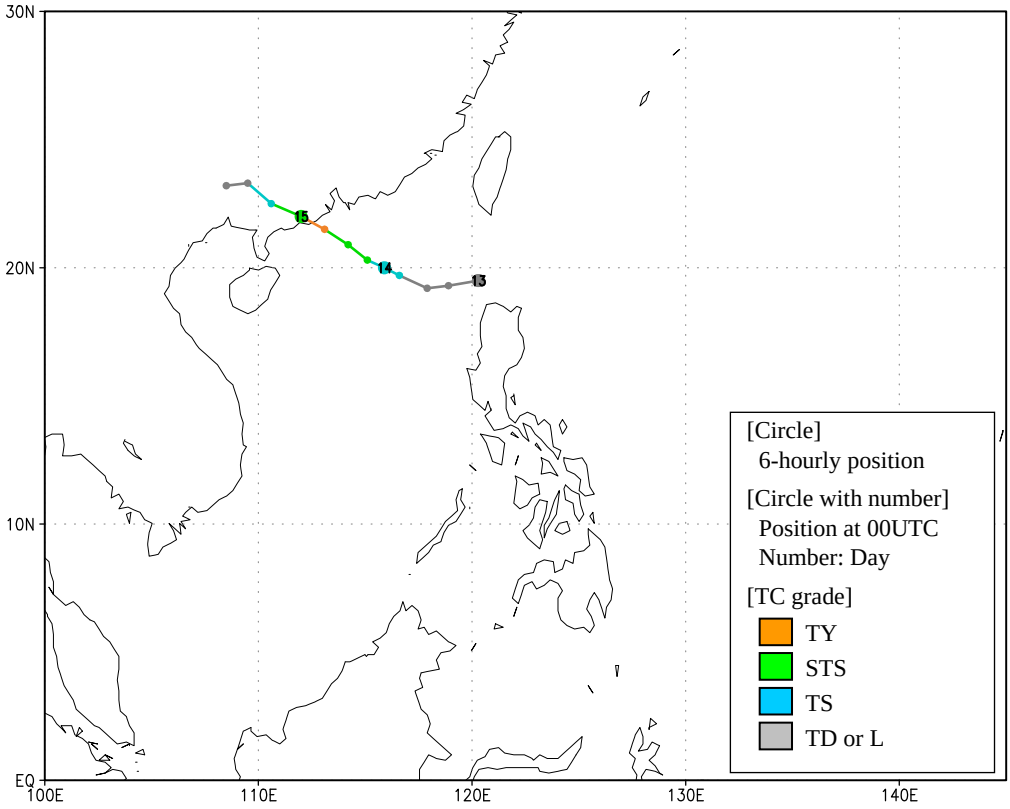
Choi-wan (0914)

Choi-wan formed as a tropical depression (TD) east of Saipan Island at 00 UTC on 12 September 2009. Moving west-northwestward, it was upgraded to tropical storm (TS) intensity over the same waters at 18 UTC that day. After turning to the west, it was rapidly upgraded to typhoon (TY) intensity at 00 UTC on 14 September. Moving west-northwestward again, it reached its peak intensity with maximum sustained winds of 105 kt and a central pressure of 915 hPa north of Saipan Island at 12 UTC on 15 September. After recurving west of Iwoto Island on 18 September, Choi-wan accelerated northeastward passing north of the Ogasawara Islands with TY intensity, and transformed into an extratropical cyclone east of Japan at 12 UTC on 20 September soon after being downgraded to severe tropical storm (STS) intensity. It dissipated over the same waters 12 hours later.



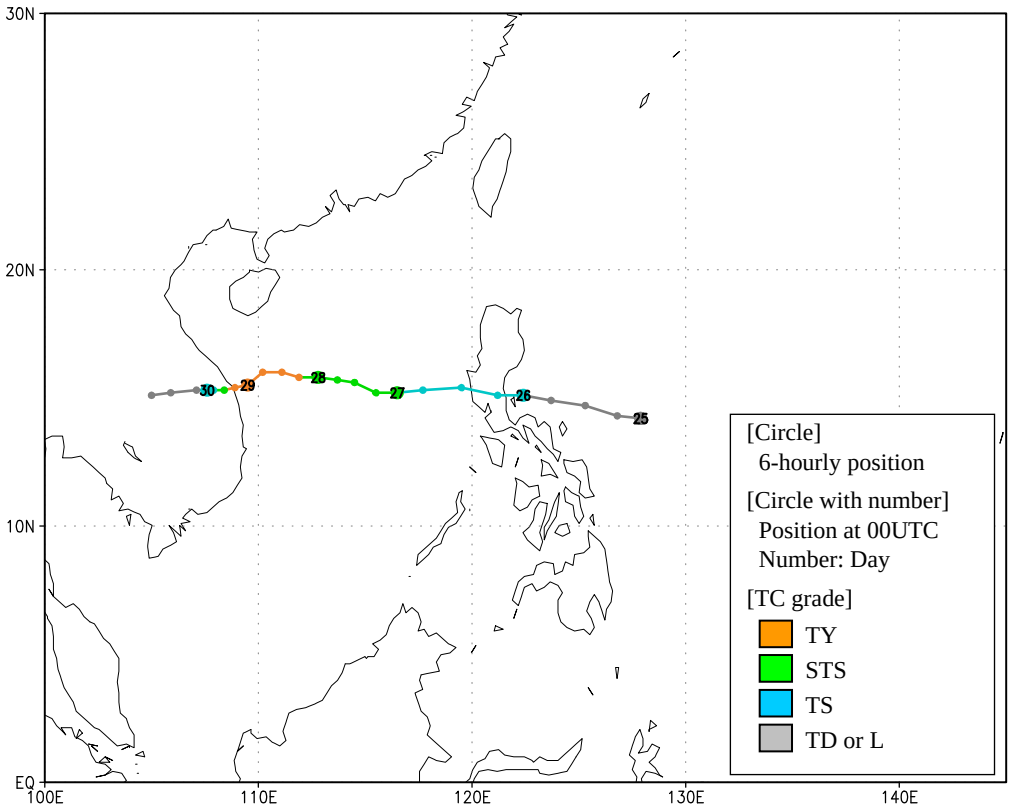
Koppu (0915)

Koppu formed as a tropical depression (TD) off the northern coast of Luzon Island at 00 UTC on 13 September 2009. Moving westward then west-northwestward, it was upgraded to tropical storm (TS) intensity over the South China Sea at 18 UTC that day. It was then upgraded to typhoon (TY) intensity, reaching its peak intensity with maximum sustained winds of 65 kt and a central pressure of 975 hPa at 18 UTC on 14 September. Shortly after, Koppu hit southern China, weakened rapidly and was downgraded to TD intensity at 12 UTC on 15 September before dissipating over southern China 12 hours later.



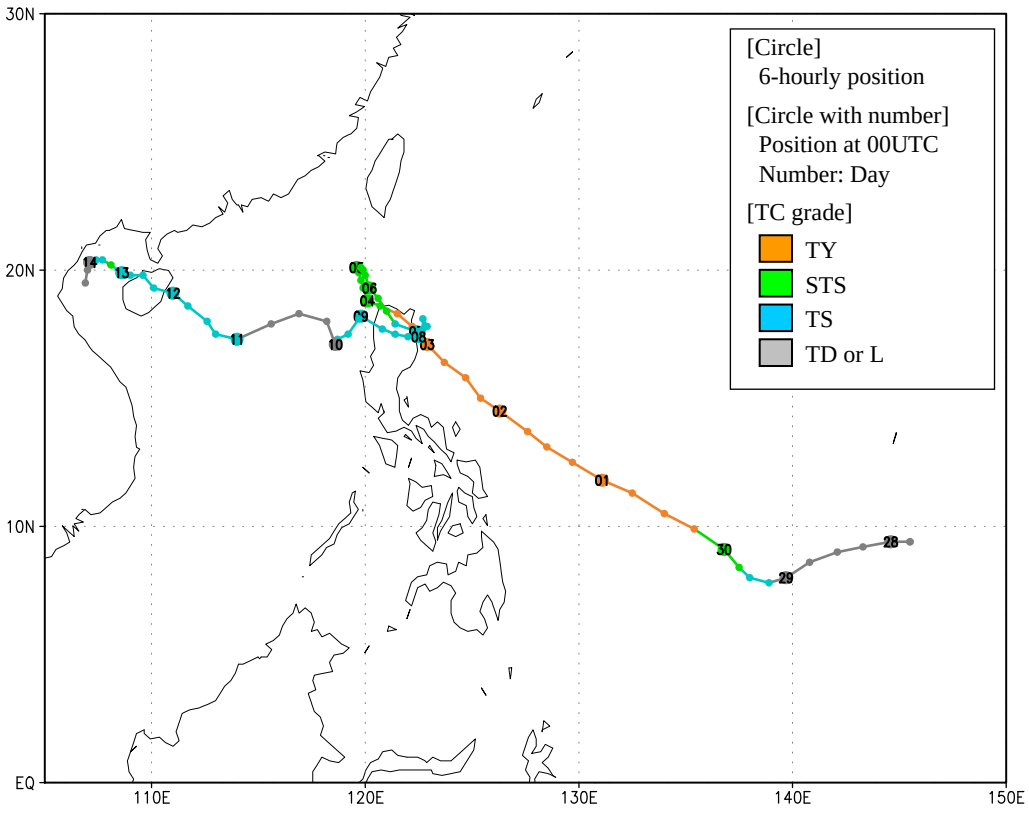
Ketsana (0916)

Ketsana formed as a tropical depression (TD) east of the Philippines at 00 UTC on 25 September 2009 and moved westward for the whole of its existence. It was upgraded to tropical storm (TS) intensity at 00 UTC on 26 September just before crossing Luzon Island. Moving westward over the South China Sea, it was upgraded to typhoon (TY) intensity at 06 UTC on 28 September, reaching its peak intensity with maximum sustained winds of 70 kt and a central pressure of 960 hPa. Ketsana hit Viet Nam the next day with a strength almost equivalent to its peak intensity, then weakened rapidly and was downgraded to TD intensity at 06 UTC on 30 September before dissipating 18 hours later.



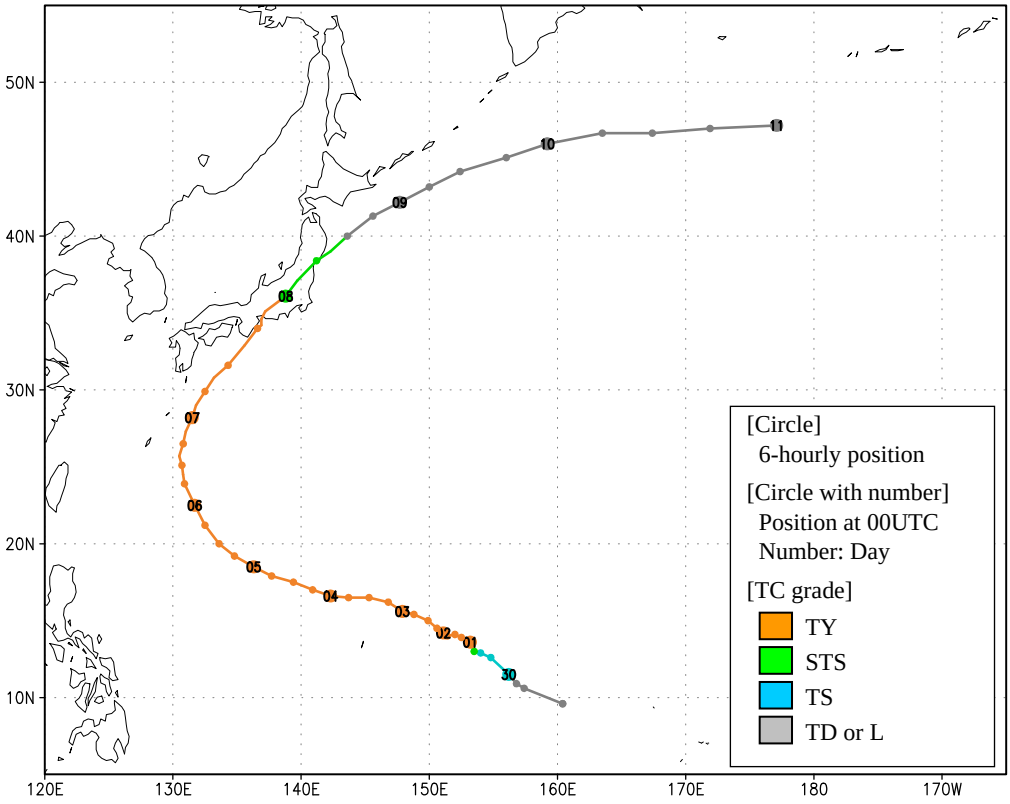
Parma (0917)

Parma formed as a tropical depression (TD) over the sea south of Guam Island at 18 UTC on 27 September 2009. Moving west-southwestward, it was upgraded to tropical storm (TS) intensity southeast of Yap Island at 06 UTC on 29 September. After turning to the west-northwest, it was upgraded to typhoon (TY) intensity north of Palau at 06 UTC on 30 September and reached its peak intensity with maximum sustained winds of 100 kt and a central pressure of 930 hPa over the sea east of the Philippines 18 hours later. It moved northwestward and hit northern Luzon Island on 3 October and then remained in the same area for as long as six days, slowly moving back and forth across the island. Parma was downgraded to TD intensity west of the island at 00 UTC on 10 October. However, while moving westward over the South China Sea, it was re-upgraded to TS intensity at 00 UTC the next day. Moving west-northwestward, it crossed Hainan Island and was re-downgraded to TD intensity over the Gulf of Tonkin at 00 UTC on 14 October before dissipating there 18 hours later.



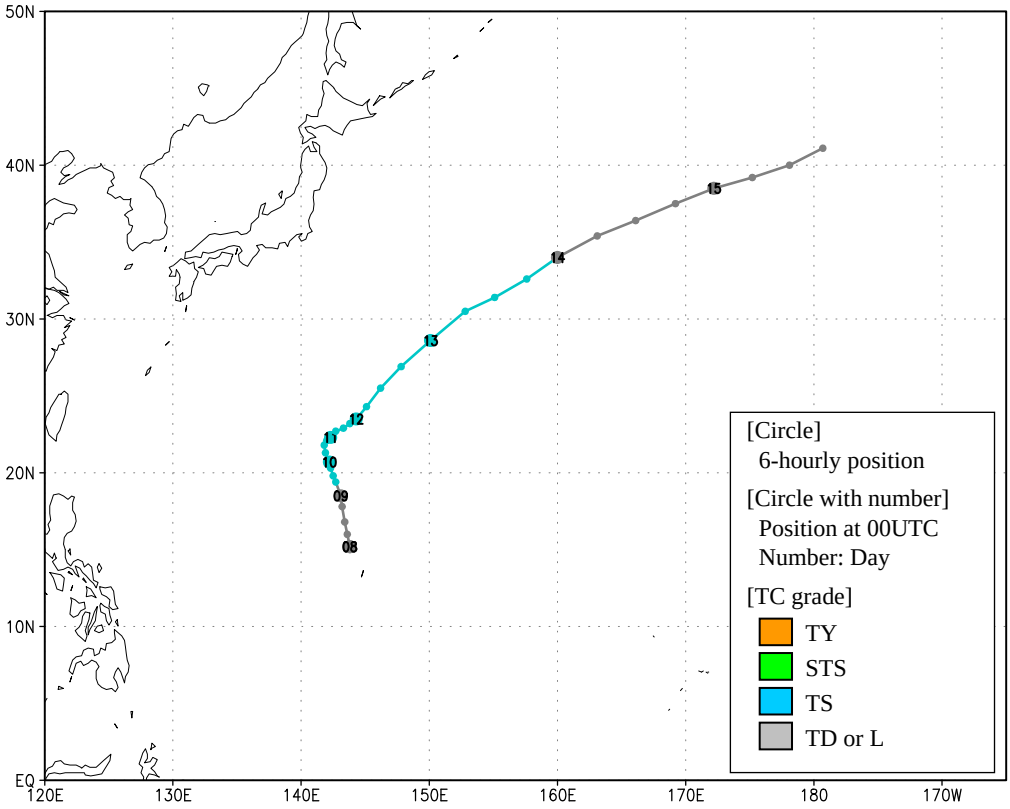
Melor (0918)

Melor formed as a tropical depression (TD) west of the Marshall Islands at 06 UTC on 29 September 2009. Moving west-northwestward, it was upgraded to tropical storm (TS) intensity north of Pohnpei Island at 00 UTC on 30 September. Keeping its west-northwestward track, it was rapidly upgraded to typhoon (TY) intensity east of the Mariana Islands 24 hours later before reaching its peak intensity with maximum sustained winds of 110 kt and a central pressure of 910 hPa west of the same islands at 06 UTC on 4 October. After recurving northward west of Minamidaitojima Island late on 6 October, it moved northeastward south of Japan. Keeping its northeastward track, Melor made landfall on Honshu late the next day with TY intensity, and transformed into an extratropical cyclone over the sea east of Honshu at 12 UTC on 8 October. Turning to the east, it dissipated south of the Aleutian Islands at 06 UTC on 11 October.



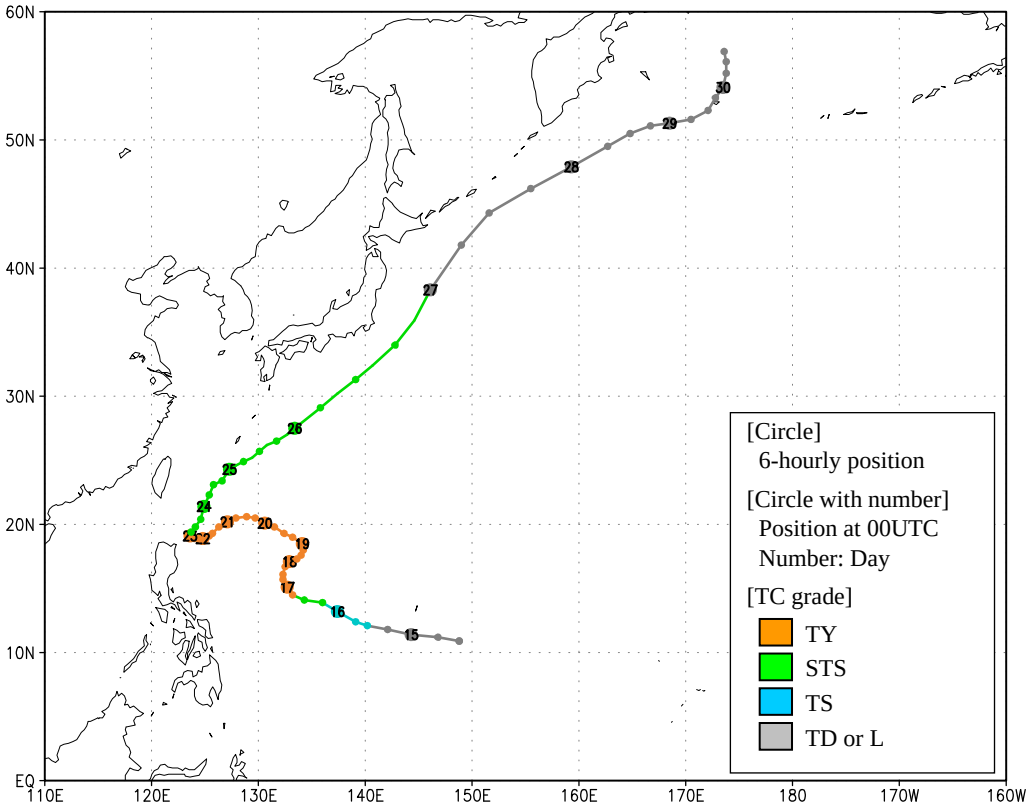
Nepartak (0919)

Nepartak formed as a tropical depression (TD) west of Saipan at 00 UTC on 8 October 2009. Moving north-northwestward, it was upgraded to tropical storm (TS) intensity west of the northern Mariana Islands at 06 UTC the next day. After turning to the northeast, it reached its peak intensity with maximum sustained winds of 45 kt and a central pressure of 992 hPa east of the Ogasawara Islands at 00 UTC on 12 October. Accelerating northeastward to east-northeastward, Nepartak was transformed into an extratropical cyclone east of Japan at 00 UTC on 14 October and crossed longitude 180 degrees east over the sea south of the Aleutian Islands before 18 UTC the next day.



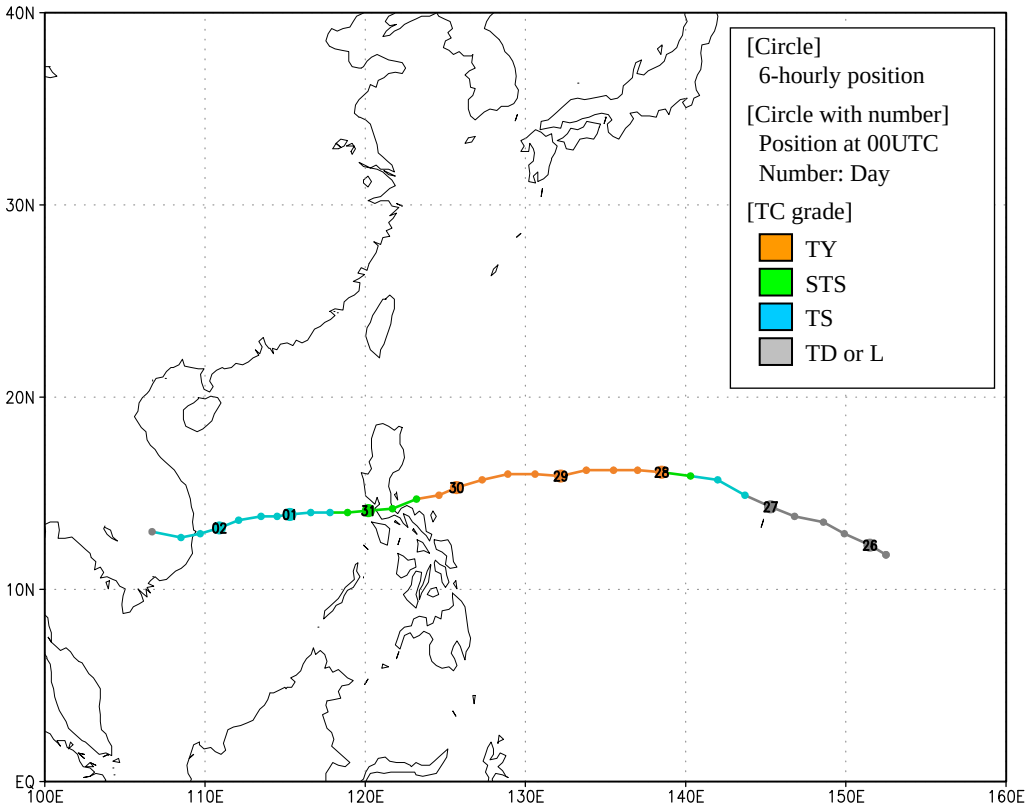
Lupit (0920)

Lupit formed as a tropical depression (TD) southeast of Guam at 12 UTC on 14 October 2009. Moving westward to west-northwestward, it was upgraded to tropical storm (TS) intensity northeast of Yap Island at 12 UTC on 15 October and to typhoon (TY) intensity east of the Philippines at 18 UTC the next day. Lupit slowly moved in a clockwise direction northward before reaching its peak intensity with maximum sustained winds of 95 kt and a central pressure of 930 hPa at 18 UTC on 18 October. After turning west-northwestward then west-southwestward and weakening slowly in intensity, Lupit was downgraded to severe tropical storm (STS) intensity off the northeastern coast of Luzon Island at 06 UTC on 23 October. After changing direction slowly but sharply northeastward, it moved to the south of the Okinawa Islands. Maintaining its STS intensity, it accelerated northeastward along south of the Japanese archipelago and transformed into an extratropical cyclone east of Japan at 00 UTC on 27 October. It dissipated north of the Aleutian Islands at 00 UTC on 31 October, 16.5 days after its formation.



Mirinae (0921)

Mirinae formed as a tropical depression (TD) over the sea north of Chuuk Island at 18 UTC on 25 October 2009. Moving west-northwestward, it was upgraded to tropical storm (TS) intensity northwest of Guam at 06 UTC on 27 October. Keeping its west-northwestward track, Mirinae was upgraded to typhoon (TY) intensity over the sea east of the Philippines at 00 UTC on 28 October and reached its peak intensity with maximum sustained winds of 80 kt and a central pressure of 955 hPa over the same waters 12 hours later. Moving west-southwestward, it was downgraded to severe tropical storm (STS) intensity off the eastern coast of Luzon Island at 12 UTC on 30 October and crossed the island that day. Soon after hitting Viet Nam with TS intensity, Mirinae was downgraded to TD intensity over Cambodia at 18 UTC on 2 November and dissipated six hours later.



Nida (0922)

Nida formed as a tropical depression (TD) west of the Truk Islands at 18 UTC on 21 November 2009. Moving northward then northwestward, it was upgraded to tropical storm (TS) intensity over the same waters at 12 UTC on 23 September. Keeping its northwestward track, it was rapidly upgraded to typhoon (TY) intensity south of Guam 18 hours later before reaching its peak intensity with maximum sustained winds of 115 kt and a central pressure of 905 hPa west of Guam at 18 UTC on 25 November. After reaching the area southeast of Okinotorishima Island at 00 UTC on 28 November, Nida remained almost stationary for two days. At 06 UTC on 30 November, it began to move west-northwestward while weakening in intensity. It was downgraded to severe tropical storm (STS) intensity at 18 UTC on 1 December and then to TD intensity northwest of Okinotorishima Island at 00 UTC on 3 December. Turning to the east, it dissipated over the same waters 18 hours later.