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METEOROLOGICAL COMPONENT

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CHAPTER 1

GENERAL

1.1 Introduction

Typhoons have always been a major threat to the Typhoon Committee region. As a result, they are a common target for meteorological services in the region to monitor, analyse, forecast and warn against.

Under the spirit of international co-operation, a regional programme to mitigate the damage due to tropical cyclones was launched by the Typhoon Committee which was established in 1968. Since its establishment under the auspices of ESCAP in co-operation with the World Meteorological Organization (WMO), the Typhoon Committee has developed its area of activities to consist of three components, i.e., meteorological, hydrological and disaster prevention and preparedness.

Of these components, the meteorological component aims at improving and upgrading the analysis and forecast used for the routine operation. For this purpose, the Typhoon Committee has arranged a variety of co-operation efforts. One of the epoch-making events in the history of the Committee was the Typhoon Operational Experiment (TOPEX), which was organized for all three components. The third component was specifically organized as Warning Dissemination and Information Exchange Component.

The Meteorological Component of TOPEX had a co-operation programme where concerted efforts were exerted to analyze and forecast specified typhoons using common technical procedures. The procedures were described in the TOPEX Operational Manual which had been utilized in meteorological services in the Typhoon Committee region during the operational phase of TOPEX.

Activities of the Meteorological Component of the Typhoon Committee – including execution of the meteorological component of TOPEX for three years – had been planned and organized under the Tropical Cyclone Programme (TCP) of the WMO. The main long-term objective of the TCP is to assist Members in upgrading the capabilities of National Meteorological and Hydrological Services (NMHSs) to provide better tropical cyclone, related flood and storm surge forecasts and more effective warnings through regionally coordinated systems, and to encourage Members to establish national disaster prevention and preparedness measures.

As a result of international cooperation and coordination, and with the aid of meteorology and modern technology, such as satellites, weather radars and computers, all tropical cyclones around the globe are now being monitored from their early stages of formation and throughout their lifetime. Six centres designated by WMO as Regional Specialized Meteorological Centres (RSMCs) located in Honolulu, La Reunion, Miami, Nadi (Fiji), New Delhi and Tokyo, as well as other centres of National Meteorological Services (NMSs) carry out these activities. These centres also provide forecasts on the behaviour of tropical cyclones, their movement and changes in intensity and on associated phenomena – principally storm surges and flash floods.

The responsibility of the RSMC Tokyo - Typhoon Center is the provision of information on tropical cyclones for Members of the Typhoon Committee. Information should

include formation, movement and development of tropical cyclones and associated meteorological phenomena. In addition, synoptic scale atmospheric situation which affects the behaviour of tropical cyclones should also be prepared by the RSMC Tokyo - Typhoon Center and disseminated to National Meteorological Centers (NMCs) in the appropriate format for operational processing. The RSMC Tokyo - Typhoon Center should be operational throughout the year and be manned round the clock when a tropical cyclone exists over the region concerned. The RSMC Tokyo - Typhoon Center should also carry out non-operational functions such as training.

In order to implement the RSMC Tokyo - Typhoon Center in the Typhoon Committee region, the Regional Co-operation Programme was discussed and adopted by the Typhoon Committee at its Extraordinary Session (Manila, March 1986). At the same time, the Committee approved a draft of the Typhoon Committee Operational Manual which specifies in more detail the extent and type of activity of the RSMC Tokyo - Typhoon Center and shows the direction of realizing the regional co-operation between Members.

The Operational Manual consists of the text and the appendices. Items included in the text relate to the Typhoon Committee agreement, in particular, basic information for executing meteorological operation, whilst the appendices contain national practices and procedures (it is felt that the Member concerned should have the right to be able to change without having to get prior formal agreement of the Typhoon Committee) together with detailed and technical information for meteorological operation. Information described in WMO official publications such as Manuals is only referred to and not included in this Manual.

Since March 1986, the draft of the Operational Manual has been revised and is still subject to further refinement and revision through experience gained in the use of the Operational Manual. It is also intended that the text of the Manual be updated or revised from time to time by the Typhoon Committee and that each item of information given in the appendices relating to the Manual be kept up to date by the Members concerned.

1.2 Terminology used in the region

1.2.1 General

Typhoon Committee Members

1.2.2 Classification of tropical cyclones*

(i)	Low pressure area	(L)
(ii)	Depression or tropical depression	(TD)
(iii)	Tropical storm	(TS)
(iv)	Severe tropical storm	(STS)
(v)	Typhoon	(TY)

1.2.3 Tropical cyclone characteristics

(i) position of centre
(ii) confidence in the centre position
(iii) size and shape of eye, if any
(iv) central pressure
(v) direction of movement

* Details are shown in 4.2.

(vi) speed of movement
(vii) maximum sustained wind
(viii) gusts
(ix) storm radius
(x) gale radius
(xi) storm surge potential for a particular coastal location
(xii) storm tide potential for a particular coastal location

1.2.4 Terms related to the warning and warning system

(i) typhoon season
(ii) tropical cyclone advisory
(iii) tropical cyclone information bulletin
(iv) gale warning
(v) storm warning
(vi) typhoon warning
(vii) visual storm signals
(viii) high sea bulletin
(ix) coastal weather bulletin
(x) bulletin or cyclone warning bulletin

1.3 Meaning of terms used for regional exchange

Average wind speed: Speed of the wind averaged over the previous 10 minutes (mean surface wind) as read from the anemogram or the 3 minutes mean determined with the non-recording anemometer or wind averaged over the previous 1 minute (mean surface wind) at 10 meter height or estimated wind at sea by mariners using the Beaufort scale.

Bulletin: Cyclone warning bulletin

Central pressure of a tropical cyclone: Surface pressure at the centre of the tropical cyclone as measured or estimated.

Centre fix of the tropical cyclone: The estimated location of the centre of a tropical cyclone.

Centre of the tropical cyclone: The centre of the cloud eye, or if not discernible, of the wind/pressure centre.

Confidence in the centre position: Degree of confidence in the centre position of a tropical cyclone expressed as the radius of the smallest circle within which the centre may be located by the analysis. "Position good" implies a radius of 30 nautical miles (55 kilometres) or less. "Position fair", a radius of 30 to 60 nautical miles (55 to 110 km) and "Position poor", a radius of greater than 60 nautical miles (110 km).

Cyclone: Tropical cyclone

Cyclone warning bulletin: A priority message for exchange of tropical cyclone information and advisories.

Direction of movement of the tropical cyclone: The direction towards which the centre of the tropical cyclone is moving.

Extra-tropical cyclone: A former tropical cyclone that has gone through extra-tropical transition and lost its initial tropical characteristics.

Extra-tropical transition: is an evolutionary process by which a symmetric warm core tropical cyclone transforms to an asymmetric cold core extratropical cyclone. This process includes a change in the distribution of clouds, winds, and precipitation. Also, the primary energy source changes from latent heat release in deep convective clouds of the tropical cyclone to baroclinic conversion of available potential energy in the extratropical cyclone.

Eye of the tropical cyclone: The relatively clear and calm area inside the circular wall of convective clouds, the geometric centre of which is the centre of the tropical cyclone.

Gale force: Average wind speed in the range of 34 knots (17.2 m/s, 62 km/h) to 47 knots (24.4 m/s, 88 km/h), or wind force 8 or 9 in the Beaufort scale.

Gale warning: Meteorological message intended to warn those concerned of the occurrence or expected occurrence of gale force wind.

Gust: Instantaneous peak value of surface wind speed.

Low pressure area: Region of the atmosphere in which the pressures are lower than those of the surrounding region at the same level. (On the weather map, the low pressure area is denoted with the capital L within the innermost isobar without showing the centre position.)

Maximum sustained wind*: Maximum value of the average wind speed at the surface.

Mean wind speed: Average wind speed.

Reconnaissance aircraft centre fix of the tropical cyclone, vortex fix: The location of the centre of a tropical cyclone obtained by reconnaissance aircraft penetration.

Severe tropical storm: A tropical cyclone with the maximum sustained winds at storm force near the centre.

Speed of movement of the tropical cyclone: Speed of movement of the centre of the tropical cyclone.

Storm force: Average wind speed of 48 knots (24.5 m/s, 89 km/h) to 63 knots (32.6 m/s, 117 km/h) , or wind force 10 or 11 in the Beaufort scale.

Storm surge: The difference between the actual water level under the influence of a meteorological disturbance (storm tide) and the level which would have been attained in the absence of the meteorological disturbance (i.e. astronomical tide). (Storm surge results mainly from the shoreward movement of water under the action of wind stress. A minor contribution is also made by the hydrostatic rise of water resulting from the lowered barometric pressure.)

Storm tide: The actual sea level as influenced by a weather disturbance. The storm tide consists of the normal astronomical tide and the storm surge.

Storm warning: Meteorological message intended to warn those concerned of the occurrence or expected occurrence of storm force wind.

* For converting the wind speeds of different averaging periods such as 1-min, 2-min, 3-min and 10-min, Tropical Cyclone Programme of WMO recommends to follow the guidelines as shown in the Appendix 1-A.

Sub-tropical cyclone: A low pressure system, developing over sub-tropical waters which initially contains few tropical characteristics. With time the sub-tropical cyclone can become tropical.

Sustained wind speed: Average wind speed. Average period of one, three or ten minutes is depending upon the regional practices.

Tropical cyclone: Generic term for a non-frontal synoptic scale cyclone originating over tropical or sub-tropical waters with organized convection and definite cyclonic surface wind circulation. (The term is also used for a storm in the South-West Indian Ocean in which the maximum of the sustained wind speed* is estimated to be in the range of 64 to 90 knots and in the South Pacific and South-East Indian Ocean with the maximum of the sustained over 33 knots.)

Tropical cyclone advisory: A priority message for exchanging information, internationally, on tropical cyclones.

Tropical cyclone coastal crossing: Cyclone centre passage across the coast.

Tropical depression: A tropical cyclone with the maximum sustained winds of 33 knots (17.1 m/s, 61 km/h) or less near the centre.

Tropical disturbance: A non-frontal synoptic scale cyclone originating in the tropics or sub-tropics with enhanced convection and light surface winds.

Tropical cyclone impact: Evidence of damage or disruption caused by tropical cyclone-generated hazard(s) either direct or indirect. (includes damaging large swells from distant tropical cyclones).

Tropical cyclone island crossing: Cyclone centre passage across the island.

Tropical cyclone landfall: refer to tropical cyclone coastal crossing.

Tropical storm: A tropical cyclone with the maximum sustained winds at gale force near the centre.

Tropical wave: A trough or cyclonic curvature maximum in the trade wind easterlies or equatorial westerlies. The wave may reach maximum amplitude in the lower middle troposphere, or may be the reflection of an upper-troposphere cold low or equatorial extension of a mid-latitude trough.

Typhoon: A tropical cyclone with the maximum sustained winds at typhoon force near the centre.

Typhoon force: Average wind speed of 64 knots (32.7 m/s, 118 km/h) or more, or wind force 12 in the Beaufort scale.

Typhoon warning: Meteorological message intended to warn those concerned of the occurrence or expected occurrence of typhoon force wind.

Visual storm signals: Visual signals displayed at coastal points to warn ships of squally winds, gales and tropical cyclones.

Weather warning: Meteorological message issued to provide appropriate warnings or hazardous weather conditions.

Zone of disturbed weather: A zone in which the pressure is low relative to the surrounding region and there are convective cloud masses which are not organized.

1.4 Units used for regional exchange

(a) The following units/indicators are used for marine purposes:

(i) Distance in nautical miles, the unit (nm) being stated;

(ii) Location (position) by degrees and where possible tenths of degrees of latitude and longitude preferably expressed by words;

(iii) Direction to the nearest sixteen points of the compass or in degree to the nearest ten, given in words;

(iv) Speed (wind speed and speed of movement of tropical cyclones) in knots, the unit (kt) being stated;

(v) Confidence in the centre position in nautical miles (nm) or in position good, fair or poor;

(b) The following units/indicators are used in non-coded segments of exchanges, other than marine bulletins:

(i) Distance in kilometres (km) or nautical miles (nm);

(ii) Location (position) by degrees and tenths of degrees in figures of latitude and longitude and/or bearing on the sixteen point compass and distance from well-known fixed place(s);

(iii) Direction in sixteen points of compass given in figures;

(iv) Speed (wind speed and speed of movement of system) in knots (kt), metres per second (m/s) or kilometres per hour (km/h);

(v) Confidence in the centre position in kilometres (km), nautical miles (nm) or in position good, fair or poor.

1.5 Identification of tropical cyclones

As soon as the wind speed in a tropical cyclone in the responsible area of the RSMC Tokyo - Typhoon Center (between 0°N and 60°N and between 100°E and 180°E) attains 34 knots, it will be given an identification name with a 4-digit number by the RSMC Tokyo - Typhoon Center. Each tropical cyclone should be identified by one of the names in Appendix 1-B, followed by the 4-digit number in brackets, whose number will consist of a year identification and a serial number identification (in two digits each). For example, the first tropical cyclone attaining the 34 knots threshold value in 2000 in the responsible area of the RSMC Tokyo-Typhoon Center will be identified as Damrey (0001). If the life of a tropical cyclone spans two calendar years, it will be accounted for in the year in which it has intensified to the stage where the wind speed has attained the 34 knots threshold value.

1.6 Acronyms

A list of acronyms used in this Operational Manual is shown in Appendix 1-C.

CHAPTER 2

OBSERVING SYSTEM AND OBSERVING PROGRAMME

2.1 Networks of synoptic land stations

The surface and upper-air stations in the regional basic synoptic network are those of the Typhoon Committee Members and are registered in Weather Reporting Volume A - Observing stations (WMO Publication No. 9).

The RSMC Tokyo - Typhoon Center and all Typhoon Committee Members should initiate enhanced observation programmes for their stations in the area within 300 km of the centre of a tropical cyclone of TS intensity or higher. All the observations should be made available to the RSMC Tokyo - Typhoon Center and all Members. Enhanced observations should include:

(i) surface observations - hourly;
(ii) buoy observations - hourly;
(iii) radar observations - hourly;
(iv) upper-air observations - 6-hourly.

2.1.1 Surface observations

All surface stations included in the regional basic synoptic network should make surface observations at the four main standard times of observation, i.e., 0000, 0600, 1200 and 1800 UTC, and at the four intermediate standard times of observation, i.e., 0300, 0900, 1500 and 2100 UTC. Any surface station that cannot carry out the full observational programme should give priority to carrying out the observations at the main standard times. Additional surface observations at hourly intervals may be requested by any Member, whenever a tropical cyclone becomes an imminent threat to the Member, from the stations shown in Appendix 2-A.

2.1.2 Upper-air synoptic observations

All the upper-air stations included in the regional basic synoptic network should carry out radiosonde and radiowind observations at 0000 and 1200 UTC, and radiowind observations at 0600 and 1800 UTC. The radiosonde/radiowind observations carried out at 0000 and 1200 UTC should reach the 30 hPa level for more than 50 per cent of the ascents. The carrying out of the radiosonde/radiowind observations at 0000 and 1200 UTC should receive priority over the radiowind observations at 0600 and 1800 UTC.

Upper-air stations in the areas affected by tropical cyclones of TS intensity or higher should also make radiowind observations at 0600 and 1800 UTC which should aim at reaching the 70 hPa level.

Enhanced upper-air observations given in Appendix 2-B will be made as appropriate whenever a tropical cyclone of TS intensity or higher is centred within 300 km of the station. The minimum required is two observations per day, but for a better understanding of the ambient wind field three or even four ascents per day on some days should be made when possible. All data of these enhanced upper-air observations will be distributed among the Members.

In addition to the upper-air synoptic observations, newly developed observations such as wind profiler observations should be carried out when possible and the data should be made available to the Members.

2.2 Ship and buoy observations

Hourly marine meteorological observations are made by the JMA research vessels (call signs of them are: JPBN and JGQH) in the seas adjacent to Japan and in the western North Pacific.

Upper-air observations are usually made twice a day (00, 12 UTC) on board the JMA research vessel JGQH. Enhanced upper-air observations are carried out six-hourly when the vessel is in the vicinity of a tropical cyclone of TS intensity or higher.

Marine meteorological observations are made by the Voluntary Observing Ships which are recruited by the Members in accordance with the WMO Voluntary Observing Ship's Scheme. These are generally carried out every six hours and transmitted over the GTS. In addition, marine meteorological observations are reported hourly by on-board automatic weather stations on some of the Voluntary Observing Ships.

Marine meteorological observations, such as air pressure, sea surface temperature, significant wave height and period, are also made by the drifting ocean data buoys by the Members. All reports are coded in the BUOY code (FM18), and immediately put onto the GTS. A list of the drifting buoy observations by the Members is shown in Appendix 2-C.

2.3 Radar observations

It is essential that radar observations continue as long as a tropical cyclone of TS intensity or higher remains within the detection range of the radar. All meteorological centres should co-operate to ensure that the radar observations are transmitted through the GTS to the RSMC Tokyo - Typhoon Center and all Members. Reports will be coded in the BUFR code (FM-94) with RADOB Template (TM316050) and/or the RADOB code (FM 20-VIII).

In case the report is in plain language, the full range of information available at the radar station should be given. The message will therefore include, where available, the confirmation of the determination of the centre, the shape, definition, size and character tendency of the eye, the distance between the end of the outermost band and the centre of the cyclone and the direction and speed of movement with a statement of the interval of time over which the movement was calculated.

Distribution of the radar stations and detailed information on the radar equipment of the Typhoon Committee Members are given in Appendices 2-D and 2-E.

2.4 Meteorological satellite observations

2.4.1 Satellite imagery data and related products

JMA started the operation of its new geostationary meteorological satellite, Himawari-8, at 02:00 UTC on 7 July 2015, replacing the previous satellite MTSAT-2. The agency also launched Himawari-9, which is identical to the Himawari-8 unit, on 2 November 2016. After a period of in-orbit testing, Himawari-9 began serving as back-up to Himawari-8 on 10 March 2017 and will continue in this role until the planned switchover in or around

2022. This dual combination of new-generation satellites will support JMA's stable provision of continuous satellite observation data for the Asia-Oceania region until 2029.

The meteorological satellite information obtained by Himawari-8/9 and related products are operated as follows:

(i) full disk data are obtained every 10 minutes with 16 observation bands;
(ii) target area data are obtained every 2.5 minutes;
(iii) AMV data are derived hourly;
(iv) Clear Sky Radiance (CSR) data are derived hourly from the full disk data.

Detailed information is given in Appendix 2-F.

A list of satellite imagery receiving facilities at meteorological centres of the Typhoon Committee Members is given in Appendix 2-G.

2.4.2 SAREP reports

SAREP reports (Part A) are disseminated eight times a day in the following cases from the RSMC Tokyo - Typhoon Center to Typhoon Committee Members through the GTS under the heading of IUCC10 RJTD in the BUFR code (FM 94):

(i) when a tropical cyclone of TS intensity or higher is located in the responsible area of the RSMC Tokyo - Typhoon Center;
(ii) when a tropical depression existing in the responsible area is forecasted to have an intensity of TS or higher within 24 hours; or
(iii) when an area of wind speed of 34 knots or higher caused by a tropical cyclone is forecasted to be in the responsible area within 24 hours.

SAREP reports are also issued by other Typhoon Committee Members. A list of SAREP reports issued by the RSMC Tokyo – Typhoon Center and other Typhoon Committee Members is shown in Appendix 2-H.

2.5 Aircraft observations

Reports from aircraft in flight (AIREPs) in the Typhoon Committee Members areas are collected and exchanged according to the Regional OPMET Bulletin Exchange (ROBEX) scheme∗.

AIREPs in the north-east Pacific area are also collected by the centres at Honolulu, Washington, etc., and relayed to Tokyo.

AMDAR (Aircraft Meteorological Data Relay) reports are collected by the NMHSs involved in respective AMDAR Programmes and relayed via the GTS to the centre at Tokyo.

All reports will be disseminated in real-time to the RSMC Tokyo - Typhoon Center and to other Members through GTS and AFTN circuits.

The Members conduct reconnaissance flights for selected tropical cyclones. Detailed information of reconnaissance flights conducted by the Members is given in Appendix 2-I.

∗ ICAO ROBEX scheme is the method to exchange operational aeronautical meteorological (OPMET) information. The scheme consists of ROBEX collecting and disseminating centres (ROBEX centres), regional OPMET data banks (RODB), and interregional OPMET gateways (IROG).

2.6 Tropical cyclone passage report

Each Member's tropical cyclone forecast center should compile reliable passage, landfall, near-buoy passage and near-ship passage data, tabulate that data and send it to the Typhoon Committee Secretariat (TCS) within a week after cyclone passage for distribution to other Members. The task is assigned to the focal point for the meteorological component of each Member. A proposed tropical cyclone passage report form is shown in Appendix 2-J.

CHAPTER 3

TROPICAL CYCLONE ANALYSIS AND FORECAST

3.1 Analysis at RSMC Tokyo - Typhoon Center

The RSMC Tokyo - Typhoon Center should produce analyses of various meteorological parameters in chart form and/or in grid point value depending on the facilities of NMCs to process these products. These analyses should include pressure distribution at the sea level and temperature, geo-potential height, humidity and wind at selected pressure levels.

The streamline analysis is indispensable over the tropical region for forecasting tropical cyclones. The RSMC Tokyo - Typhoon Center should produce streamline analyses of the upper and lower atmospheric levels utilizing cloud motion wind, aircraft reports, as well as upper-air observations. Furthermore, the RSMC Tokyo - Typhoon Center should issue analyses of ocean wave and sea surface temperature for the western North Pacific. A list of products provided by the RSMC Tokyo - Typhoon Center is given in Tables 3.1 to 3.4.

The RSMC Tokyo - Typhoon Center should produce additional analyses of the tropical cyclone when it is in the responsible area, based on the enhanced observations. Such analyses should be disseminated in the form of additional bulletins consisting of information on:

(i) position of the tropical cyclone;

(ii) direction and speed of movement;

(iii) central pressure;

(iv) maximum wind and wind distribution.

Various analyses based on Himawari data other than cloud imagery itself should be produced by the RSMC Tokyo - Typhoon Center. Analysis of sea-surface temperature combining satellite data and in-situ measurements should be prepared every five days. These analyses are useful for the better understanding of the tropical atmosphere and medium-range assessment of forecasting tropical cyclones.

Table 3.1 Chart-form products provided by RSMC Tokyo - Typhoon Center for regional purposes

Area	Contents and Level	Forecast hours	Initial time	Availability
A' (Far East)	500hPa (Z, ζ)	Analysis	00, 12UTC	GTS
		24, 36	00, 12UTC	GTS, JMH
	500hPa (T), 700hPa (D)	24, 36	00, 12UTC	GTS, JMH
	700hPa (ω), 850hPa (T, A)	Analysis	00, 12UTC	GTS
		24, 36	00, 12UTC	GTS, JMH
	Surface (P, R, A)	24, 36	00, 12UTC	GTS, JMH
C (East Asia)	300hPa (Z, T, W, A)	Analysis	00UTC	GTS
	500hPa (Z, T, A)	Analysis	00, 12UTC	GTS, JMH
	500hPa (Z, ζ)	48, 72	00, 12UTC	GTS
	700hPa (Z, T, D, A)	Analysis	00, 12UTC	GTS
	700hPa (ω), 850hPa (T, A)	48, 72	12UTC	GTS
	850hPa (Z, T, D, A)	Analysis	00, 12UTC	GTS, JMH
	Surface (P, R)	24, 48, 72	00, 12UTC	GTS, JMH
		96, 120	12UTC	JMH
O (Asia)	500hPa (Z, ζ)	96, 120, 144, 168, 192	12UTC	GTS
	850hPa (T), Surface (P)			
Q (Asia Pacific)	200hPa (Z, T, W), Tropopause (Z)	Analysis	00, 12UTC	GTS
	250hPa (Z, T, W)	Analysis, 24	00, 12UTC	
	500hPa (Z, T, W)	24	00, 12UTC	
D (N.H.)	500hPa (Z, T)	Analysis	12UTC	GTS
W (NW Pacific)	200hPa (streamline)	Analysis, 24, 48	00, 12UTC	GTS
	850hPa (streamline)		00, 12UTC	
C'' (NW Pacific)	Ocean Wave (height, period and direction)	Analysis	00, 12UTC	GTS, JMH
	Ocean Wave (height, period and direction)	12, 24, 48, 72		
	Ocean Wave (height, period, direction and rough sea area)	24		
C	Sea Surface Temperature	Daily analysis	-	JMH
C'2 (Asia Pacific)	Surface (P)	Analysis	00,06,12, 18UTC	GTS, JMH
		24	00, 12UTC	
		48		
	Surface (Typhoon Forecast)	12,24,48,72	00,06,12, 18UTC	
		24,48,72,96, 120		JMH

Notes:

(a) Area

A', C, O, Q, D, W,C'' and C'2 are illustrated in Figure 3.1.

(b) Contents

Z: geopotential height	ζ: vorticity	T: temperature
D: dewpoint depression	ω: vertical velocity	W: wind speed by isotach
A: wind arrows	P: sea level pressure	R: rainfall

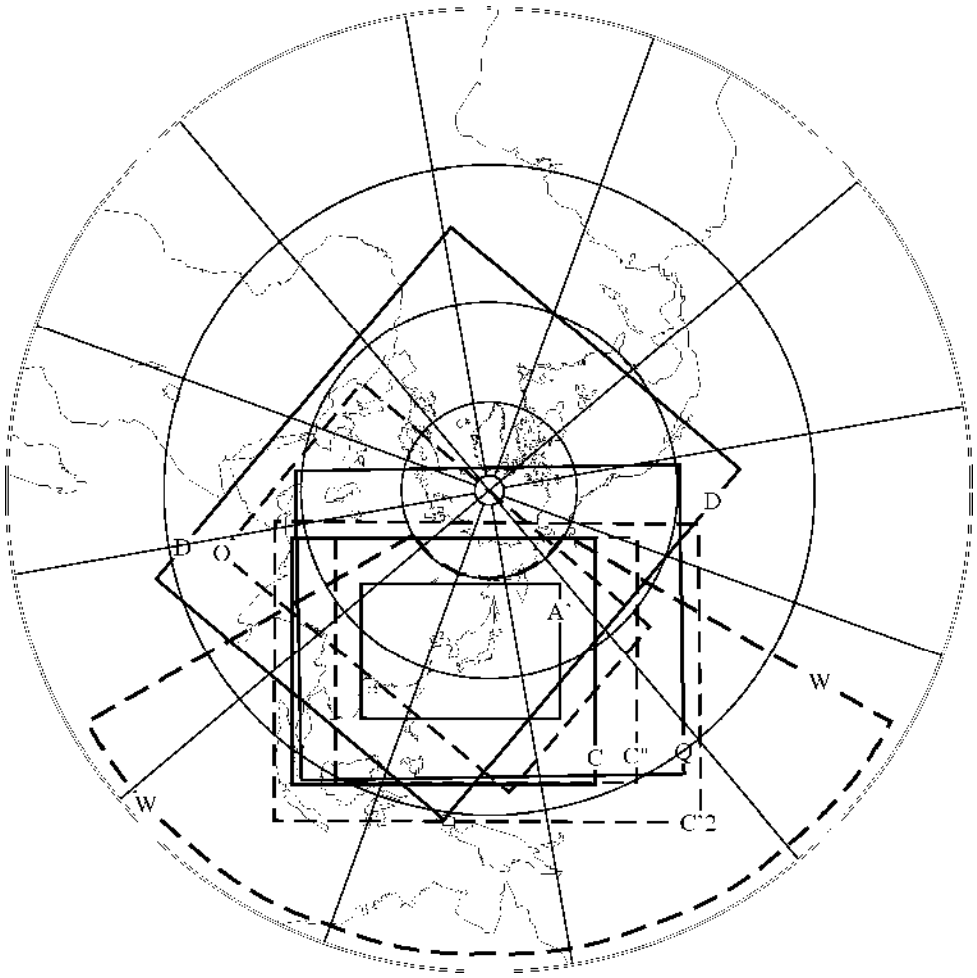

Figure 3.1 Output areas for facsimile charts transmitted through GTS and radio facsimile JMH

Table 3.2 NWP products (GSM and EPS) provided by RSMC Tokyo - Typhoon Center
(Available at http://www.wis-jma.go.jp/cms/)

Model	GSM	GSM	GSM
Area and resolution	Whole globe, 1.25°×1.25°	20°S–60°N, 60°E–160°W 1.25°×1.25°	Whole globe, 2.5°×2.5°
Levels and elements	10 hPa: Z, U, V, T 20 hPa: Z, U, V, T 30 hPa: Z, U, V, T 50 hPa: Z, U, V, T 70 hPa: Z, U, V, T 100 hPa: Z, U, V, T 150 hPa: Z, U, V, T 200 hPa: Z, U, V, T, ψ, χ 250 hPa: Z, U, V, T 300 hPa: Z, U, V, T, H, ω 400 hPa: Z, U, V, T, H, ω 500 hPa: Z, U, V, T, H, ω, ζ 600 hPa: Z, U, V, T, H, ω 700 hPa: Z, U, V, T, H, ω 850 hPa: Z, U, V, T, H, ω, ψ, χ 925 hPa: Z, U, V, T, H, ω 1000 hPa: Z, U, V, T, H, ω Surface: P, U, V, T, H, R†	10 hPa: Z, U, V, T 20 hPa: Z, U, V, T 30 hPa: Z, U, V, T 50 hPa: Z, U, V, T 70 hPa: Z, U, V, T 100 hPa: Z, U, V, T 150 hPa: Z, U, V, T 200 hPa: Z[§], U[§], V[§], T[§], ψ, χ 250 hPa: Z, U, V, T 300 hPa: Z, U, V, T, D 400 hPa: Z, U, V, T, D 500 hPa: Z[§], U[§], V[§], T[§], D[§], ζ 700 hPa: Z[§], U[§], V[§], T[§], D[§], ω 850 hPa: Z[§], U[§], V[§], T[§], D[§], ω, ψ, χ 925 hPa: Z, U, V, T, D, ω 1000 hPa: Z, U, V, T, D Surface: P[¶], U[¶], V[¶], T[¶], D[¶], R[¶]	10 hPa: Z*, U*, V*, T* 20 hPa: Z*, U*, V*, T* 30 hPa: Z°, U°, V°, T° 50 hPa: Z°, U°, V°, T° 70 hPa: Z°, U°, V°, T° 100 hPa: Z°, U°, V°, T° 150 hPa: Z*, U*, V*, T* 200 hPa: Z, U, V, T 250 hPa: Z°, U°, V°, T° 300 hPa: Z, U, V, T, D*‡ 400 hPa: Z*, U*, V*, T*, D*‡ 500 hPa: Z, U, V, T, D*‡ 700 hPa: Z, U, V, T, D 850 hPa: Z, U, V, T, D 1000 hPa: Z, U*, V*, T*, D*‡ Surface: P, U, V, T, D*‡, R†
Forecast hours	0–84 every 6 hours and 96–192 every 12 hours for 12UTC initial † Except analysis	0–84 (every 6 hours) § 96–192 (every 24 hours) for 12UTC initial ¶ 90–192 (every 6 hours) for 12UTC initial	0–72 every 24 hours and 96–192 every 24 hours for 12UTC ° 0–120 for 12UTC † Except analysis * Analysis only
Initial times	00, 06, 12, 18UTC	00, 06, 12, 18UTC	00UTC and 12UTC ‡ 00UTC only

Model	Global EPS
Area and resolution	Whole globe, 2.5°×2.5°
Levels and elements	250 hPa: μU, σU, μV, σV 500 hPa: μZ, σZ 850 hPa: μU, σU, μV, σV, μT, σT 1000 hPa: μZ, σZ Surface: μP, σP
Forecast hours	0–192 every 12 hours
Initial times	00, 12UTC

Model	GSM	GSM
Area and resolution	5S-90N and 30E-165W, Whole globe 0.25° × 0.25°	5S-90N and 30E-165W, Whole globe 0.5° × 0.5°
Levels and elements	Surface: U, V, T, H, P, Ps, R, Cla, Clh, Clm, Cll	10 hPa: Z, U, V, T, H, ω 20 hPa: Z, U, V, T, H, ω 30 hPa: Z, U, V, T, H, ω 50 hPa: Z, U, V, T, H, ω 70 hPa: Z, U, V, T, H, ω 100 hPa: Z, U, V, T, H, ω 150 hPa: Z, U, V, T, H, ω 200 hPa: Z, U, V, T, H, ω, ψ, χ 250 hPa: Z, U, V, T, H, ω 300 hPa: Z, U, V, T, H, ω 400 hPa: Z, U, V, T, H, ω 500 hPa: Z, U, V, T, H, ω, ζ 600 hPa: Z, U, V, T, H, ω 700 hPa: Z, U, V, T, H, ω 800 hPa: Z, U, V, T, H, ω 850 hPa: Z, U, V, T, H, ω, ψ, χ 900 hPa: Z, U, V, T, H, ω 925 hPa: Z, U, V, T, H, ω 950 hPa: Z, U, V, T, H, ω 975 hPa: Z, U, V, T, H, ω 1000 hPa: Z, U, V, T, H, ω Surface: U, V, T, H, P, Ps, R, Cla, Clh, Clm, Cll
Forecast hours	0– 84 (every 3 hours) 90– 264 (every 6 hours) are available for 12 UTC Initial	0– 84 (every 3 hours) 90– 264 (every 6 hours) are available for 12 UTC Initial
Initial times	00, 06, 12, 18 UTC	00, 06, 12, 18 UTC

Notes: Z: geopotential height U: eastward wind V: northward wind
T: temperature D: dewpoint depression H: relative humidity
ω: vertical velocity ζ: vorticity ψ: stream function
χ: velocity potential P: sea level pressure Ps: pressure
R: rainfall Cla: total cloudiness Clh: cloudiness (upper layer)
Clm: cloudiness (middle layer) Cll: cloudiness (lower layer)

The prefixes μ and σ represent the average and standard deviation of ensemble prediction results respectively.
The symbols °, *, ¶, §, ‡ and † indicate limitations on forecast hours or initial time as shown in the tables.

Table 3.3 List of other products provided by RSMC Tokyo - Typhoon Center
(Available at the Global Information System Center Tokyo server: http://www.wis-jma.go.jp/cms/)

Data	Contents / frequency (initial time)
Satellite products	High density atmospheric motion vectors (BUFR) Himawari-8 (VIS, IR, WVx3: every hour), 60S-60N, 90E-170W Clear Sky Radiance (CSR) data (BUFR) Himawari-8 radiances and brightness temperatures averaged over cloud-free pixels: every hour
Tropical cyclone Information	Tropical cyclone related information (BUFR) • tropical cyclone analysis data (00, 06, 12 and 18 UTC)
Wave data	Global Wave Model (GRIB2) • significant wave height • prevailing wave period • wave direction Forecast hours: 0–84 every 6 hours (00, 06 and 18UTC) 0–84 every 6 hours and 96-192 every 12 hours (12 UTC)
Observational data	(a) Surface data (TAC/TDCF) SYNOP, SHIP, BUOY: Mostly 4 times a day (b) Upper-air data (TAC/TDCF) TEMP (parts A-D), PILOT (parts A-D): Mostly twice a day
SATAID service	(a) Satellite imagery (SATAID) Himawari-8 (b) Observation data (SATAID) SYNOP, SHIP, METAR, TEMP (A, B) and ASCAT sea-surface wind (c) NWP products (SATAID) GSM (Available at http://www.wis-jma.go.jp/cms/sataid/)

Table 3.4 List of other products provided by RSMC Tokyo - Typhoon Center
(Available at the Numerical Typhoon Prediction Website:
https://tynwp-web.kishou.go.jp/)

Products	Frequency	Details
Observation/Analysis		
TC Analysis	At least 4 times/day	• Results and historical logs of RSMC Tokyo – Typhoon Center's TC analysis conducted using satellite images (Conventional Dvorak analysis and Early-stage Dvorak analysis)
Satellite Microwave Products		• TC snapshot images • Warm-core-based TC intensity estimates • Weighted consensus TC intensity estimates made using Dvorak analysis and satellite microwave warm-core-based intensity estimates
Radar	Every hour	• Radar composite imagery of the Typhoon Committee Regional Radar Network
Upper-Air Analysis	4 times/day	• Upper-air analysis based on GSM initial field data - Streamlines at 850 and 200 hPa - Vertical wind shear between 200 and 850 hPa - Divergence at 200 hPa - Vorticity at 850 hPa
Ocean Analysis	Once/day	• Sea surface temperature and difference from 24 hours ago • Tropical cyclone heat potential and difference from 24 hours ago
Forecasting/NWP		
TC Track Prediction	4 times/day	• TC track prediction of deterministic NWP models from nine centers (BoM, CMA, CMC, DWD, ECMWF, KMA, NCEP, UKMO and JMA) and a related consensus • TC track prediction of ensemble NWP models from four centers (ECMWF, NCEP, UKMO and JMA)
NWP Weather Maps	Twice/day	• Mean sea level pressure and 500 hPa Geopotential height (up to 72 hours at 00 UTC, up to 168 hours at 12 UTC) of deterministic NWP models from nine centers (BoM, CMA, CMC, DWD, ECMWF, KMA, NCEP, UKMO and JMA)
TC Activity Prediction	Twice/day	• Two- and five-day TC activity prediction maps based on ensemble NWP models from two centers (ECMWF and UKMO) and a related consensus
Storm Surge/Waves		
Storm Surge Forecasts	4 times/day	• Distribution maps of storm surge for RSMC Tokyo – Typhoon Center's TC track forecast and each of five TC track forecasts selected from GEPS ensemble members and maximum storm surge among these six TC track forecasts (up to 72 hours ahead) • Time-series storm surge forecast charts for RSMC Tokyo – Typhoon Center's TC track forecast and each of five TC track forecasts selected from GEPS ensemble members (up to 72 hours ahead)
Wave Height Forecasts	4 times/day	• Distribution maps of ensemble mean wave height, maximum wave height, probability of exceeding various wave heights and ensemble spread based on Wave EPS Model (up to 264 hours ahead) • Time-series charts of ensemble mean wave height with ensemble spread information and probability of exceeding various wave heights based on Wave EPS Model (up to 264 hours ahead)

3.2 Forecast at RSMC Tokyo - Typhoon Center

The RSMC Tokyo - Typhoon Center should prepare the products for numerical weather prediction shown in the WMO Manual on the Global Data-Processing and Forecasting System (GDPFS). These products should be made available to Members in real-time, and should include the following:

(i) deterministic forecast products of a high resolution global model to predict the change in large-scale atmospheric circulation patterns as well as the tropical cyclone movement and intensity

(ii) ensemble forecast products using a lower resolution version of the global model to enable estimation of uncertainties in tropical cyclone movement and intensity as well as to reduce forecast errors by using statistical methods such as ensemble mean.

The RSMC Tokyo - Typhoon Center should also prepare several statistical models for predicting the track of the tropical cyclone and apply the Dvorak method for the prediction of the intensity change of the tropical cyclone. Other relevant synoptic methods should also be applied for predicting the tropical cyclone.

The RSMC Tokyo - Typhoon Center should summarize in a consolidated form all available information and prepare the final forecasts of the tropical cyclone when it exists in the responsible area. These forecasts should include:

(i) 24, 48, 72, 96 and 120-hour forecast position;

(ii) forecast intensity and wind distribution;

(iii) prognostic reasoning;

(iv) tendency assessment if possible.

Furthermore, the RSMC Tokyo - Typhoon Center should prepare a 24-hour ocean wave forecast once a day for the western North Pacific. Storm surge products suitable for the Typhoon Committee region should be provided by the RSMC Tokyo - Typhoon Center. A list of forecast products of the RSMC Tokyo - Typhoon Center, other than alphanumeric form, is shown in Tables 3.1 to 3.4.

3.3 Operational analysis and forecast at centres of Typhoon Committee Members

The NMSs of Typhoon Committee Members are performing analysis and forecasting development and movement of tropical cyclones in the region. The final responsibility for the operational analysis and forecasting will be with the NMSs of each of the Members.

CHAPTER 4

TROPICAL CYCLONE WARNINGS AND ADVISORIES

4.1 General

The responsibility for warning the human settlements on land which are threatened by a tropical cyclone rests in all cases with the NMSs. These national responsibilities are not subject to regional agreement. Therefore, only the cyclone warning systems intended for international users and exchanges among the Typhoon Committee Members are described in this chapter.

4.2 Classification of tropical cyclones[*, **]

Classifications of tropical cyclones for the exchange of messages among the Typhoon Committee Members are given below:

(i)	Low pressure area	(L)	Central position cannot be accurately assessed
(ii)	Tropical depression	(TD)	Central position can be identified, but the maximum sustained wind is 33 kt or less.
(iii)	Tropical storm	(TS)	Maximum sustained wind is between 34 and 47 kt.
(iv)	Severe tropical storm	(STS)	Maximum sustained wind is between 48 and 63 kt.
(v)	Typhoon	(TY)	Maximum sustained wind is 64 kt or more.

4.3 Tropical cyclone advisories

The RSMC Tokyo - Typhoon Center should disseminate six to three-hourly analyses and forecasts of tropical cyclones in the form of bulletins (tropical cyclone advisories - see examples in Appendix 4-B):

(i) analysis of the central position, intensity and wind distribution;

(ii) 24, 48, 72, 96 and 120-hour forecasts of the central position;

(iii) forecasts of intensity and wind distribution;

(iv) prognostic reasoning;

(v) tendency assessment if possible.

[*] "Tropical cyclone" is a generic term that includes tropical depression, tropical storm, severe tropical storm and typhoon.

[**] Classifications internally used by Members are shown in Appendix 4-A.

4.4 Tropical cyclone warnings for the high seas

The WMO in its Manual on Marine Meteorological Services sets out the issue of weather and sea bulletins for the high seas in six parts. The first part relates to storm warnings in plain language. Areas of responsibility of each nation for issuing the storm warnings are pre-assigned. The pre-assigned forecast areas of Typhoon Committee Members were agreed upon by Regional Associations II and V (Res. 17 (IV-RA II) and Res.10 (IV-RA V)). Weather forecast areas fixed nationally by individual Typhoon Committee Members are shown in WMO Publication No. 9, Weather Reporting Volume D - Information for Shipping.

The radio stations broadcasting tropical cyclone forecasts and warnings for the benefit of the ships on the high seas in the Typhoon Committee Members are listed in Appendix 4-C, where are shown the names of coastal radio stations with their call signs and the area covered by their bulletins. The details are shown in WMO Publication No. 9, Weather Reporting Volume D - Information for Shipping.

4.5 Warnings and advisories for aviation

In accordance with the International Civil Aviation Organization (ICAO) Annex 3 - *Meteorological Service for International Air Navigation*/WMO No. 49 Technical Regulations, Volume II: Meteorological Service for International Air Navigation (WMO-No. 49 Vol. 2), tropical cyclone warnings, required for the international air navigation, are issued by designated meteorological watch offices (MWO) as SIGMET messages. SIGMET messages give a concise description in abbreviated plain language concerning the occurrence and/or expected occurrence of specified en-route weather phenomena, which may affect the safety of aircraft operations, and of the development of those phenomena in time and space. Each MWO provides information for one or more specified flight information regions (FIRs) or upper information regions (UIRs). The boundaries of the FIRs/UIRs are defined in ICAO Air Navigation Plan - Asia and Pacific Region (Doc 9673).

The content and order of elements in a SIGMET message for tropical cyclone shall be in accordance with ICAO Annex 3/WMO-No. 49 Vol. 2. The data type designator to be used in the WMO abbreviated heading of such messages shall be T1T2 = WC (WMO-No. 386, Manual on GTS refers).

The designated Tropical Cyclone Advisory Centre (TCAC) Tokyo shall monitor the development of tropical cyclones in its area of responsibility, as determined in the ICAO Air Navigation Plan - Asia and Pacific Region (Doc 9673) and issue advisory information concerning the position of the cyclone centre, its direction and speed of movement, central pressure and maximum surface wind near the centre. The tropical cyclone advisories shall be disseminated to the MWOs by TCAC Tokyo in its area of responsibility. In addition, the tropical cyclone advisories shall be disseminated to other TCACs, whose areas of responsibility may be affected, to the World Area Forecast Centres (WAFC) London and Washington, and international OPMET data banks.

The format of the tropical cyclone advisories shall be in accordance with the ICAO Annex 3/WMO-No. 49 Vol. 2. The data type designator to be used in the WMO abbreviated heading of such messages shall be T1T2 = FK (WMO-No. 386, Manual on GTS, refers).

TCAC Tokyo shall issue updated advisory information for its area of responsibility, for each tropical cyclone, as necessary, but at least every six hours.

CHAPTER 5

TELECOMMUNICATIONS

5.1 General

The basic meteorological telecommunication network for the exchange of forecasts, warnings and observational data will be the Global Telecommunication System (GTS).

5.2 Dissemination of data and products

The RSMC Tokyo - Typhoon Center should have adequate telecommunication facilities for the real-time collection and dissemination of data and products. A large amount of grid point data produced at the RSMC Tokyo - Typhoon Center should be exchanged between the RSMC Tokyo - Typhoon Center and NMCs where adequate circuits for this purpose exist, such as GTS and Internet.

Conventional radio facsimile broadcasts are widely used in the region, though they have some disadvantages, i.e., it takes a long time to transmit a number of charts and received charts are sometimes distorted due to noises. Nevertheless, facsimile broadcasts and reception facilities shall be retained in full operation until telecommunications via satellite is introduced to transmit products both in chart and grid point value form.

5.3 Schedule for exchange of cyclone advisories

Tropical cyclone advisories issued by the RSMC Tokyo - Typhoon Center shall be transmitted at intervals of six to three hours. These messages shall be given high priority.

5.4 Meteorological telecommunication network for the Typhoon Committee region

The network is shown in Appendix 5-A and its present status is summarized in Appendix 5-B.

5.5 Addresses, telex/cable and telephone numbers of the tropical cyclone warning centres

A list of addresses of the tropical cyclone warning centres of the Typhoon Committee Members, together with their telex/cable and telephone numbers and e-mail addresses, is given in Appendix 5-C.

5.6 Abbreviated headings of tropical cyclone advisories and warnings

The abbreviated headings of meteorological messages containing tropical cyclone advisories issued by the RSMC Tokyo - Typhoon Center shall be:

(i) analysis and forecast - WTPQ20 RJTD through WTPQ25 RJTD;

(ii) prognostic reasoning - WTPQ30 RJTD through WTPQ35 RJTD;

(iii) five-day track forecast - WTPQ50 RJTD through WTPQ55 RJTD;

(iv) numerical prediction - FXPQ20 RJTD through FXPQ25 RJTD.

The abbreviated headings of meteorological bulletins used for the exchange of tropical cyclone warnings by the Typhoon Committee Members are given in Appendix 5-D.

5.7 Exchange of information related to tropical cyclones

Collection and dissemination of observational and processed data plus warnings related to tropical cyclones at Regional Telecommunication Hubs (RTHs) and NMCs are summarized in Appendix 5-E.

The meanings of the symbols used in abbreviated headings in the meteorological messages transmitted to the GTS are listed in Appendix 5-F. The details are described in the Manual on the Global Telecommunication System (WMO Publication No. 386) and Weather Reporting Volume C - Transmissions, Chapter I Catalogue of Meteorological Bulletins (WMO Publication No. 9).

CHAPTER 6

MONITORING AND QUALITY CONTROL OF DATA

6.1 Quality control of observational data

NMCs will make additional efforts to ensure that all observational data disseminated during periods of cyclone threat to the area are specifically free from errors. Wherever appropriate, verification of reports or of elements of reports will be requested of the observing station and communication channels will be kept open to facilitate this, particularly in cases where an enhanced observing programme is being carried out.

In the exchange of data during periods of cyclone threat, queries concerning reports on which there is doubt should be addressed to the relevant NMC.

Examples of message format for inquiry on doubtful and garbled reports are shown in Appendix 6-A.

6.2 Monitoring of exchange of information

Monitoring will be carried out by the RSMC Tokyo - Typhoon Center and all Typhoon Committee Members in accordance with their standard procedures. Special attention will be given to identification of deficiencies during the cyclone season in the flow of observational data and processed information relating to cyclone analysis and forecast with a view to appropriate remedial action.

The Members will inform the RSMC Tokyo - Typhoon Center of any shortcomings in the flow of data (raw and processed) and also indicate any requirements over and above those already agreed upon for tropical cyclone warning purposes.

Regular monitoring at the RSMC Tokyo - Typhoon Center should be made twice a year for appropriate periods when enhanced observations are carried out. Special monitoring may be made depending on the situation.

The procedure of regular monitoring is shown in Appendix 6-B.

6.3 Verification

Immediately after the dissipation of a tropical cyclone of TS grade or stronger, the RSMC Tokyo - Typhoon Center should disseminate a report on the tropical cyclone in the form of bulletins to provide Members with data needed for verification, such as position and intensity of the tropical cyclone (see the example in Appendix 6-C):

After the end of each typhoon season, each Member will conduct the verification for its analyses and forecasts and send the report to the RSMC Tokyo - Typhoon Center in accordance with the standard procedure as shown in Appendix 6-D. Verification sheets for positioning of the centre, prediction of movement, and analysis and forecast of intensity of a tropical cyclone are shown in Appendix 6-E.

The RSMC Tokyo - Typhoon Center should summarize the reports issued in a year and the results of verification conducted by Members. It should publish an annual report with respect to tropical cyclones and activities of the RSMC Tokyo - Typhoon Center

and Members. The report should also identify specific areas where further co-operative research needs to be carried out by Members.

CHAPTER 7

ARCHIVAL OF DATA

7.1 Data to be archived by Typhoon Committee Members

Members should establish tropical cyclone data files and information services nationally, archiving all appropriate available data.

7.2 Data to be archived by RSMC Tokyo - Typhoon Center

The RSMC Tokyo - Typhoon Center should archive as far as possible tropical cyclone related data received at the centre. The data set should be produced during the period when tropical cyclone(s) is (are) in the range of 1,000 km around Typhoon Committee Members. Except for satellite imagery data, all data should be recorded by the RSMC Tokyo - Typhoon Center preferably on electronic media. A proposed list of data to be archived by the RSMC Tokyo - Typhoon Center is shown in Appendix 7-A.

7.3 Exchange of archived data

Whenever possible Members should supply the RSMC Tokyo - Typhoon Center with all additional data requested by the RSMC Tokyo - Typhoon Center. The RSMC Tokyo - Typhoon Center should make available the archived data to Members on request for use in research, studies, investigations and training. As to distribution, similar arrangements should be made as for the TOPEX data sets which were provided by the Japan Meteorological Agency to Typhoon Committee Members (one set each) with financial assistance from UNDP. The detailed arrangements for exchange of data should be agreed upon bilaterally. Request for data sets by non-Typhoon Committee Members should be made through the WMO Secretariat upon payment of net cost (for electronic media, copying, handling, postal fees, etc.) by the requesting WMO Members.

In accordance with the directive of the WMO Executive Council (EC-XLV), (Geneva, June 1993) an international format for the archiving of tropical cyclone data is to be used by all RSMCs with activity specialization in tropical cyclones.

Complete historical data using the international format given in Appendix 7-B will be made available for research applications. RSMC Tokyo - Typhoon Center will provide such data to the Director of the National Climatic Data Center (NCDC), USA.

The Tropical Cyclone Programme (TCP) Division of the WMO Secretariat has the responsibility for the maintenance of the format, including assignment of the source codes to appropriate organizations, and authorizing additions and changes.

APPENDICES

GUIDELINES FOR CONVERTING BETWEEN VARIOUS WIND AVERAGING PERIODS IN TROPICAL CYCLONE CONDITIONS

This note is based on recommendations from Harper et al. (2010) and extracts from Knaff and Harper (2010), providing advice on why, when and how "wind averaging conversions" can be made.

a) Why Convert Wind Speeds?

From the observational perspective, the aim is to process measurements of the wind so as to extract an estimate of the **mean** wind at any time and its **turbulence** properties. From the forecasting viewpoint, the aim is, given a specific wind speed metric derived from a process or product, to usefully predict other metrics of the wind. Typically these needs revolve around the concept of the mean wind speed and an associated peak gust wind speed; such that the statistical properties of the expected level of wind turbulence under **different exposures** can be used to permit useful conversions **between peak gust wind speed** estimates.

b) When to Convert Wind Speeds?

Wind speed conversions to account for varying averaging periods only apply in the context of a maximum (peak gust) wind speed of a given duration observed within some longer interval. Simply measuring the wind for a shorter period of time at random will not ensure that it is always higher than the mean wind (given that there are both lulls and gusts). It is important that all wind speed values be correctly identified as an estimate of the **mean wind** or an estimate of a **peak gust**.

Once the mean wind is reliably estimated, the random effects of turbulence in producing higher but shorter-acting wind gusts, typically of greater significance for causing damage, can be estimated using a "gust factor". In order for a gust factor to be representative, certain conditions must be met, many of which may not be exactly satisfied during a specific weather event or at a specific location:

- Wind flow is turbulent with a steady mean wind speed (**statistically stationary**);
- Constant surface features exist within the period of measurement, such that the boundary layer is in equilibrium with the underlying surface roughness (**exposure**);
- The conversion assumes the mean wind speed and the peak gust wind speed are at the same **height** (e.g. the WMO standard observation height +10 m) above the surface.

c) How to Convert Individual Point-Specific Wind Speeds

Firstly, the mean wind speed estimate V should be explicitly identified by its averaging period T_o in seconds, described here as V_{To} , e.g.

$V_{600}$is a 10-min averaged mean wind estimate;
$V_{60}$is a 1-min averaged mean wind estimate;
$V_{3}$is a 3-sec averaged mean wind estimate.

Next, a peak gust wind speed should be additionally prefixed by the gust averaging period τ , and the time period over which it is observed (also termed the **reference period**), described here as $V_{\tau,To}$, e.g.

$V_{60,600}$is the highest 1-min mean (peak 1-min gust) within a 10-min observation period;
$V_{3,60}$is the highest 3-sec mean (peak 3-sec gust) within a 1-min observation period.

The "gust factor" $G_{\tau,To}$ then relates as follows to the mean and the peak gust:

$$V_{\tau,To} = G_{\tau,To}\, V ,$$

where the (true) mean wind V is estimated on the basis of a suitable sample, e.g. V_{600} or V_{3600}.

On this basis, Table 1 provides the recommended near-surface (+10 m) conversion factors $G_{\tau,To}$ between typical peak gust wind averaging periods, which are a strong function of the exposure class because the turbulence level varies depending on the surface roughness. Table 1 only provides a range of indicative exposures for typical forecasting environments and Harper et al. (2010) or WMO (2008) should be consulted for more specific advice regarding particular types of exposures - especially if it is intended to calibrate specific measurement sites to "standard exposure".

Table 1 Wind speed conversion factors for tropical cyclone conditions (after Harper et al. 2010).

Exposure at +10 m		Reference Period	Gust Factor $G_{\tau,To}$				
Class	Description		*Gust Duration* τ (s)				
		T_o (s)	*3*	*60*	*120*	*180*	*600*
In-Land	Roughly open terrain	3600	1.75	1.28	1.19	1.15	1.08
		600	1.66	1.21	1.12	1.09	1.00
		180	1.58	1.15	1.07	1.00	
		120	1.55	1.13	1.00		
		60	1.49	1.00			
Off-Land	Offshore winds at a coastline	3600	1.60	1.22	1.15	1.12	1.06
		600	1.52	1.16	1.09	1.06	1.00
		180	1.44	1.10	1.04	1.00	
		120	1.42	1.08	1.00		
		60	1.36	1.00			
Off-Sea	Onshore winds at a coastline	3600	1.45	1.17	1.11	1.09	1.05
		600	1.38	1.11	1.05	1.03	1.00
		180	1.31	1.05	1.00	1.00	
		120	1.28	1.03	1.00		
		60	1.23	1.00			
At-Sea	> 20 km offshore	3600	1.30	1.11	1.07	1.06	1.03
		600	1.23	1.05	1.02	1.00	1.00
		180	1.17	1.00	1.00	1.00	
		120	1.15	1.00	1.00		
		60	1.11	1.00			

Some example applications of the above recommendations are:

- To estimate the expected “off-land” 3-sec peak gust in a 1-min period, multiply the estimated “off-land” mean wind speed by 1.36
- To estimate the expected “off-sea” 3-sec peak gust in a 10-min period, multiply the estimated “off-sea” mean wind speed by 1.38
- To estimate an “at-sea” 1-min peak gust in a 10-min period, multiply the estimated “at-sea” mean wind speed by 1.05

Note that it is not possible to convert from a peak gust wind speed back to a **specific** time-averaged mean wind – only to the **estimated true mean** speed. Hence to estimate the “off-sea” mean wind speed given only a peak observed gust of 1-min duration (τ = 60 s) measured in a 10-min period (T_o = 600 s), multiply the observed 1-min peak gust by (1/1.11) = 0.90. This does not guarantee that the estimated mean wind will be the same as the 10-min averaged wind at that time but, because the 10-min average is normally a reliable estimate of the true mean wind, it will likely be similar. In all cases, measurement systems should aim to reliably measure the mean wind speed and the standard deviation using a sample duration of not less than 10-min (WMO 2008), i.e. V_{600}. Additional shorter averaging periods and the retaining of peak information should then be targeted at operational needs.

d) Converting Between Agency Estimates of Storm Maximum Wind Speed *Vmax*

This is a slightly different situation from converting a point specific wind estimate because the concept of a storm-wide maximum wind speed *Vmax* is a metric with an associated spatial context (i.e. anywhere within or associated with the storm) as well as a temporal fix context (at this moment in time or during a specific period of time). While it may be expressed in terms of any wind averaging period it remains important that it be unambiguous in terms of representing a mean wind or a peak gust. Agencies that apply the WMO standard 10-min averaged *Vmax* wind have always applied a wind-averaging conversion to reduce the maximum “sustained” 1-min wind value (a 1-min peak gust) that has been traditionally associated with the Dvorak method (Dvorak 1984, Atkinson and Holliday 1977)*. As noted in the previous section, it is technically not possible to convert from a peak gust back to a specific

* As detailed in Harper et al. (2010), this traditional assumption is without a firm basis.

time-averaged mean wind – only to the estimated true mean wind speed. However, in Harper et al. (2010) a practical argument is made for nominal conversion between $Vmax_{60}$ and $Vmax_{600}$ values via an hourly mean wind speed reference, and the recommendations are summarised in Table 2.

It can be noted that the recommended conversion for at-sea exposure is about 5% higher than the "traditional" value of 0.88 (WMO 1993), which is more appropriate to an off-land exposure. This has special implications for the Dvorak method because "at sea" is the typical exposure of interest where such conversions have been traditionally applied.

Table 2 Conversion factors between agency estimates of maximum 1-min and maximum 10-min averaged tropical cyclone wind speed *Vmax*. (after Harper et al. 2010).

$Vmax_{600}=K\ Vmax_{60}$	At-Sea	Off-Sea	Off-land	In-Land
K	0.93	0.90	0.87	0.84

e) References

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Knaff, J.A. and B.A. Harper, 2010: Tropical cyclone surface wind structure and wind-pressure relationships. In: Proc. WMO IWTC-VII, *World Meteorological Organization* , Keynote 1,La Reunion, Nov.

Harper, B.A.,, J. D. Kepert, and J. D. Ginger, 2010: Guidelines for converting between various wind averaging periods in tropical cyclone conditions. *World Meteorological Organization*, TCP Sub-Project Report, WMO/TD-No. 1555.

WMO 1993: Global guide to tropical cyclone forecasting. Tropical Cyclone Programme Report No. TCP-31, *World Meteorological Organization*, WMO/TD – No. 560, Geneva.

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LIST OF NAMES FOR TROPICAL CYCLONES ADOPTED BY THE TYPHOON COMMITTEE FOR THE WESTERN NORTH PACIFIC OCEAN AND THE SOUTH CHINA SEA

(Valid as of 2018)

Contributed by	I	II	III	IV	V
	Name	Name	Name	Name	Name
Cambodia	Damrey	Kong-rey	Nakri	Krovanh	Trases
China	Haikui	Yutu	Fengshen	Dujuan	Mulan
DPR Korea	Kirogi	Toraji	Kalmaegi	Surigae	Meari
Hong Kong, China	Kai-tak	Man-yi	Fung-wong	Choi-wan	Ma-on
Japan	Tembin	Usagi	Kammuri	Koguma	Tokage
Lao PDR	Bolaven	Pabuk	Phanfone	Champi	Hinnamnor
Macao, China	Sanba	Wutip	Vongfong	In-fa	Muifa
Malaysia	Jelawat	Sepat	Nuri	Cempaka	Merbok
Micronesia	Ewiniar	Mun	Sinlaku	Nepartak	Nanmadol
Philippines	Maliksi	Danas	Hagupit	Lupit	Talas
RO Korea	Gaemi	Nari	Jangmi	Mirinae	Noru
Thailand	Prapiroon	Wipha	Mekkhala	Nida	Kulap
U.S.A.	Maria	Francisco	Higos	Omais	Roke
Viet Nam	Son-Tinh	Lekima	Bavi	Conson	Sonca
Cambodia	Ampil	Krosa	Maysak	Chanthu	Nesat
China	Wukong	Bailu	Haishen	Dianmu	Haitang
DPR Korea	Jongdari	Podul	Noul	Mindulle	Nalgae
Hong Kong, China	Shanshan	Lingling	Dolphin	Lionrock	Banyan
Japan	Yagi	Kajiki	Kujira	Kompasu	Hato
Lao PDR	Leepi	Faxai	Chan-hom	Namtheun	Pakhar
Macao, China	Bebinca	Peipah	Linfa	Malou	Sanvu
Malaysia	Rumbia	Tapah	Nangka	Nyatoh	Mawar
Micronesia	Soulik	Mitag	Saudel	Rai	Guchol
Philippines	Cimaron	Hagibis	Molave	Malakas	Talim
RO Korea	Jebi	Neoguri	Goni	Megi	Doksuri
Thailand	Mangkhut	Bualoi	Atsani	Chaba	Khanun
U.S.A.	Barijat	Matmo	Etau	Aere	Lan
Viet Nam	Trami	Halong	Vamco	Songda	Saola

Replaced names

Aere	for	Kodo	(2002)	Mangkhut	for	Durian	(2008)	Mulan	for	Haima	(2018)
Morakot	for	Hanuman	(2002)	Atsani	for	Morakot	(2011)	Hinnamnor	for	Nock-ten	(2018)
Matmo	for	Chataan	(2004)	Champi	for	Ketsana	(2011)				
Nuri	for	Rusa	(2004)	In-fa	for	Parma	(2011)	**Corrected spelling**			
Peipah	for	Vamei	(2004)	Rai	for	Fanapi	(2012)	Megkhla	to	Mekkhala	(2002)
Molave	for	Imbudo	(2004)	Hato	for	Washi	(2013)	Kularb	to	Kulap	(2002)
Noul	for	Pongsona	(2006)	Ampil	for	Bopha	(2014)	Ramasoon	to	Rammasun	(2002)
Dolphin	for	Yanyan	(2006)	Jongdari	for	Sonamu	(2015)	Vipa	to	Wipha	(2002)
Mujigae	for	Maemi	(2006)	Barijat	for	Utor	(2015)	Kaemi	to	Gaemi	(2008)
Mirinae	for	Sudal	(2006)	Mun	for	Fitow	(2015)	Chebi	to	Jebi	(2008)
Lionrock	for	Tingting	(2006)	Bailu	for	Haiyan	(2015)	Noguri	to	Neoguri	(2008)
Fanapi	for	Rananim	(2006)	Lan	for	Vicente	(2015)	Changmi	to	Jangmi	(2008)
Pakhar	for	Matsa	(2007)	Bualoi	for	Rammasun	(2016)	Koni	to	Goni	(2008)
Doksuri	for	Nabi	(2007)	Saudel	for	Soudelor	(2017)	SonTinh	to	Son-Tinh	(2008)
Haikui	for	Longwang	(2007)	Surigae	for	Mujigae	(2017)				
Sanba	for	Chanchu	(2008)	Koguma	for	Koppu	(2017)				
Maliksi	for	Bilis	(2008)	Cempaka	for	Melor	(2017)				
SonTinh	for	Saomai	(2008)	Nyatoh	for	Meranti	(2018)				
Leepi	for	Xangsane	(2008)	Trases	for	Sarika	(2018)				

OPERATIONAL PROCEDURES FOR THE ASSIGNMENT OF NAMES OF TROPICAL CYCLONES

(a) RSMC Tokyo – Typhoon Center will assign a name each time a 4-digit identification number is to be assigned. That is, names on the Typhoon Committee list will only be given to tropical cyclones of tropical storm strength or above. Each tropical cyclone should be identified by its name followed by the 4-digit number in brackets. The same names and numbers should also be used in bulletins issued by the Tokyo Tropical Cyclone Advisory Centre under the umbrella of the International Civil Aviation Organization (ICAO) as well as in bulletins for Meteorological Area (METAREA)-XI of the Global Maritime Distress and Safety System (GMDSS) issued by both China and Japan. This would contribute to the standardization of the usage of names of tropical cyclones as was desired by the Typhoon Committee.

(b) The exchange of observational data should be promoted as much as possible in addition to what is already exchanged among the warning centres and the meteorological services in the region, to ensure that RSMC Tokyo – Typhoon Center would benefit from the best possible data and information needed for it to carry out its work.

(c) On the operation of the name list, the names will be assigned following the pre-determined order. The name would remain unchanged throughout the life history of the tropical cyclone. To avoid confusion, tropical cyclones given a name before crossing the Date Line and entering the western North Pacific should be assigned a number by RSMC Tokyo – Typhoon Center but should not be assigned a new name in the Typhoon Committee list. RSMC Honolulu Hurricane Center will continue the use of the tropical cyclone names assigned by RSMC Tokyo – Typhoon Center when tropical cyclones cross the Date Line from west to east.

(d) The names and numbers assigned by RSMC Tokyo – Typhoon Center will be used by all Typhoon Committee Members when issuing warning bulletins intended for the international community including the press, aviation and shipping.

(e) The Typhoon Committee, as the authority to maintain the list, shall review the list of names and its operation regularly at its annual sessions as the need arises.

(f) Members may request the retirement of a name from the list particularly in case of tropical cyclones causing extensive destruction or for other reasons. Such notification shall be made preferably within a year of the event. The decision to retire names should be made at the regular review at annual sessions of the Typhoon Committee.

LIST OF ACRONYMS USED IN THE OPERATIONAL MANUAL
- METEOROLOGICAL COMPONENT –

AFTN	Aeronautical Fixed Telecommunication Network
AIREP	Aircraft En-route Report
AMeDAS	Automated Meteorological Data Acquisition System
AMV	Atmospheric Motion Vector
APT	Automatic Picture Transmission
ASCAT	Advanced SCATterometer
ASDAR	Aircraft to Satellite Data Relay
BOM	Bureau of Meteorology
BUFR	Binary Universal Form for the Representation of meteorological data
BUOY	Report of a buoy operation
CAPPI	Constant Altitude Plan Position Indicator
CMA	China Meteorological Administration
CMC	Canadian Meteorological Centre
CSR	Clear Sky Radiance
DDN	DataDirect Networks
DWD	Deutscher Wetterdienst
ECMWF	European Centre for Medium-Range Weather Forecasts
EPS	Ensemble Prediction System
ESCAP	Economic and Social Commission for Asia and the Pacific
FAX	Facsimile
FTP	File Transfer Protocol
GEPS	Global EPS
GMS	Geostationary Meteorological Satellite
GNSS	Global Navigation Satellite System
GRIB	General regularly distributed information in binary form
GSM	Global Spectral Model
GTS	Global Telecommunication System
HKO	Hong Kong Observatory
HRPT	High Resolution Picture Transmission
ICAO	International Civil Aviation Organization
IR	Infrared
JCOMM	Joint Technical Commission for Oceanography and Marine Meteorology
JCSAT	Japan Communications Satellite
JMA	Japan Meteorological Agency
JTWC	Joint Typhoon Warning Centre
KMA	Korea Meteorological Administration
METER	Aerodrome routine meteorological report
MPLS	Multi-Protocol Label Switching
MSTP	Multiple Spanning Tree Protocol
MTI	Moving Target Indicator
MTSAT	Multi-functional Transport Satellite
NCEP	National Centers for Environmental Prediction
NESDIS	National Environmental Satellite, Data and Information Service
NMC	National Meteorological Centre
NMHS	National Meteorological and Hydrological Service
NMS	National Meteorological Service
NOAA	National Oceanic and Atmospheric Administration
NWP	Numerical Weather Prediction

OPMET	Operational Meteorological Data
PILOT	Upper-wind report from a fixed land station
PNG	Portable Network Graphics
PWV	Precipitable Water Vapour
R/A	Radar/raingauge-Analyzed precipitation
RADOB	Report of ground radar weather observations
RO	Radio Occultation
ROBEX	Regional OPMET Bulletin Exchange
RSMC	Regional Specialized Meteorological Centre
RTH	Regional Telecommunication Hub
S.VISSR	Stretched VISSR
SAREP	Report of synoptic interpretation of cloud data obtained by a meteorological satellite
SATAID	SATellite Animation and Interactive Diagnosis
SATEM	Report of satellite remote upper-air soundings of pressure, temperature and humidity
SATOB	Report of satellite observations of wind, surface temperature, cloud, humidity and radiation
SHIP	Report of surface observation from a sea station
SST	Sea Surface Temperature
SYNOP	Report of surface observation from a fixed land station
TAC	Traditional Alphanumeric Code Form
TBB	Temperature Black Body
TC	Typhoon Committee
TCP	Tropical Cyclone Programme
TCP/IP	Transmission Control Protocol / Internet Protocol
TCS	Typhoon Committee Secretariat
TDCF	Table-Driven Code Form
TEMP	Upper-level pressure, temperature, humidity and wind report from a fixed land station
TOPEX	Typhoon Operational Experiment
TS	Tropical Storm
UKMO	United Kingdom Met Office
UNDP	United Nations Development Programme
UTC	Universal Time Coordinated
VIS	Visible
VISSR	Visible and Infrared Spin Scan Radiometer
VPN	Virtual Private Network
WMO	World Meteorological Organization
WV	Water Vapour

LIST OF STATIONS FROM WHICH ENHANCED SURFACE OBSERVATIONS ARE AVAILABLE

The following stations will make hourly surface observations when they are within 300 km of the centre of a tropical cyclone of TS intensity or higher:

Cambodia

China

(54): 324, 337, 342, 346, 405, 423, 436, 471, 493, 497,
511, 534, 539, 602, 618, 662, 715, 751, 753, 776,
823, 826, 836, 843, 857, 863, 929, 945
(58): 040, 141, 150, 238, 251, 265, 345, 362, 457, 472,
477, 543, 556, 569, 646, 652, 666, 752, 754, 834,
847, 911, 921, 926, 931, 944
(59): 007, 023, 046, 058, 072, 082, 087, 096, 117, 134,
209, 211, 254, 278, 287, 293, 316, 417, 431, 456,
493, 501, 632, 644, 658, 663, 673, 758, 838, 845,
855, 948, 981

Democratic People's Republic of Korea

(47): 003, 005, 008, 014, 016, 020, 022, 025, 028, 031,
035, 037, 039, 041, 045, 050, 052, 055, 058, 060,
061, 065, 067, 068, 069

Hong Kong, China

(45): 007

Japan

(47): 401, 407, 409, 412, 418, 420, 421, 426, 430, 570,
575, 582, 584, 590, 600, 604, 605, 610, 624, 629,
636, 648, 651, 655, 662, 675, 678, 740, 741, 746,
750, 765, 772, 778, 800, 807, 815, 817, 827, 830,
843, 887, 891, 893, 895, 909, 918, 927, 936, 945,
971, 991

Lao People's Democratic Republic

Macao, China

(45): 011

Malaysia

(48): 601, 615, 620, 647, 650, 657, 665
(96): 413, 421, 441, 449, 465, 471, 481, 491

Philippines

(98): 132, 133, 135, 222, 232, 233, 324, 325, 328, 329,
330, 333, 336, 425, 427, 428, 429, 430, 431, 432,
434, 435, 437, 440, 444, 446, 447, 526, 531, 536,
538, 543, 546, 548, 550, 555, 558, 618, 630, 637,
642, 644, 646, 648, 653, 741, 746, 747, 748, 751,
752, 753, 755, 836, 851

Republic of Korea

(47): 090, 093, 095, 098, 099, 100, 101, 102, 105, 106,
108, 112, 114, 115, 119, 121, 127, 129, 130, 131,
133, 135, 136, 137, 138, 140, 143, 146, 152, 155,
156, 159, 162, 165, 168, 169, 170, 172, 174, 175,
177, 184, 185, 188, 189, 192 201, 202, 203, 211,
212, 214, 216, 217, 221, 226, 232, 235, 236, 243,
244, 245, 247, 248, 251, 252, 253, 254, 255, 257,
258, 259, 260, 261, 262, 263, 264, 266, 268, 271,
272, 273, 276, 277, 278, 279, 281, 283, 284, 285,
288, 289, 294, 295

Thailand

(48): 300, 303, 310, 327, 328, 329, 330, 331, 351, 352,
353, 354, 356, 357, 372, 375, 376, 378, 379, 380,
381, 383, 400, 403, 405, 407, 425, 426, 430, 431,
432, 437, 450, 453, 455, 456, 459, 462, 465, 477,
478, 480, 500, 501, 517, 532, 551, 552, 561, 564,
565, 566, 567, 568, 569, 570, 580, 583

USA

(91): 203, 212, 258, 317, 324, 334, 339, 348, 353, 356,
366, 367, 369, 371, 376, 378, 408, 413, 425, 434

Viet Nam

(48): 820, 826, 839, 845, 848, 855, 870, 877, 900, 914,
917, 918, 920

Note: Name, latitude, longitude and elevation of these stations are included in Weather Reporting, Volume A - Observing Stations (WMO Publication No. 9).

LIST OF STATIONS FROM WHICH ENHANCED UPPER-AIR OBSERVATIONS ARE AVAILABLE

The following stations will make 6-hourly upper-air observations when they are within 300 km of the centre of a tropical cyclone of TS intensity or higher:

Cambodia

China

(54): 511, 727, 857
(57): 083, 494, 972
(58): 150, 362, 457, 665, 847, 968
(59): 134, 316, 758, 981

Democratic People's Republic of Korea

(47): 041, 058

Hong Kong, China

(45): 004
upper-air observations are made by wind profiler at 06 and 18 UTC normally, but radiosondes will be launched when warranted by local wind conditions

Japan

(47): 401, 412, 418, 582, 600, 646, 678, 741, 778,
807, 827, 909, 918, 945, 971*, 991*
* except 18 UTC

Lao People's Democratic Republic

Macao, China

Malaysia

(48): 601, 615, 650, 657
(96): 413, 441, 471, 481

Philippines

(98): 223, 433, 444, 618, 646, 573

Republic of Korea

(47): 102, 104, 122, 138, 158, 169, 186

Thailand

(48): 327, 354, 378, 407, 431, 453, 480, 500, 551, 565, 568

USA

(91): 212, 334, 348, 366, 376, 408, 413

Viet Nam

(48): 820, 855, 900

Note: Name, latitude, longitude and elevation of these stations are included in Weather Reporting, Volume A - Observing Stations (WMO Publication No. 9).

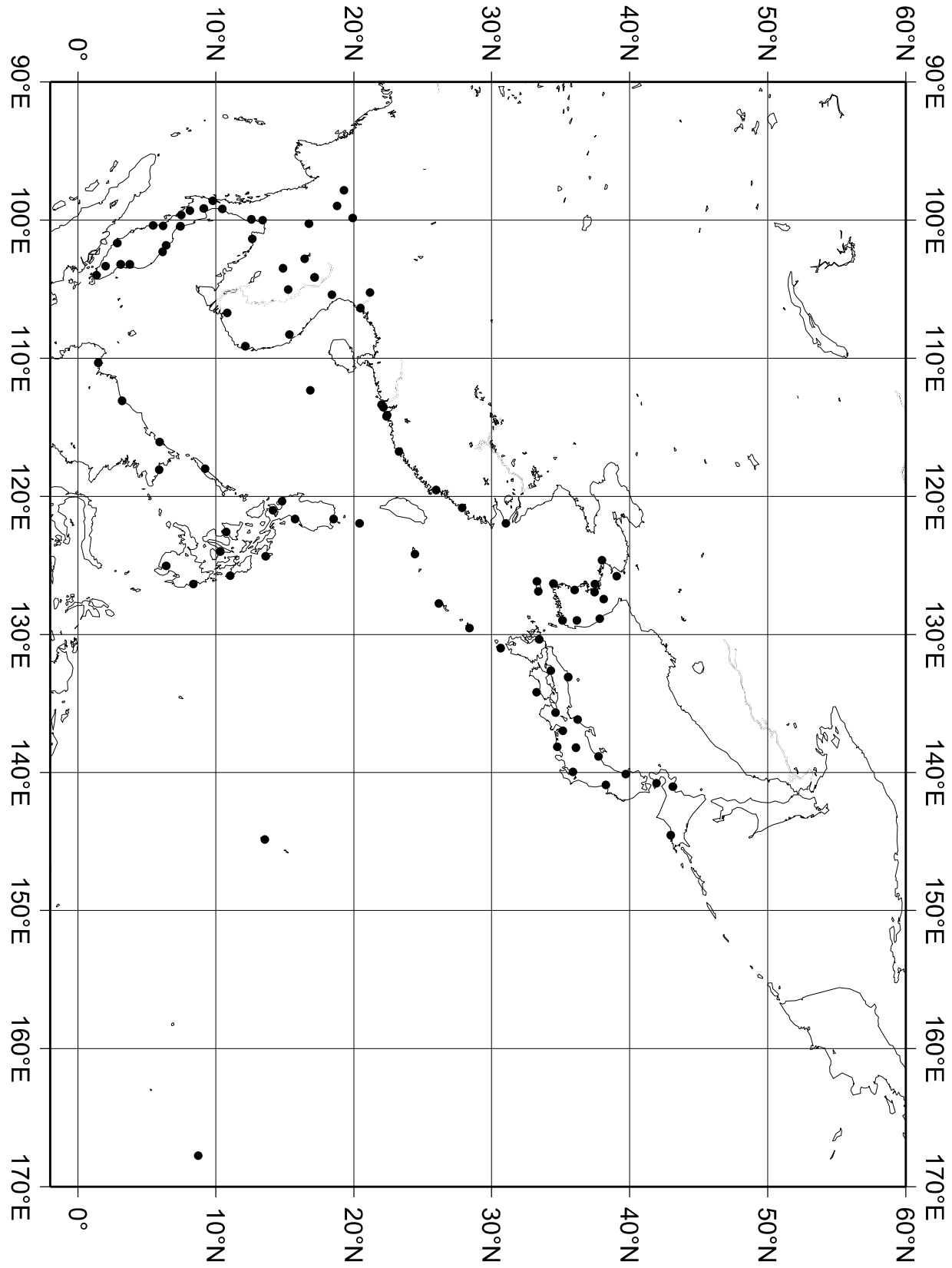
APPENDIX 2-C

LIST OF BUOY OBSERVATIONS BY TYPHOON COMMITTEE MEMBERS

Member	Area	Observation Elements	Frequency	Heading in the BUFR code (FM 94)
Hong Kong, China	South China Sea	Air pressure and sea surface temperature	Every hour during tropical cyclone seasons	IOBC01 VHHH for buoys operated solely by Hong Kong, China IOBX02 KWBC for buoys operated under the Barometer Upgrade Scheme of the Global Drifter Programme of Data Buoy Cooperation Panel of JCOMM.
Japan	Western North Pacific	Air pressure, sea surface temperature, significant wave height and period	Every 3 hours (Every hour when waves are higher than thresholds set beforehand)	SSVB01-19 RJTD

APPENDIX 2-D

DISTRIBUTION OF THE RADAR STATIONS OF TYPHOON COMMITTEE MEMBERS



TECHNICAL SPECIFICATIONS OF RADARS OF TYPHOON COMMITTEE MEMBERS

Name of the Member **China**

NAME OF STATION		Shanghai	Wenzhou	Fuzhou	Shantou	Xis hadao
SPECIFICATIONS	Unit					
Index number		58367	58659	58941	59316	59981
Location of station		31° 02′ N 121° 57′ E	27° 51′ N 120° 49′ E	25° 59′ N 119° 32′ E	23° 17′ N 116° 44′ E	16° 50′ N 112° 20′ E
Antenna elevation	m	68	294	652.5	196.7	8.5
Wave length	cm	10.6	10.6	10.4	10.4	10.6
Peak power of transmitter	kW	500	500	500	500	500
Pulse length	μ s	1	3.0	1.0	1	3
Sensitivity minimum of receiver	dBm	-110	-110	-119	-109	-110
Beam width (Width of over -3dB antenna gain of maximum)	deg	2.0	2.0	2.0	1.2	2.0
Detection range	km	600	600			
Scan mode in observation						
1.Fixed elevation		1	1	1	1	
2.CAPPI		2	2	2	2	2
3.Manually controlled		3	3	3	3	
DATA PROCESSING						
MTI processing 1.Yes, 2.No		2	2	2	2	2
Doppler processing 1.Yes, 2.No		2	2	1	1	2
Display 1.Digital, 2.Analog		1	1	1	1	2
OPERATION MODE (When tropical cyclone is within range of detection)						
1.Hourly		1	1	1	1	1
2.3-hourly						
3.Others						
PRESENT STATUS						
1.Operational		1	1	1	1	1
2.Not operational (for research etc.)						

APPENDIX 2-E, p.2

Name of the Member **Democratic People's Republic of Korea**

NAME OF STATION		Pyongyang				
SPECIFICATIONS	Unit					
Index number		47058				
Location of station		39° 02′ N 125° 47′ E				
Antenna elevation	m	90				
Wave length	cm	3.2				
Peak power of transmitter	kW	150				
Pulse length	μ s	1, 2				
Sensitivity minimum of receiver	dBm	-132				
Beam width (Width of over -3dB antenna gain of maximum)	deg	44				
Detection range	km	300				
Scan mode in observation 1.Fixed elevation 2.CAPPI 3.Manually controlled		 1 2 3				
DATA PROCESSING						
MTI processing 1.Yes, 2.No		2				
Doppler processing 1.Yes, 2.No		2				
Display 1.Digital, 2.Analog		1				
OPERATION MODE (When tropical cyclone is within range of detection) 1.Hourly 2.3-hourly 3.Others		 1				
PRESENT STATUS 1.Operational 2.Not operational (for research etc.)		 1				

Name of the Member **Hong Kong, China**

NAME OF STATION		Tai Mo Shan	Tate's Cairn			
SPECIFICATIONS	Unit					
Index number		45009	45010			
Location of station		22° 25′ N 114° 07′ E	22° 21′ N 114° 13′ E			
Antenna elevation	m	968	582			
Wave length	cm	10.6	10.3			
Peak power of transmitter	kW	650	650			
Pulse length	μ s	1.0/2.0	1.0/2.0			
Sensitivity minimum of receiver	dBm	-117	-114			
Beam width (Width of over -3dB antenna gain of maximum)	deg	0.9(H) 0.9(V)	0.9			
Detection range	km	500	500			
Scan mode in observation 1.Fixed elevation 2.CAPPI 3.Manually controlled		2	2			
DATA PROCESSING						
MTI processing 1.Yes, 2.No		2	2			
Doppler processing 1.Yes, 2.No		1	1			
Display 1.Digital, 2.Analog		1	1			
OPERATION MODE (When tropical cyclone is within range of detection) 1.Hourly 2.3-hourly 3.Others		3 (Continuous)	3 (Continuous)			
PRESENT STATUS 1.Operational 2.Not operational (for research etc.)		1	1			

Name of the Member **Japan - 1**

NAME OF STATION		Sapporo /Kenashiyama	Kushiro /Kombumori	Hakodate /Yokotsudake	Sendai	Akita
SPECIFICATIONS	Unit					
Index number		47415	47419	47432	47590	47582
Location of station		43° 08´ N 141° 01´ E	42° 58´ N 144° 31´ E	41° 56´ N 140° 47´ E	38° 16´ N 140° 54´ E	39° 43´ N 140° 06´E
Antenna elevation	m	749.0	121.5	1141.7	98.2	55.3
Wave length	cm	5.61	5.61	5.60	5.61	5.59
Peak power of transmitter	kW	250	250	250	250	250
Pulse length	μ s	1.1/2.6	1.1/2.6	1.1/2.6	1.0/2.6	1.1/2.6
Sensitivity minimum of receiver	dBm	-109/-112	-110/-113	-108/-111	-108/-111	-108/-112
Beam width (Width of over -3dB antenna gain of maximum)	deg	1.1(H) 1.1(V)	1.1(H) 1.0(V)	1.0(H) 1.0(V)	1.0(H) 1.0(V)	1.0 (H) 0.9 (V)
Detection range	km	400	400	400	400	400
Scan mode in observation 1.Fixed elevation 2.CAPPI 3.Manually controlled		2	2	2	2	2
DATA PROCESSING						
MTI processing 1.Yes, 2.No		1	1	1	1	1
Doppler processing 1.Yes, 2.No		1	1	1	1	1
Display 1.Digital, 2.Analog		1	1	1	1	1
OPERATION MODE (When tropical cyclone is within range of detection) 1.Hourly 2.3-hourly 3.Others		1	1	1	1	1
PRESENT STATUS 1.Operational 2.Not operational (for research etc.)		1	1	1	1	1

Name of the Member **Japan - 2**

NAME OF STATION		Tokyo /Kashiwa	Niigata /Yahikoyama	Fukui /Tojimbo	Nagano /Kurumayama	Shizuoka /Makinohara
SPECIFICATIONS	Unit					
Index number		47695	47572	47705	47611	47659
Location of station		35° 52´ N 139° 58´ E	37° 43´ N 138° 49´ E	36° 14´ N 136° 09´ E	36° 06´ N 138° 12´ E	34° 45´ N 138° 08´E
Antenna elevation	m	74.0	645.0	107.0	1937.1	186.0
Wave length	cm	5.59	5.61	5.59	5.64	5.66
Peak power of transmitter	kW	250	250	250	250	250
Pulse length	μ s	1.1/2.6	1.0/2.5	1.1/2.7	1.0/2.6	1.1/2.6
Sensitivity minimum of receiver	dBm	-109/-113	-109/-113	-109/-113	-110/-114	-110/-113
Beam width (Width of over -3dB antenna gain of maximum)	deg	1.0(H) 1.0(V)	1.0(H) 1.0(V)	1.1(H) 1.0(V)	1.1(H) 1.0V)	1.1(H) 1.1(V)
Detection range	km	400	400	400	400	400
Scan mode in observation 1.Fixed elevation 2.CAPPI 3.Manually controlled		2	2	2	2	2
DATA PROCESSING						
MTI processing 1.Yes, 2.No		1	1	1	1	1
Doppler processing 1.Yes, 2.No		1	1	1	1	1
Display 1.Digital, 2.Analog		1	1	1	1	1
OPERATION MODE (When tropical cyclone is within range of detection) 1.Hourly 2.3-hourly 3.Others		1	1	1	1	1
PRESENT STATUS 1.Operational 2.Not operational (for research etc.)		1	1	1	1	1

Name of the Member **Japan - 3**

NAME OF STATION		Nagoya	Osaka /Takayasuyama	Matsue /Misakayama	Hiroshima /Haigamine	Murotomisaki
SPECIFICATIONS	Unit					
Index number		47636	47773	47791	47792	47899
Location of station		35° 10´ N 136° 58´ E	34° 37´ N 135° 39´ E	35° 33´ N 133° 06´ E	34° 16´ N 132° 36´ E	33° 15´ N 134° 11´E
Antenna elevation	m	73.1	497.6	553.0	746.9	198.9
Wave length	cm	5.60	5.61	5.61	5.59	5.60
Peak power of transmitter	kW	250	250	250	250	250
Pulse length	μ s	1.1/2.6	1.0/2.6	1.1/2.6	1.1/2.7	1.1/2.6
Sensitivity minimum of receiver	dBm	-108/-112	-108/-112	-109/-112	-109/-111	-109/-113
Beam width (Width of over -3dB antenna gain of maximum)	deg	1.0(H) 1.0(V)	1.1(H) 1.1(V)	1.0(H) 1.1(V)	1.1(H) 1.0(V)	1.0(H) 1.0(V)
Detection range	km	400	400	400	400	400
Scan mode in observation 1.Fixed elevation 2.CAPPI 3.Manually controlled		2	2	2	2	2
DATA PROCESSING						
MTI processing 1.Yes, 2.No		1	1	1	1	1
Doppler processing 1.Yes, 2.No		1	1	1	1	1
Display 1.Digital, 2.Analog		1	1	1	1	1
OPERATION MODE (When tropical cyclone is within range of detection) 1.Hourly 2.3-hourly 3.Others		1	1	1	1	1
PRESENT STATUS 1.Operational 2.Not operational(for research etc.)		1	1	1	1	1

Name of the Member **Japan - 4**

NAME OF STATION		Fukuoka /Sefuriyama	Tanegashima /Nakatane	Naze /Funchatoge	Okinawa /Itokazu	Ishigakijima /Omotodake
SPECIFICATIONS	Unit					
Index number		47806	47869	47909	47937	47920
Location of station		33° 26´ N 130° 21´ E	30° 38´ N 130° 59´ E	28° 24´ N 129° 33´ E	26° 09´ N 127° 46´ E	24° 26´ N 124° 11´E
Antenna elevation	m	982.7	290.5	318.8	208.2	533.5
Wave length	cm	5.60	5.61	5.66	5.61	5.61
Peak power of transmitter	kW	250	250	250	250	250
Pulse length	μ s	1.1/2.7	1.1/2.7	1.1/2.6	1.0/2.5	1.1/2.7
Sensitivity minimum of receiver	dBm	-109/-112	-108/-112	-109/-113	-109/-113	-107/-111
Beam width (Width of over -3dB antenna gain of maximum)	deg	1.0(H) 1.0(V)	1.1(H) 1.0(V)	1.1(H) 1.0(V)	1.0(H) 1.0(V)	1.1(H) 1.1(V)
Detection range	km	400	400	400	400	400
Scan mode in observation 1.Fixed elevation 2.CAPPI 3.Manually controlled		2	2	2	2	2
DATA PROCESSING						
MTI processing 1.Yes, 2.No		1	1	1	1	1
Doppler processing 1.Yes, 2.No		1	1	1	1	1
Display 1.Digital, 2.Analog		1	1	1	1	1
OPERATION MODE (When tropical cyclone is within range of detection) 1.Hourly 2.3-hourly 3.Others		1	1	1	1	1
PRESENT STATUS 1.Operational 2.Not operational(for research etc.)		1	1	1	1	1

Name of the Member **Macao, China**

NAME OF STATION		TAIPA GRANDE	ZHUHAI-MACAO RADAR			
SPECIFICATIONS	Unit					
Index number		45011				
Location of station		22.1599N 113.5624E	22.0240N 113.3756E			
Antenna elevation	m	183	250			
Wave length	cm	3.4	~10			
Peak power of transmitter	kW	200	> 800			
Pulse length	μ s	0.4, 0.8, 1.0, 2.0	0.5, 1.57, 4.5			
Sensitivity minimum of receiver	dBm	-113	-114 for 4.5us -111 for 1.57us			
Beam width (Width of over -3dB antenna gain of maximum)	deg	1°	< +/- 0.01°			
Detection range	km	128	230/460			
Scan mode in observation 1. Fixed elevation 2. CAPPI 3. Manually controlled		3	3			
DATA PROCESSING						
MTI processing 1.Yes, 2.No		2	2			
Doppler processing 1.Yes, 2.No		1	1			
Display 1.Digital, 2.Analog		1	1			
OPERATION MODE (When tropical cyclone is within range of detection) 1. Hourly 2. 3-hourly 3. Others		3	3			
PRESENT STATUS 1.Operational 2.Not operational (for research etc.)		2	1			

Name of the Member **Malaysia - 1**

NAME OF STATION		Alor Star	Kota Bharu	Kuala Lumpur (Sepang)	Kuala Lumpur (Subang)	Kluang
SPECIFICATIONS						
Index number		48603	48615	48650	48647	48672
Location of station		6° 11´ N 100° 24´ E	6° 10´ N 102° 17´ E	2° 51´ N 101° 40´ E	3° 07´ N 103° 13´ E	2° 01´ N 103° 19´E
Antenna elevation	m	24	33	25	32	113
Wave length	cm	10	10	10	10	10
Peak power of transmitter	kW	650	650	750	650	650
Pulse length	μ s	0.8 and 2	2	1 and 3	2	0.8 and 2
Sensitivity minimum of receiver	dBm	-110 (.8 μs) -113 (2 μs)	-113	-110 (.8 μs) -115 (3 μs)	-113	-110 (.8 μs) -113 (2 μs)
Beam width (Width of over -3dB antenna gain of maximum)	deg	2	2	1	2	2
Detection range	km	400	400	400	400	400
Scan mode in observation 1.Fixed elevation 2.CAPPI 3.Manually controlled		2	2	2	2	2
DATA PROCESSING						
MTI processing 1.Yes, 2.No		2	2	2	2	2
Doppler processing 1.Yes, 2.No		2	2	1	2	2
Display 1.Digital, 2.Analog		1	1	1	1	1
OPERATION MODE (When tropical cyclone is within range of detection) 1.Hourly 2.3-hourly 3.Others		3 (every 10 mins)	3 (every 10 mins)	3 (every 5 mins)	3 (every 10 mins)	3 (every 10 mins)
PRESENT STATUS 1.Operational 2.Not operational(for research etc.)		1 (from May 2005)	1	1	1	1 (from Apr 2005)

Name of the Member **Malaysia - 2**

NAME OF STATION		Kuantan	Butterworth	Kuching	Bintulu	Kota Kinabalu
SPECIFICATIONS						
Index number		48657	48602	96413	96441	96471
Location of station		3° 47´ N 103° 13´ E	5° 28´ N 100° 23´ E	1° 29´ N 110° 20´ E	3° 13´ N 113° 04´ E	5° 56´ N 116° 03´E
Antenna elevation	m	32	20	57	151	27
Wave length	cm	10	10	5	5	5
Peak power of transmitter	kW	650	650	250	250	250
Pulse length	μ s	2	2	2	2	2
Sensitivity minimum of receiver	dBm	-113	-113	-113	-113	-113
Beam width (Width of over -3dB antenna gain of maximum)	deg	2	2	1.6	1.6	1.6
Detection range	km	400	400	250	250	250
Scan mode in observation 1.Fixed elevation 2.CAPPI 3.Manually controlled		2	2	2	2	2
DATA PROCESSING						
MTI processing 1.Yes, 2.No		2	2	2	2	2
Doppler processing 1.Yes, 2.No		2	2	2	2	2
Display 1.Digital, 2.Analog		1	1	1	1	1
OPERATION MODE (When tropical cyclone is within range of detection) 1.Hourly 2.3-hourly 3.Others		3 (every 10 mins)	3 (every 10 mins)	3 (every 10 mins)	3 (every 10 mins)	3 (every 10 mins)
PRESENT STATUS 1.Operational 2.Not operational(for research etc.)		1	1	1	1	1

Name of the Member **Malaysia - 3**

NAME OF STATION		Sandakan				
SPECIFICATIONS						
Index number		96491				
Location of station		5° 54´ N 118° 04´ E				
Antenna elevation	m	28				
Wave length	cm	5				
Peak power of transmitter	kW	250				
Pulse length	μ s	2				
Sensitivity minimum of receiver	dBm	-113				
Beam width (Width of over -3dB antenna gain of maximum)	deg	1.6				
Detection range	km	250				
Scan mode in observation 1.Fixed elevation 2.CAPPI 3.Manually controlled		2				
DATA PROCESSING						
MTI processing 1.Yes, 2.No		2				
Doppler processing 1.Yes, 2.No		2				
Display 1.Digital, 2.Analog		1				
OPERATION MODE (When tropical cyclone is within range of detection) 1.Hourly 2.3-hourly 3.Others		3 (every 10 mins)				
PRESENT STATUS 1.Operational 2.Not operational(for research etc.)		1				

Name of the Member **Philippines - 1**

NAME OF STATION		Aparri	Virac	Mactan	Guiuan	Subic
SPECIFICATIONS	Unit					
Index number		98231	98447	98646	98558	
Location of station		18° 31' 36.36'' N 121° 38' 08.58'' E	13° 37' 47.18'' N 124° 20' 02.57'' E	10° 19' 20.80'' N 123° 58' 48.47'' E	11° 02' 48.48'' N 125° 45' 19.55'' E	14° 49' 19.44'' N 120° 21' 49.68''E
Antenna elevation	m	39	39	26	39	40
Wave length	cm	10.52	10.52	5.33	10.52	10.4
Peak power of transmitter	kW	10	10	250	10	850
Pulse length	μ s	2& 100 – intensity mode 1 @ 50 – Doppler mode	2 & 100 – intensity mode 1 @ 50 – Doppler mode	2.0, 1.0, 0.8, 0.4	2 & 100 – intensity mode 1 @ 50 – Doppler mode	2.0, 1.0, 0.8, 0.4
Sensitivity minimum of receiver	dBm	-114	-114	-114	-114	-114
Beam width (Width of over -3dB antenna gain of maximum)	deg	1.8	1.8	1.0	1.8	1.83
Detection range	km	440	440	250	440	480
Scan mode in observation 1.Fixed elevation 2.CAPPI 3.Manually controlled		2	2	2	2	2
DATA PROCESSING						
MTI processing 1.Yes, 2.No		1	1	2	1	2
Doppler processing 1.Yes, 2.No		2	2	1	2	1
Display 1.Digital, 2.Analog		1	1	1	1	1
OPERATION MODE (When tropical cyclone is within range of detection) 1.Hourly 2.3-hourly 3.Others		3 (constantly tracking)	3 (constantly tracking)	3	3 (constantly tracking)	3
PRESENT STATUS 1.Operational 2.Not operational (for research etc.)		1	1	1	1	1

Name of the Member **Philippines - 2**

NAME OF STATION		Baler	Hinatuan	Tampakan	Ilo-Ilo	Tagaytay
SPECIFICATIONS	Unit					
Index number		98333	98755		98637	
Location of station		15° 44' 57.72'' N 121° 37' 55.37'' E	08° 22' 02.37'' N 126° 20' 18.73'' E	06° 25' 03.81'' N 125° 01' 51.41'' E	10° 46' 20.08'' N 122° 34' 45.08'' E	14° 09' 31.28'' N 121° 01' 12.49'' E
Antenna elevation	m	15	26	26	26	35
Wave length	cm	10.68	10.78	10.4	10.44	5.34
Peak power of transmitter	kW	600	850	850	850	250
Pulse length	μ s	2.0, 1.0, 0.8, 0.4	2.0, 1.0, 0.8, 0.4	2.0, 1.0, 0.8, 0.4	3.0, 1.0, 0.8, 0.4	2.0, 1.0, 0.8, 0.4
Sensitivity minimum of receiver	dBm	-114	-114	-114	-114	-114
Beam width (Width of over -3dB antenna gain of maximum)	deg	1.83	1.3	1.3	1.3	1.0
Detection range	km	480	480	480	480	250
Scan mode in observation 1.Fixed elevation 2.CAPPI 3.Manually controlled		2	2	2	2	2
DATA PROCESSING						
MTI processing 1.Yes, 2.No		2	2	2	2	2
Doppler processing 1.Yes, 2.No		1	1	1	1	1
Display 1.Digital, 2.Analog		1	1	1	1	1
OPERATION MODE (When tropical cyclone is within range of detection) 1.Hourly 2.3-hourly 3.Others		3	3	3	3	3
PRESENT STATUS 1.Operational 2.Not operational (for research etc.)		2 (for replacement)	1	2 (for replacement of gears)	1	1

Name of the Member **Philippines - 3**

NAME OF STATION		Basco	Quezon, Palawan			
SPECIFICATIONS	Unit					
Index number		98135				
Location of station		20° 25' 14.87'' N 121° 57' 54.76'' E	9° 13' 50.01'' N 118° 00' 20.09'' E			
Antenna elevation	m	15	26			
Wave length	cm	5.33	5.35			
Peak power of transmitter	kW	250	250			
Pulse length	μ s	2.0, 1.0, 0.8, 0.4	2.0, 1.0, 0.8, 0.4			
Sensitivity minimum of receiver	dBm	-114	-114			
Beam width (Width of over -3dB antenna gain of maximum)	deg	1.0	1.0			
Detection range	km	250	250			
Scan mode in observation 1.Fixed elevation 2.CAPPI 3.Manually controlled		2	2			
DATA PROCESSING						
MTI processing 1.Yes, 2.No		2	2			
Doppler processing 1.Yes, 2.No		1	1			
Display 1.Digital, 2.Analog		1	1			
OPERATION MODE (When tropical cyclone is within range of detection) 1.Hourly 2.3-hourly 3.Others		3	3			
PRESENT STATUS 1.Operational 2.Not operational (for research etc.)		1 (no communication link to central office but we get data via FTP)	1			

Name of the Member **Republic of Korea - 1**

NAME OF STATION		Gosan	Seongsan	Gangneung	Oseongsan	Baengnyeong-do
SPECIFICATIONS	Unit					
Index number		47185	47188	47105	47144	47102
Location of station		33° 17′ N 126° 09′ E	33° 23′ N 126° 52′ E	37° 49′ N 128° 51′ E	36° 00′ N 126° 47′ E	37° 58′ N 124° 37′ E
Antenna elevation	m	101	68	99	231	188
Wave length	Cm	10.9	10.8	10.5	10.9	5.3
Peak power of transmitter	kW	750	750	750	750	250
Pulse length	μ s	1.0; 4.5	1.0; 4.5	1.0; 4.5	1.0; 4.5	1.0; 2.0
Sensitivity minimum of receiver	dBm	-112	-112	-112	-112	-108
Beam width (Width of over -3dB antenna gain of maximum)	deg	1.0	1.0	1.0	1.0	1.0
Detection range	km	250 (volume) 500 (lowest tilt)	250, 500	280, 500	240, 480	256, 480
Scan mode in observation 1. Fixed elevation 2. CAPPI 3. Manually controlled		1, 2	1, 2	1, 2	1, 2	1, 2
DATA PROCESSING						
MTI processing 1.Yes, 2.No		2	2	2	2	2
Doppler processing 1.Yes, 2.No		1	1	1	1	1
Display 1.Digital, 2.Analog		1	1	1	1	1
OPERATION MODE (When tropical cyclone is within range of detection) 1. Hourly 2. 3-hourly 3. Others		3 (continuous)	3 (continuous)	3 (continuous)	3 (continuous)	3 (continuous)
PRESENT STATUS 1.Operational 2.Not operational(for research etc.)		1	1	1	1	1

Name of the Member **Republic of Korea - 2**

NAME OF STATION		Jindo	Gwangdeok - san	Myeonbong - san	Gwanaksan	Gudeoksan
SPECIFICATIONS	Unit					
Index number		47175	47094	47148	47116	47160
Location of station		34° 28´ N 126° 19´ E	38° 07´ N 127° 26´ E	36° 10´ N 128° 59´ E	37° 26´ N 126° 57´ E	35° 07´ N 128° 59´ E
Antenna elevation	m	497	1064	1127	640	547
Wave length	cm	10.3	10.3	5.3	11	11
Peak power of transmitter	kW	750	750	250	850	850
Pulse length	μ s	1.0; 2.5	1.0; 4.5	0.83; 2.5	1.0; 4.5	1.0; 4.5
Sensitivity minimum of receiver	dBm	-112	-112	-112	-114	-114
Beam width (Width of over -3dB antenna gain of maximum)	deg	1.0	1.0	1.0	1.0	1.0
Detection range	km	240, 480	250, 500	200	240, 480	240, 480
Scan mode in observation 1. Fixed elevation 2. CAPPI 3. Manually controlled		1, 2	1, 2	1, 2	1, 2	1, 2
DATA PROCESSING						
MTI processing 1.Yes, 2.No		2	2	2	2	2
Doppler processing 1.Yes, 2.No		1	1	1	1	1
Display 1.Digital, 2.Analog		1	1	1	1	1
OPERATION MODE (When tropical cyclone is within range of detection) 1. Hourly 2. 3-hourly 3. Others		3 (continuous)	3 (continuous)	3 (continuous)	3 (continuous)	3 (continuous)
PRESENT STATUS 1.Operational 2.Not operational(for research etc.)		1	1	1	1	1

Name of the Member **Republic of Korea - 3**

NAME OF STATION		Korean Aviation Meteorological Agency				
SPECIFICATIONS	Unit					
Index number		47113				
Location of station		37° 28′ N 126° 21′ E				
Antenna elevation	m	145				
Wave length	cm	5.32				
Peak power of transmitter	kW	250				
Pulse length	μ s	1.0; 2.0				
Sensitivity minimum of receiver	dBm	-110				
Beam width (Width of over -3dB antenna gain of maximum)	deg	0.53				
Detection range	km	30, 480				
Scan mode in observation 1. Fixed elevation 2. CAPPI 3. Manually controlled		1, 2				
DATA PROCESSING						
MTI processing 1.Yes, 2.No		2				
Doppler processing 1.Yes, 2.No		1				
Display 1.Digital, 2.Analog		1				
OPERATION MODE (When tropical cyclone is within range of detection) 1. Hourly 2. 3-hourly 3. Others		3 (continuous)				
PRESENT STATUS 1.Operational 2.Not operational(for research etc.)		1				

Name of the Member **Singapore**

NAME OF STATION		Changi				
SPECIFICATIONS	Unit					
Index number		48698				
Location of station		1° 22´ N 103° 59´ E				
Antenna elevation	m	35				
Wave length	cm	10				
Peak power of transmitter	kW	750				
Pulse length	μ s	1 or 3				
Sensitivity minimum of receiver	dBm	-110				
Beam width (Width of over -3dB antenna gain of maximum)	deg	< 1				
Detection range	km	480				
Scan mode in observation 1. Fixed elevation 2. CAPPI 3. Manually controlled		2				
DATA PROCESSING						
MTI processing 1.Yes, 2.No		1				
Doppler processing 1.Yes, 2.No		1				
Display 1.Digital, 2.Analog		1				
OPERATION MODE (When tropical cyclone is within range of detection) 1. Hourly 2. 3-hourly 3. Others		3 (continuous)				
PRESENT STATUS 1.Operational 2.Not operational(for research etc.)		1				

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Name of the Member **Thailand - 1**

NAME OF STATION		Mahong Son	Chiang Rai	Chiang Mai	Sakol Nakon	Phitsanulok
SPECIFICATIONS	Unit					
Index number		48300	48303	48327	48356	48378
Location of station		19° 18´ N 97° 50´ E	19° 55´ N 99° 50´ E	18° 47´ N 98° 59´ E	17° 09´ N 104° 08´ E	16° 46´ N 100° 16´ E
Antenna elevation	m	292	440	337	198	56
Wave length	cm	3	5	5	5	5
Peak power of transmitter	kW	200	300	300	300	300
Pulse length	μ s	0.5&1	0.8&2	0.8&2	0.8&2	0.8&2
Sensitivity minimum of receiver	dBm	-90	-110	-110	-110	-110
Beam width (Width of over -3dB antenna gain of maximum)	deg	2	1.0	1.0	1.0	1.0
Detection range	km	120	240	240	240	240
Scan mode in observation 1.Fixed elevation 2.CAPPI 3.Manually controlled		2, 3	2, 3	2, 3	2,3	2, 3
DATA PROCESSING						
MTI processing 1.Yes, 2.No		1	1	1	1	1
Doppler processing 1.Yes, 2.No		1	1	1	1	1
Display 1.Digital, 2.Analog		1	1	1	1	1
OPERATION MODE (When tropical cyclone is within range of detection) 1.Hourly 2.3-hourly 3.Others		1, 3	1, 3	1, 3	1, 3	1, 3
PRESENT STATUS 1.Operational 2.Not operational(for research etc.)		1	1	1	1	1

APPENDIX 2-E, p.20

Name of the Member **Thailand - 2**

NAME OF STATION		Khon Khaen	Samut Songkram	Ubol	Surin	Hua Hin
SPECIFICATIONS	Unit					
Index number		48381	48402	48407	48432	48475
Location of station		16° 27´ N 102° 47´ E	13° 24´ N 100° 01´ E	15° 14´ N 105° 01´ E	14° 53´ N 103° 29´ E	12° 35´ N 99° 57´ E
Antenna elevation	m	215	29	155	175	30
Wave length	cm	5	5	5	5	10
Peak power of transmitter	kW	300	300	300	300	500
Pulse length	μ s	0.8&2	0.812	0.8&2	0.8&2	0.8&2
Sensitivity minimum of receiver	dBm	-106	-110	-108	-106	-106
Beam width (Width of over -3dB antenna gain of maximum)	deg	1.0	1.0	1.0	1.0	2.1
Detection range	km	240	240	240	240	240
Scan mode in observation 1.Fixed elevation 2.CAPPI 3.Manually controlled		2, 3	2, 3	2, 3	2, 3	2, 3
DATA PROCESSING						
MTI processing 1.Yes, 2.No		1	1	1	1	1
Doppler processing 1.Yes, 2.No		1	1	1	1	1
Display 1.Digital, 2.Analog		1	1	1	1	1
OPERATION MODE (When tropical cyclone is within range of detection) 1.Hourly 2.3-hourly 3.Others		1, 3	1, 3	1, 3	1, 3	1, 3
PRESENT STATUS 1.Operational 2.Not operational(for research etc.)		1	1	1	1	1

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Name of the Member **Thailand - 3**

NAME OF STATION		Rayong	Chumporn	Ranong	Surat Thani	Phuket
SPECIFICATIONS	Unit					
Index number		48478	48517	48532	48551	48565
Location of station		12° 38´ N 101° 21´ E	10° 29´ N 99° 11´ E	9° 47´ N 98° 36´ E	9° 08´ N 99° 09´ E	8° 08´ N 99° 19´ E
Antenna elevation	m	32	28	45	33	281
Wave length	cm	5	5	3	5	5
Peak power of transmitter	kW	300	300	200	300	300
Pulse length	μ s	0.882	0.8&2	0.5&1	0.8&2	0.852
Sensitivity minimum of receiver	dBm	-115	-110	-90	-110	-106
Beam width (Width of over -3dB antenna gain of maximum)	deg	1.0	1.0	2	1.0	1.0
Detection range	km	240	240	120	240	240
Scan mode in observation 1.Fixed elevation 2.CAPPI 3.Manually controlled		2, 3	2, 3	2, 3	2, 3	2, 3
DATA PROCESSING						
MTI processing 1.Yes, 2.No		1	1	1	1	1
Doppler processing 1.Yes, 2.No		1	1	1	1	1
Display 1.Digital, 2.Analog		1	1	1	1	1
OPERATION MODE (When tropical cyclone is within range of detection) 1.Hourly 2.3-hourly 3.Others		1, 3	1, 3	1, 3	1, 3	1, 3
PRESENT STATUS 1.Operational 2.Not operational(for research etc.)		1	1	2	1	1

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Name of the Member **Thailand - 4**

NAME OF STATION		Trang	Sathing Pra (Songkla)	Narathiwat		
SPECIFICATIONS	Unit					
Index number		48567	48568	48583		
Location of station		7° 31´ N 99° 37´ E	7° 26´ N 100° 27´ E	6° 25´ N 101° 49´ E		
Antenna elevation	m	40	30	29		
Wave length	cm	3	5	5		
Peak power of transmitter	kW	200	300	300		
Pulse length	μ s	0.5&1	0.8&2	0.5&1		
Sensitivity minimum of receiver	dBm	-90	-115	-110		
Beam width (Width of over -3dB antenna gain of maximum)	deg	2	1.0	1.0		
Detection range	km	120	240	120		
Scan mode in observation 1.Fixed elevation 2.CAPPI 3.Manually controlled		2, 3	2, 3	2, 3		
DATA PROCESSING						
MTI processing 1.Yes, 2.No		1	1	1		
Doppler processing 1.Yes, 2.No		1	1	1		
Display 1.Digital, 2.Analog		1	1	1		
OPERATION MODE (When tropical cyclone is within range of detection) 1.Hourly 2.3-hourly 3.Others		1, 3	1, 3	1, 3		
PRESENT STATUS 1.Operational 2.Not operational(for research etc.)		1	1	1		

Name of the Member **USA**

NAME OF STATION		Guam	Kwajalein			
SPECIFICATIONS	Unit					
Index number		91217	91366			
Location of station		13° 33′ N 144° 50′ E	8° 44′ N 167° 44′ E			
Antenna elevation	m	110	30			
Wave length	cm	10.6	10.0			
Peak power of transmitter	kW	750	500			
Pulse length	μ s	1.57/ 4.5	0.8			
Sensitivity minimum of receiver	dBm	-113	-107			
Beam width (Width of over -3dB antenna gain of maximum)	deg	0.96	1.0			
Detection range	km	399	250			
Scan mode in observation 1. Fixed elevation 2. CAPPI 3. Manually controlled		2	2			
DATA PROCESSING						
MTI processing 1.Yes, 2.No		1	2			
Doppler processing 1.Yes, 2.No		1	1			
Display 1.Digital, 2.Analog		1	1			
OPERATION MODE (When tropical cyclone is within range of detection) 1. Hourly 2. 3-hourly 3. Others		3 6-minute continuous	3 continuous			
PRESENT STATUS 1.Operational 2.Not operational(for research etc.)		1	1			

APPENDIX 2-E, p.24

Name of the Member **Viet Nam – 1**

NAME OF STATION		Phu Lien	Viet Tri	Vinh	Tam Ky	Nha Trang
SPECIFICATIONS	Unit					
Index number		48826	48813	48845	48833	48877
Location of station		20.48 °N 106.38 °E	21.18 °N 105.25 °E	18.40 °N 105.41 °E	15.34 °N 108.28 °E	12.13 °N 109.12 °E
Antenna elevation	m	140	56	27	40	52
Wave length	cm	5.3	5.3	5.3	5.6	5.6
Peak power of transmitter	kW	250	250	250	250	250
Pulse length	μ s	2	2	2	0.8;2.0	0.8;2.0
Sensitivity minimum of receiver	dBm	-110	-110	-110	-113	-113
Beam width (Width of over -3dB antenna gain of maximum)	deg	1.1	1.1	1.1	1	1
Detection range	km	384	384	384	480	480
Scan mode in observation 1.Fixed elevation 2.CAPPI 3.Manually controlled		1,3	1,3	1,3	1,2,3	1,2,3
DATA PROCESSING						
MTI processing 1.Yes, 2.No		1	1	1	1	1
Doppler processing 1.Yes, 2.No		2	2	2	1	1
Display 1.Digital, 2.Analog		1	1	1	1	1
OPERATION MODE (When tropical cyclone is within range of detection) 1.Hourly 2.3-hourly 3.Others		1, 3	1, 3	1, 3	1, 3	1, 3
PRESENT STATUS 1.Operational 2.Not operational(for research etc.)		1	1	1	1	1

Name of the Member **Viet Nam - 2**

NAME OF STATION		Nha Be				
SPECIFICATIONS	Unit					
Index number						
Location of station		10° 49´ N 106° 43´ E				
Antenna elevation	m	25				
Wave length	cm	5.6				
Peak power of transmitter	kW	250				
Pulse length	μ s	0.4; 0.8; 2.0				
Sensitivity minimum of receiver	dBm	-122				
Beam width (Width of over -3dB antenna gain of maximum)	deg	1				
Detection range	km	480				
Scan mode in observation 1.Fixed elevation 2.CAPPI 3.Manually controlled		1, 2, 3				
DATA PROCESSING						
MTI processing 1.Yes, 2.No		1				
Doppler processing 1.Yes, 2.No		1				
Display 1.Digital, 2.Analog		1				
OPERATION MODE (When tropical cyclone is within range of detection) 1.Hourly 2.3-hourly 3.Others		1, 3				
PRESENT STATUS 1.Operational 2.Not operational(for research etc.)		1				

APPENDIX 2-F

SCHEDULE OF HIMAWARI OBSERVATIONS AND DISSEMINATIONS

1. Observations

Himawari observations are as follows:
(a) full-disk observations are made every 10 minutes;
(b) target area observations are made every 2.5 minutes in addition to the full-disk observations;

2. HimawariCloud (Internet cloud service)

JMA distributes full-spec imagery derived from the Himawari-series satellites via an Internet cloud service, HimawariCloud. See the following webpage for details.
http://www.data.jma.go.jp/mscweb/en/himawari89/cloud_service/cloud_service.html

3. HimawariCast (communication satellite dissemination service)

JMA operates the HimawariCast service which disseminates primary sets of imagery from the Himawari-series satellites via a communication satellite, See the following webpage for details.
http://www.data.jma.go.jp/mscweb/en/himawari89/himawari_cast/himawari_cast.html

4. Internet Service for National Meteorological and Hydrological Services (NMHSs)

Besides the above services, JMA provides satellite imagery through various methods.

[JMA real-time satellite imagery webpage]
http://www.jma.go.jp/en/gms/

[MSC (Meteorological Satellite Center) real-time satellite imagery webpage]
http://www.data.jma.go.jp/mscweb/data/himawari/

[SATAID (Satellite Animation and Interactive Diagnosis) Service]
http://www.wis-jma.go.jp/cms/sataid/

[JDDS (JMA Data Dissemination Service)]
http://www.data.jma.go.jp/mscweb/en/himawari89/JDDS_service/JDDS_service.html

SATELLITE IMAGERY RECEIVING FACILITIES AT TYPHOON COMMITTEE MEMBERS

Member	Station		Himawari 1. Himawari Cloud 2. Himawari Cast	NOAA 1. HRPT 2. APT	Meteosat 1. P-DUS
Cambodia			1, 2		
China	Beijing Shanghai Shenyan Guangzhou Cheng-chou Cheng-tu Lan-chou Kunming Changsha Nanjing Harbin	(39.9°N, 116.4°E) (31.1°N, 121.4°E) (41.8°N, 123.6°E) (23.1°N, 113.3°E) (34.7°N, 113.7°E) (31.2°N, 114.0°E) (36.1°N, 103.9°E) (25.0°N, 102.7°E) (28.2°N, 113.1°E) (32.0°N, 118.8°E) (45.8°N, 126.8°E)	1	1, 2 2	
Democratic People's Republic of Korea	Pyongyang	(39.0°N, 125.8°E)		1	
Hong Kong, China*	Kowloon	(22.3°N, 114.2°E)	1, 2	1	
Japan	Minamitorishima	(24.3°N, 154.0°E)	2		
Lao People's Democratic Republic			2		
Macao, China*	Macao	(22.2°N, 113.5°E)	1, 2	1	
Malaysia	Petaling Jaya	(3.1°N, 101.7°E)	1, 2	1	
Philippines	Quezon City Cagayan de Oro City Pasay City Cebu	(14.7°N, 121.0°E) (8.5°N, 124.6°E) (14.5°N, 121.0°E) (10.3°N, 124.0°E)	1, 2	1	

*Hong Kong, China receives AQUA (MODIS), NPP(CrIs, VIIRS, ATMS), FY-2 (S-VISSR), and TERRA (MODIS).

* Macao, China receives FY-2D, FY-2E (S-VISSR) Stretched VISSR.

Member	Station		Himawari 1. Himawari Cloud 2. Himawari Cast	NOAA 1. HRPT 2. APT	Meteosat 1. P-DUS
Republic of Korea*	Seoul Incheon Int. Airport Munsan Seosan Pusan Pusan Kimhae Air Kwangju Taejon Kangnung Cheju Taegu Taegu/Air Traffic Chonju Chongju Ullung-Do Mokpo Chunchon Masan Tongyong Inchon Huksando Suwon Sokcho Pohang Kunsan Baengnyeong-do	(37.6°N, 127.0°E) (37.3°N, 126.3°E) (37.9°N, 126.8°E) (36.8°N, 126.5°E) (35.1°N, 129.0°E) (35.2°N, 126.9°E) (35.2°N, 126.9°E) (36.4°N, 127.4°E) (37.5°N, 130.9°E) (33.5°N, 126.5°E) (35.9°N, 128.6°E) (35.9°N, 128.7°E) (35.8°N, 127.2°E) (36.6°N, 127.4°E) (37.5°N, 130.9°E) (34.8°N, 126.4°E) (37.9°N, 127.7°E) (35.2°N, 128.6°E) (34.9°N, 128.4°E) (37.5°N, 126.6°E) (34.7°N, 125.5°E) (37.3°N, 127.0°E) (38.3°N, 128.6°E) (36.0°N, 129.4°E) (36.0°N, 126.7°E) (37.9°N, 124.6°E)	1	1 1	 1
Singapore*	Changi Airport	(1.4°N, 104.0°E)	1	1	1
Thailand	Bangkok	(13.7°N, 100.6°E)	1, 2	1	
USA	Guam	(13.4°N, 144.6°E)	1	1	
Viet Nam	Hanoi Ho Chi Ming City	(21.0°N, 105.5°E) (10.5°N, 106.4°E)	1, 2	2 2	

* Republic of Korea receives AQUA (MODIS, AIRS, AMSU, AMSR-E), FY-1 (CHRPT) and TERRA (MODIS).
* Singapore receives AQUA (MODIS), FY2B (S-VISSR), FY-1 (CHRPT) and TERRA (MODIS).

APPENDIX 2-H

LIST OF SAREP REPORTS ISSUED BY TYPHOON COMMITTEE MEMBERS

Member	Frequency	Heading in the BUFR code (FM 94)	Issuance Condition
RSMC Tokyo – Typhoon Center	8 times/day	IUCC10 RJTD	(i) When a tropical cyclone of TS intensity or higher is located in the responsible area of the RSMC Tokyo - Typhoon Center; (ii) When a tropical depression existing in the responsible area is forecasted to have an intensity of TS or higher within 24 hours; or (iii) When an area of wind speed of 34 knots or higher caused by a tropical cyclone is forecasted to be in the responsible area within 24 hours.
Hong Kong, China	8 times/day	IUCC01 VHHH IUCC02 VHHH IUCC03 VHHH IUCC04 VHHH	When a tropical cyclone is located within 10N to 30N and 105E to 125E.

APPENDIX 2-I

RECONNAISSANCE FLIGHTS CONDUCTED BY TYPHOON COMMITTEE MEMBERS

HKO conducts dropsonde reconnaissance flights for selected tropical cyclones over the northern part of the South China Sea. Data is disseminated in BUFR format through GTS circuit.

APPENDIX 2-J

TROPICAL CYCLONE PASSAGE REPORT FORM

TROPICAL CYCLONE PASSAGE REPORT FORM

TC Name (RSMC No.) _____

Station/ buoy/ship Number	Minimum Sea Level Pressure		Maximum Sustained Wind		Peak Gust		Rainfall	
	hPa	Time Observed (UTC)	(10-min ave.) m/sec	Time Observed (UTC)	m/sec	Time Observed (UTC)	Amount mm	Date Observed

APPENDIX 4-A

CLASSIFICATIONS OF TROPICAL CYCLONES IN THE WESTERN NORTH PACIFIC INTERNALLY USED BY MEMBERS

Maximum sustained winds (knots)	≤33	34 - 47	48 - 63	≥ 64		
Typhoon Committee (10 min)	Tropical Depression (TD)	Tropical Storm (TS)	Severe Tropical Storm (STS)	Typhoon (TY)		
China (2 min)	TD	TS	STS	64 - 80 TY	81 - 99 Severe Typhoon (STY)	≥ 100 Super Typhoon (Super TY)
Hong Kong, China (10 min)	TD	TS	STS	64 - 80 TY	81 - 99 Severe Typhoon (ST)	≥ 100 Super Typhoon (Super T)
Japan (10 min)	TD	TS	STS	64 - 84 TY	85 - 104 Very Strong TY	≥ 105 Violent TY
U.S. (1 min)	TD	TS		64 - 129 TY		≥ 130 Super TY

EXAMPLES OF ADVISORIES ISSUED FROM RSMC TOKYO - TYPHOON CENTER

RSMC Tropical Cyclone Advisory

WTPQ20 RJTD 271200
RSMC TROPICAL CYCLONE ADVISORY
NAMETY 0815 JANGMI (0815)
ANALYSIS
PSTN271200UTC 21.3N 124.4E GOOD
MOVENW 13KT
PRES910HPA
MXWD115KT
GUST165KT
50KT120NM
30KT240NM
FORECAST
24HF281200UTC 24.7N 121.1E 75NM 70%
MOVENW 12KT
PRES950HPA
MXWD080KT
GUST115KT
48HF291200UTC 27.3N 121.3E 160NM 70%
MOVEN 07KT
PRES980HPA
MXWD060KT
GUST085KT
72HF301200UTC 29.3N 124.9E 220NM 70%
MOVEENE 09KT
PRES994HPA
MXWD035KT
GUST050KT =

RSMC Guidance for Forecast

D20080927152930
FXPQ20 RJTD 271200
RSMC GUIDANCE FOR FORECAST
NAME TY 0815 JANGMI (0815)
PSTN 271200UTC 21.3N 124.4E
PRES 910HPA
MXWD 115KT
FORECAST BY GLOBAL MODEL
TIME PSTN PRES MXWD
(CHANGE FROM T=0)
T=06 22.0N 124.0E -002HPA +001KT
T=12 23.0N 123.4E 000HPA +004KT
T=18 24.5N 122.7E -003HPA +013KT
T=24 25.0N 121.3E +009HPA -005KT
:
T=72 29.5N 125.8E +040HPA -039KT
T=78 29.5N 127.6E +039HPA -040KT
T=84 29.7N 129.7E +039HPA -039KT
T=90 ///// ////// /////// //////=

RSMC Prognostic Reasoning

WTPQ30 RJTD 250600
RSMC TROPICAL CYCLONE PROGNOSTIC REASONING
REASONING NO. 4 FOR STS 0815 JANGMI (0815)
1.GENERAL COMMENTS
 REASONING OF PROGNOSIS THIS TIME IS SIMILAR TO PREVIOUS ONE.
 POSITION FORECAST IS MsAINLY BASED ON NWP AND PERSISTENCY.
2.SYNOPTIC SITUATION
 NOTHING PARTICULAR TO EXPLAIN.
3.MOTION FORECAST
 POSITION ACCURACY AT 250600 UTC IS FAIR.
 STS WILL DECELERATE FOR THE NEXT 24 HOURS.
 STS WILL MOVE NORTHWEST FOR THE NEXT 48 HOURS THEN MOVE GRADUALLY TO WEST-NORTHWEST.
4.INTENSITY FORECAST
 STS WILL BE GRADED UP TO TY WITHIN 24 HOURS.
 STS WILL DEVELOP BECAUSE SPIRAL CLOUD BANDS HAVE BECOME WELL ORGANIZED AND CYCLONE WILL STAY IN HIGH SST AR
EA.
 FI-NUMBER WILL BE 4.5 AFTER 24 HOURS.=

RSMC Tropical Cyclone Advisory for Five-day Track Forecast

WTPQ50 RJTD 190000
RSMC TROPICAL CYCLONE ADVISORY
NAME TY 0910 VAMCO (0910) UPGRADED FROM STS
ANALYSIS
PSTN 190000UTC 17.3N 157.5E GOOD
MOVE E SLOWLY
PRES 970HPA
MXWD 065KT
GUST 095KT
50KT 40NM
30KT 180NM NORTHEAST 120NM SOUTHWEST
FORECAST
24HF 200000UTC 18.0N 156.9E 70NM 70%
MOVE ALMOST STATIONARY
PRES 960HPA
MXWD 075KT
GUST 105KT
48HF 210000UTC 18.7N 156.5E 110NM 70%
MOVE ALMOST STATIONARY
PRES 950HPA
MXWD 080KT
GUST 115KT
72HF 220000UTC 21.2N 155.9E 160NM 70%
MOVE N 06KT
PRES 950HPA
MXWD 080KT
GUST 115KT
96HF 230000UTC 24.5N 154.4E 240NM 70%
MOVE NNW 09KT
120HF 240000UTC 29.2N 153.5E 375NM 70%
MOVE N 12KT =

APPENDIX 4-C

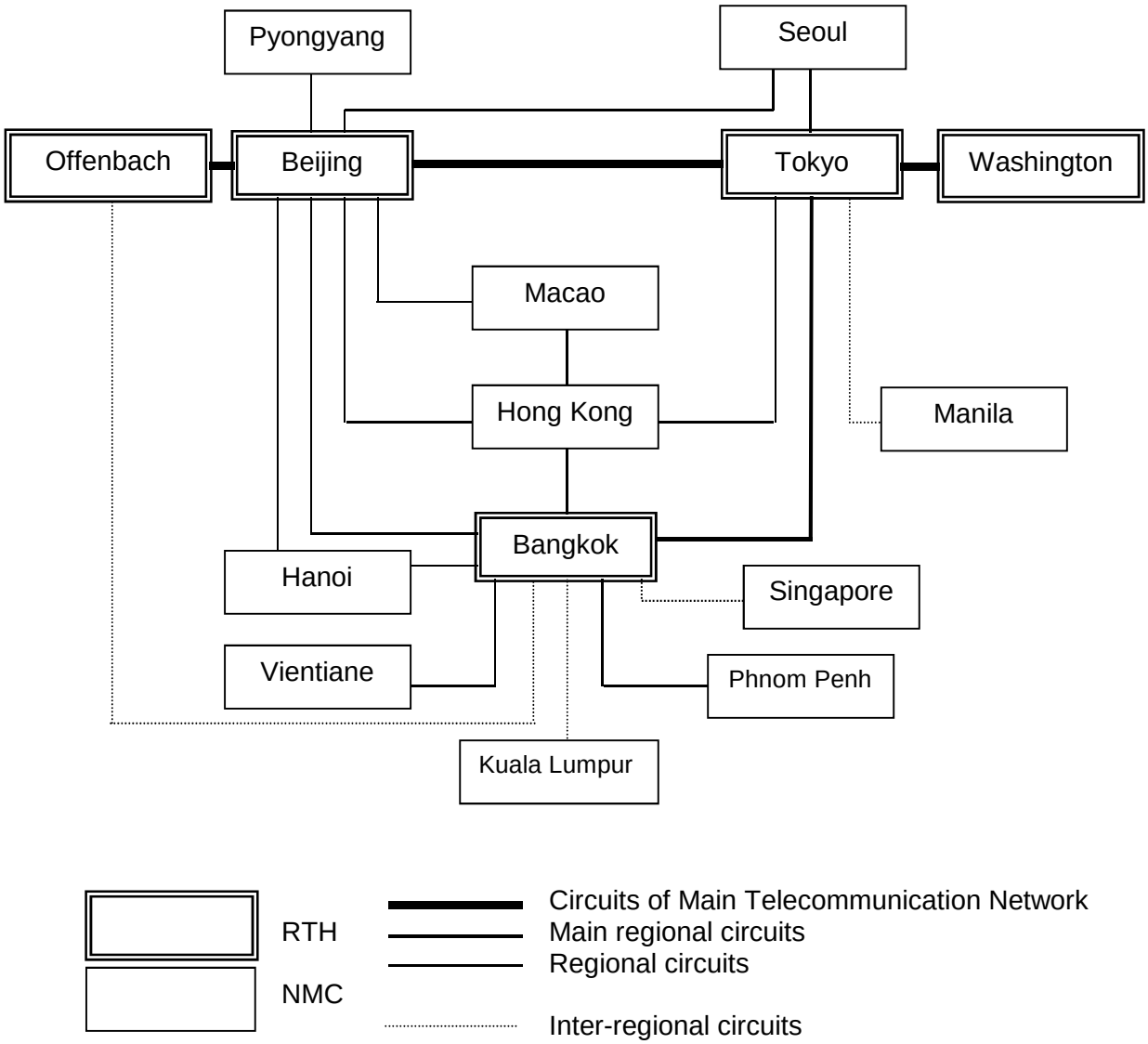
STATIONS BROADCASTING CYCLONE WARNINGS FOR SHIPS ON THE HIGH SEAS

Station		Call sign of coastal radio station	Area covered
Member	Station		
China	Shanghai	XSG	Bohai Sea, Huanghai Sea, Donghai Sea, Shanghai Port, Taiwan Straits and sea around Taiwan province
	Tianjin	XSZ	North and Central Huanghai Sea and Bohai Sea
	Guangzhou	XSQ	Taiwan Straits, Bashi Channel, Nanhai Sea and Beibu Wan Gulf
Hong Kong, China	Hong Kong	Broadcast via NAVTEX on 518 kHz*	Waters inside the boundary line: 30N 105E to 30N 125E to 10N 125E, to 10N 105E, to 30N 105E
Japan	Hokkaido	JNL	Hokkaido area
	Shiogama	JNN	Sendai area
	Yokohama	JGC	Tokyo area
	Nagoya	JNT	Nagoya area
	Kobe	JGD	Kobe area
	Hiroshima	JNE	Hiroshima area
	Niigata	JNV	Niigata area
	Maizuru	JNC	Maizuru area
	Moji	JNR	Fukuoka area
	Kagoshima	JNJ	Kagoshima area
	Okinawa	JNB	Okinawa area
Malaysia	Port Penang Labuan Miri	LY 3010 OA 3010 OE 3010	Strait of Malacca* South China Sea* South China Sea* *within 300nm from station
Philippines	Manila	DZR, DZG, DSP, DZD, DZF, DFH, DZO, DZN, DZS	Pacific waters inside the boundary line: 25N 120E to 25N 135E, to 5N 135E, to 5N 115E, to 15N 115E, to 21N 120E, to 20N 120E
	San Miguel	NPO	North Pacific waters east of 160E; Philippine Sea, Japan Sea, Yellow Sea, East China Sea, South China Sea
Republic of Korea	Seoul	HLL	East Sea, Yellow Sea, Jeju, Chusan, Nagasaki, and Kagoshima areas
Thailand	Bangkok	HSA	Gulf of Thailand, West coast of Southern Thailand, Strait of Malacca and South China Sea
U.S.A.	Honolulu, Hawaii	KMV-99	Pacific Ocean
Viet Nam	Dannang	XVT 1-2	Basco Gulf, Blendong Sea and Gulf of Thailand
	Halphong	XVG 5, 9	*ditto*
	Ho Chi Minh Ville	XVS 1, 3, 8	*ditto*
	Nha Trang	XVN 1, 2	*ditto*

*Coast station VRX closed on 1 October 2006.

APPENDIX 5-A

METEOROLOGICAL TELECOMMUNICATION NETWORK FOR THE TYPHOON COMMITTEE



**PRESENT OPERATIONAL STATUS
OF THE METEOROLOGICAL TELECOMMUNICATION NETWORK
FOR THE TYPHOON COMMITTEE REGION**

1. Main Telecommunication Network	Present Operational Status
Beijing - Tokyo	Cable (MPLS), TCP/IP Beijing 16 Mbps/Tokyo 10 Mbps
Beijing - Offenbach	Cable (MPLS), TCP/IP Beijing 16 Mbps/Offenbach 50 Mbps
Washington - Tokyo	Cable (MPLS), TCP/IP Washington 50 Mbps/Tokyo 10 Mbps
2. Main regional circuit	
Tokyo - Bangkok	Cable (MPLS), TCP/IP Tokyo 2 Mbps/Bangkok 128 kbps
3. Regional circuits	
Bangkok - Beijing	64 kbps leased line CMACast (Satellite broadcast)
Bangkok - Hanoi	64 kbps leased line, FTP protocol
Bangkok – Hong Kong	Internet, FTP protocol
Bangkok - Phnom Penh	Internet (VPN), TCP/IP
Bangkok - Vientiane	Cable (DDN), 64 kbps, FTP protocol and Internet, FTP protocol
Beijing - Hanoi	64 kbps leased line, CMACast (Satellite broadcast)
Beijing - Hong Kong	Cable (MSTP), 4 Mbps TCP/IP CMACast (Satellite broadcast)
Beijing - Macao	2Mbps leased line CMACast (Satellite broadcast)
Beijing - Pyongyang	64 kbps leased line,; CMACast (Satellite broadcast)
Beijing - Seoul	Cable (MPLS), TCP/IP Beijing 16 Mbps/Seoul 4 Mbps
Beijing - Vientiane	CMACast (Satellite broadcast)

Hong Kong - Macao	Internet (VPN)
Tokyo - Hong Kong	Cable (MPLS), TCP/IP Tokyo 2 Mbps/Hong Kong 1 Mbps
Tokyo - Seoul	Cable (MPLS), TCP/IP Tokyo 10 Mbps/Seoul 4 Mbps

4. Inter-regional circuits

Bangkok - Kuala Lumpur	Cable (MPLS), TCP/IP 64 kbps
Bangkok - Singapore	Cable (MPLS), TCP/IP 64 kbps
Bangkok - Offenbach	Internet, FTP protocol
Tokyo - Manila	Cable (MPLS), TCP/IP Tokyo 2 Mbps/Manila 64 kbps

5. RTH radio broadcast

Bangkok	1 FAX
Tokyo	1 FAX

6. Satellite broadcast

Operated by China: Asiasat-4 (122.2°E)	Operational observations, warnings, NWP products, satellite image and fax distribution
Operated by Japan: HimawariCast (JCSAT-2, 154°E)	Operational satellite image, NWP products, in-situ observation data and ASCAT ocean surface wind data distribution

7. Internet Cloud Service

Operated by Japan: HimawariCloud	Operational satellite image in full resolutions and bands

LIST OF ADDRESSES, TELEX/CABLE AND TELEPHONE NUMBERS OF THE TROPICAL CYCLONE WARNING CENTERS IN THE REGION

Centre numbers	Mailing address	Telex/cable, Telephone, fax
Cambodia		
Attn. Mr Ly Chana Deputy Director Department of Agricultural Hydraulics and Hydrometeorology	Norodom Boulevard	Tel.: (+855) 15 913081 Fax: (+855) 23 26345
Attn. Mr Hun Kim Hak Chief of Cambodian National Airport	Pochentong	Tel/Fax:(+855) 23 66193 66192 NMC 66191
China		
National Meteorological Center China Meteorological Adm. (Director: Bi Baogui)	No. 46 Zhongguancun Nandajie, Beijing 100081	Tel.: (+86) (10) 5899 5809 Cable: 2894 Fax: (+86) (10) 6217 2956 E-mail: bibg@cma.gov.cn
Democratic People's Republic of Korea		
Mr Ko Sang Bok Director Central Forecast Research Insitute State Hydrometeorological Adm.	Oesong-dong Central District	Telex: 38022 TCT KP Tel.: (+850) (2) 321 4539 Fax: (+850) (2) 381 4410
Hong Kong, China		
Central Forecasting Office Hong Kong Observatory (Attn. Mr. L.S. Lee)	134A Nathan Road Tsim Sha Tsui Kowloon Hong Kong, China	Tel.: (+852) 2926 8371 (Office hours) (+852) 2368 1944 (24 hours) Fax: (+852) 2311 9448 (24 hours) E-mail: lslee@hko.gov.hk
Japan		
Forecast Division Forecast Department Japan Meteorological Agency (Director: Y. Kajihara)	1-3-4 Otemachi Chiyoda-ku Tokyo 100-8122	Telex: 2228080 METTOKJ (24 hours) Tel.: (+81) (3)3211 8303 (00 - 09 UTC on weekdays) (+81) (3) 3211 7617 (24 hours) Fax: (+81) (3) 3211 8303

Lao People's Democratic Republic

Ministry of Agriculture and Forestry, Department of Meteorology and Hydrology	P.O. Box 811 Vientiane VIENTIANE	Telex: 4306 ONU VTELS Cable: UNDEVPRO

Macao, China

Meteorological and Geophysical Bureau (Director: Tam Vai Man)	P.O. Box 93 Macao, China	Tel.: (+853) 88986173 Fax: (+853) 28850773 E-mail: meteo@smg.gov.mo

Malaysia

Malaysian Meteorological Dep. (Central Forecast Office, Director: Mr. Saw Bun Liong)	Jalan Sultan 46667 Petaling Jaya Selangor Malaysia	Tel.: (+60) (3) 7967 8116 (+60) (3) 7967 8119 Fax: (+60) (3) 7955 0964 E-mail: cfo@met.gov.my

Philippines

Esperanza O. Cayanan Ph.D. Weather Services Chief Weather Division, PAGASA	WFFC Bldg., BIR Road, Diliman, Quezon City 1100	Telex: 66682 WXMLA PN Tel.: (+63) (2) 922 1996 Cable: 66682 WX MLA Fax: (+63) (2) 922 5287 (24 hours)

T C S

Secretary: Yu Jixin	Avenida de 5 de Outubro Coloane, Macau	Tel: (853) 8 8010531 Fax: (853) 8 8010530 E-mail: yujx@typhooncommittee.org

Republic of Korea

National Typhoon Center Korea Meteorological Administration (Director: Deok Hwan JEONG) 2 Seoseongro 810-gil, Namwon-eup, Seogwipo, Jeju, 63614, Republic of Korea		Tel.: (+82) (70) 7850-6351 Fax: (+82) (64) 805-0368

Thailand

Thai Meteorological Department	4353 Sukhumvit Road Bangkok 10260	Tel.: (+66) (2) 366 6325 Fax.: (+66) (2) 399 4020
(Director-General: Mr. Wanchai Sakudomchai)		E-mail: tmd_inter@tmd.go.th
Weather Forecast Bureau Thai Meteorological Department	4353 Sukhumvit Road Bangkok 10260	
(Director: Dr. Sugunyanee Yavinchan)		Tel&Fax:(+66) (2) 399 4001 E-mail: sugunyanee@hotmail.com
Telecommunications and Information Technology Bureau Thai Meteorological Department (Acting Director : Mr. Wirat Woranut)	4353 Sukhumvit Road Bangkok 10260	Tel.: (+66) (2) 399 4555 Fax: (+66) (2) 398 9861 E-mail: tmd_inter@tmd.go.th

USA

National Weather Service (Genevieve Miller, Meteorologist in charge)	3232 Hueneme Road Barrigada Guam 96913	Tel.: (+1-671) 472 0944 Fax: (+1-671) 472 7405
RSMC Honolulu (Director: Raymond Tanabe)	2525 Correa Road Suite 250 Honolulu, HI 96822	Tel.: (+1-808) 973-5272 Fax: (+1-808) 973-5271

Viet Nam

Forecast Division Forecast Department Hydro-Meteorological Service (Director: Nguyan Cong Thanh)	4 Dan Thai Than Hanoi	Tel.: (+84) (4) 264020 Fax: (+84) (4) 254278

APPENDIX 5-D

ABBREAVIATED HEADINGS FOR THE TROPICAL CYCLONE WARNINGS

Member	Abbreviated WMO Communication Headings
Cambodia	
China	WTPQ20 BABJ
Democratic People's Republic of Korea	
Hong Kong, China	WTPQ20 VHHH, WTSS20 VHHH
Japan	WTPQ20 RJTD, WTPQ21 RJTD, WTPQ22 RJTD, WTPQ23 RJTD, WTPQ24 RJTD, WTPQ25 RJTD
Lao People's Democratic Republic	
Macao, China	For domestic dissemination only and WTMU40 VMMC
Malaysia	For domestic dissemination only
Philippines	WTPH20 RPMM, WTPH21 RPMM
Republic of Korea	WTKO20 RKSL
Singapore	WTSR20 WSSS
Thailand	WTTH20 VTBB
USA	WTPQ31 - 35 PGUM
Viet Nam	WTVS20 VNNN

COLLECTION AND DISTRIBUTION OF INFORMATION RELATED TO TROPICAL CYCLONES

Type of Data	Heading		Receiving station TD	BJ	BB	HH	MM	SL	NN	KK	IV	PP	MC
Enhanced	SNCI30	BABJ	BJ	O	BJ	BJ	TD	TD	BJ	BB	BB	BB	
surface	SNHK20	VHHH	HH	HH	BJ	O		TD	BB	BB	BB	BB	HH
observation	SNJP20	RJTD	O	TD	TD	TD		TD	BB	BB	BB	BB	
	SNKO20	RKSL	SL	TD	TD	TD		O	BB	BB	BB	BB	
	SNLA20	VLIV	BB	BB	IV				BB	BB	O	BB	
	SNMS20	WMKK	BB	BB	KK	BJ			BB	O	BB	BB	
	SNMU40	VMMC		MC	BJ	BJ		TD	BB	BB	BB	BB	O
	SNPH20	RPMM	MM	TD	TD	TD	O	TD	BB	BB	BB	BB	
	SNTH20	VTBB	BB	TD	O	TD		TD	BB	BB	BB	BB	
	SNVS20	VNNN	BB		NN	BJ			O	BB	BB	BB	
Enhanced	USCI01	BABJ	BJ	O	BJ	BJ	TD	TD	BJ	BB	BB	BB	
upper-air	USCI03	BABJ	BJ	O	BJ	BJ	TD	TD	BJ	BB	BB	BB	
observation	USCI05	BABJ	BJ	O	BJ	BJ	TD	TD	BJ	BB	BB	BB	
	USCI07	BABJ	BJ	O	BJ	BJ	TD	TD	BJ	BB	BB	BB	
	USCI09	BABJ	BJ	O	BJ	BJ	TD	TD	BJ	BB	BB	BB	
	UKCI01	BABJ	BJ	O	BJ	BJ		TD	BJ	BB	BB	BB	
	ULCI01	BABJ	BJ	O	BJ	BJ		TD	BB	BB	BB	BB	
	ULCI03	BABJ	BJ	O	BJ	BJ		TD	BB	BB	BB	BB	
	ULCI05	BABJ	BJ	O	BJ	BJ		TD	BB	BB	BB	BB	
	ULCI07	BABJ	BJ	O	BJ	BJ		TD	BB	BB	BB	BB	
	ULCI09	BABJ	BJ	O	BJ	BJ		TD	BJ	BB	BB	BB	
	UECI01	BABJ	BJ	O	BJ	BJ		TD	BB	BB	BB	BB	
	USHK01	VHHH	HH	HH	BJ	O	TD	TD	BB	BB	BB	BB	HH
	UKHK01	VHHH	HH	HH	BJ	O		TD	BB	BB	BB	BB	HH
	ULHK01	VHHH	HH	HH	BJ	O		TD	BB	BB	BB	BB	HH
	UEHK01	VHHH	HH	HH	BJ	O		TD	BB	BB	BB	BB	HH
	USJP01	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	UKJP01	RJTD	O	TD	TD	TD		TD	BB	BB	BB	BB	
	ULJP01	RJTD	O	TD	TD	TD		TD	BB	BB	BB	BB	
	UEJP01	RJTD	O	TD	TD	TD		TD	BB	BB	BB	BB	
	USKO01	RKSL	SL	TD	TD	TD	TD	O	BB	BB	BB	BB	
	UKKO01	RKSL	SL	TD	TD	TD		O	BB	BB	BB	BB	
	ULKO01	RKSL	SL	TD	TD	TD		O	BB	BB	BB	BB	
	UEKO01	RKSL	SL	TD	TD	TD		O	BB	BB	BB	BB	
	USMS01	WMKK	BB	TD	KK	TD	TD	TD	BB	O	BB	BB	
	UKMS01	WMKK	BB	TD	KK	TD	TD	TD	BB	O	BB	BB	
	ULMS01	WMKK	BB	TD	KK	TD	TD	TD	BB	O	BB	BB	
	UEMS01	WMKK	BB	TD	KK	TD	TD	TD	BB	O	BB	BB	
	USPH01	RPMM	MM	TD	TD	TD	O	TD	BB		BB	BB	
	UKPH01	RPMM	MM	TD	TD	TD	O	TD	BB		BB	BB	
	ULPH01	RPMM	MM	TD	TD	TD	O	TD	BB		BB	BB	
	UEPH01	RPMM	MM	TD	TD	TD	O	TD	BB		BB	BB	
	USTH01	VTBB	BB	TD	O	TD	TD	TD	BB	BB	BB	BB	

Continued to the next page

Type of Data	Heading		Receiving station TD	BJ	BB	HH	MM	SL	NN	KK	IV	PP	MC
Enhanced	UKTH01	VTBB	BB	TD	O	TD		TD	BB	BB	BB	BB	
Upper-air	ULTH01	VTBB	BB	TD	O	TD		TD	BB	BB	BB	BB	
observation	UETH01	VTBB	BB	TD	O	TD		TD	BB	BB	BB	BB	
	USVS01	VNNN	BB	TD	NN	TD	TD	TD	O	BB	BB	BB	
	UKVS01	VNNN	BB	TD	NN	TD		TD	O	BB	BB	BB	
	ULVS01	VNNN	BB	TD	NN	TD	TD	TD	O	BB	BB	BB	
	UEVS01	VNNN	BB	TD	NN	TD	TD	TD	O	BB	BB	BB	
	URPA10	PGTW	*	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	URPA11	PGTW	*	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	URPA12	PGTW	*	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	URPA14	PGTW	*	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	URPN10	PGTW	*	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	UZPA13	PGTW	*	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	UZPN13	KNHC	*		TD	TD		TD	BB	BB	BB	BB	
	UZPN13	KWBC	*	TD	TD	TD		TD	BB	BB	BB	BB	
	UZPN13	PGTW	*	TD	TD	TD		TD	BB	BB	BB	BB	
Enhanced	SNVB20	VTBB			O				BB	BB	BB	BB	
ship	SNVB20	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
observation	SNVD20	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	SNVE20	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	SNVX20	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	SNVB21	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	SNVD21	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	SNVE21	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	SNVX21	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	SNVX20	RPMM	MM	TD	TD	TD	O	TD	BB		BB	BB	
	SNVX20	VHHH	HH	HH	BJ	O	TD	TD	BB	BB	BB	BB	HH
	SNVX20	VNNN	BB	TD	NN	TD		TD	O	BB	BB	BB	
Enhanced	SBCI30	BABJ	BJ	O	BJ	TD	TD	TD	BJ	BB	BB	BB	
radar	SCCI30	BABJ		O	BJ	BJ			BB	BB	BB	BB	
observation	SBCI60	BCGZ		O	BJ				BJ	BB	BB	BB	
	SCCI60	BCGZ	HH	O	BJ				BB	BB	BB	BB	
	SBHK20	VHHH	HH	HH	BJ	O	TD		BB	BB	BB	BB	HH
	ISBC01	VHHH	HH	HH	HH	O	TD	TD		BB	BB	BB	
	ISBC01	RJTD	O	TD	TD	TD	TD	TD		BB	BB	BB	
	SDKO20	RKSL						O					
	SDMS20	WMKK	BB	TD	KK	TD			BB	O	BB	BB	
	SDPH20	RPMM	MM	TD	TD			TD	BB		BB	BB	
	SDTH20	VTBB	BB	TD	O	TD			BB	BB	BB	BB	
	SDVS20	VNNN	BB	TD	NN	TD	TD		O	BB	BB	BB	

Type of Data	Heading		Receiving station TD	BJ	BB	HH	MM	SL	NN	KK	IV	PP	MC
			*										
Satellite	TPPN10	PGTW			TD	TD			BB	BB	BB	BB	
guidance	TPPN10	PGUA	*		TD	TD			BB	BB	BB	BB	
	TPPA1	RJTY	*	TD	TD	TD	TD		BB	BB	BB	BB	
	TPPA1	RODN	*	TD	TD	TD	TD		BB	BB	BB	BB	
	IUCC10	RJTD	O	TD	TD	TD	TD	TD		BB	BB	BB	
	IUCC01	VHHH	HH	HH	HH	O							
	IUCC02	VHHH	HH	HH	HH	O							
	IUCC03	VHHH	HH	HH	HH	O							
	IUCC04	VHHH	HH	HH	HH	O							
Tropical	FXPQ01	VHHH	HH	HH	BJ	O			BB	BB	BB	BB	HH
Cyclone	FXPQ02	VHHH	HH	HH	BJ	O			BB	BB	BB	BB	HH
Forecast	FXPQ03	VHHH	HH	HH	BJ	O			BB	BB	BB	BB	HH
	FXPQ20	VHHH	HH	HH	BJ	O	TD	TD	BB	BB	BB	BB	HH
	FXPQ21	VHHH	HH	HH		O							
	FXPQ20	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	FXPQ21	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	FXPQ22	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	FXPQ23	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	FXPQ24	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	FXPQ25	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	FXPQ29	VTBB			O								
	FXPH20	RPMM	MM	TD	TD	TD	O	TD	BB	BB	BB	BB	
	FXSS01	VHHH	HH	HH	BJ	O			BB	BB	BB	BB	HH
	FXSS02	VHHH	HH	HH	BJ	O			BB	BB	BB	BB	HH
	FXSS03	VHHH	HH	HH	BJ	O			BB	BB	BB	BB	HH
	FXSS20	VHHH	HH	HH	BJ	O	TD	TD	BB	BB	BB	BB	HH
	FXSS21	VHHH	HH	HH		O							
Warning	WDPN31	PGTW	*	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	WDPN32	PGTW	*	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	WHCI28	BCGZ			BJ	BJ			BJ	BB	BB	BB	
	WHCI40	BABJ	BJ	O	BJ	BJ			BJ	BB	BB	BB	
	WSPH	RPMM	*	TD	TD	TD	O	TD	BB	BB	BB	BB	
	WTMU40	VMMC	BJ	MC	BJ	BJ			BB	BB	BB	BB	O
	WTPN21	PGTW	*	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	WTPN31	PGTW	*	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	WTPN32	PGTW	*	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	WTPH20	RPMM	MM	TD	TD	TD	O		BB		BB	BB	
	WTPH21	RPMM			TD		O		BB		BB	BB	
	WTPQ20	VHHH	HH	HH	BJ	O		TD	BB	BB	BB	BB	HH
	WTSS20	VHHH	HH	HH	BJ	O			BB	BB	BB	BB	HH
	WTTH20	VTBB	BB	TD	O	TD			BB	BB	BB	BB	
	WTVS20	VNNN			NN	BJ			O	BB	BB	BB	
Continued to	WTPQ20	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
the next page	WTPQ21	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	

Type of Data	Heading		Receiving station TD	BJ	BB	HH	MM	SL	NN	KK	IV	PP	MC
	WTPQ22	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	WTPQ23	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	WTPQ24	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	WTPQ25	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	WTKO20	RKSL	SL	TD	TD	TD		O	BB	BB	BB	BB	
Prognostic Reasoning	WTPQ30	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	WTPQ31	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	WTPQ32	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	WTPQ33	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	WTPQ34	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	WTPQ35	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
Five-day track forecast	WTPQ50	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	WTPQ51	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	WTPQ52	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	WTPQ53	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	WTPQ54	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	WTPQ55	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
Others Best track	AXPQ20	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	

Note: Meaning of abbreviation

O	:	Data originating centre
TD	:	Data transmitting centre - Tokyo
BJ	:	- Beijing
BB	:	- Bangkok
HH	:	- Hong Kong
MM	:	- Manila
SL	:	- Seoul
NN	:	- Hanoi
KK	:	- Kuala Lumpur
IV	:	- Vientiane
PP	:	- Phnom Penh
MC	:	- Macao
*	:	Places other than described above

APPENDIX 5-F

TABLE of Abbreviated headings (TTAAii CCCC)

TT	Data designator
FX	Miscellaneous forecasts
SB	Radar reports PART A
SC	Radar reports PART B
SD	Radar reports (PART A and PART B)
SN	Synoptic reports (non-standard hours)
TP	Satellite guidance
UA	Aircraft reports (AIREP)
UE	Upper-level observation, PART D
UK	Upper-level observation, PART B
UL	Upper-level observation, PART C
US	Upper-level observation, PART A
WD	Prognostic reasoning for typhoon
WH	Marine/Coastal flood warnings
WO	Other warnings
WC	Tropical cyclone(SIGMET)
WT	Tropical cyclone warnings
WW	Warning and weather summary

TABLE of Abbreviated Headings
(TTAAii CCCC) for BUFR

TTAAii CCCC	Data type
ISBC01 RJTD	Radar reports
ISBC01 VHHH	Radar reports
IUCC01-04 VHHH	SAREP reports
IUCC10 RJTD	SAREP reports

AA	Geographic designator
CI	China
HK	Hong Kong, China
JP	Japan
KO	Republic of Korea
KP	Cambodia
LA	Lao People's Democratic Republic
MS	Malaysia
MU	Macao, China
PA	Pacific area
PH	Philippines
PN	North Pacific area
PQ	Western North Pacific
PW	Western Pacific area
SS	South China Sea area
TH	Thailand
VS	Viet Nam

CCCC	Location indicator
BABJ	Beijing
BCGZ	Guangzhou
KWBC	Washington
PGFA	Guam (F.W.C)
PGTW	Guam (JTWC)
PGUM	Guam (Agana)
RJTD	Tokyo
RJTY	Yokota
RKSL	Seoul
RKSO	Osan
RODN	Okinawa / Kadena AB
RPMK	Clark AB
RPMM	Manila / Intl.
VDPP	Phnom Penh
VHHH	Hong Kong
VLIV	Vientiane
VMMC	Macao
VNNN	Hanoi
VTBB	Bangkok
WMKK	Kuala Lumpur

APPENDIX 6-A

EXAMPLE OF THE MESSAGE FORMAT FOR INQUIRY ON DOUBTFUL AND GARBLED REPORTS

Example 1. Inquiry on a doubtful report

BMBB01 VTBB 220245
RJTD
PLEASE CHECK THE FOLLOWING REPORT

BULLETIN	SNTH20 VTBB
DATE AND TIME	210200
LOCATION	48300
CONTENT	SECTION 1, 2ND GROUP: 80540

REGARDS
RSMC TOKYO =

Example 2. Inquiry on a garbled report

BMRR01 RPMM 210425
RJTD
AHD SNPH20 RPMM 210400 =

PROCEDURES OF REGULAR MONITORING AT RSMC TOKYO - TYPHOON CENTER

1. Monitoring period

The two appropriate periods are selected from the one year starting on 1st January and ending on 31st December. Each period will be up to five consecutive days.

2. Items of monitoring

The reception time of reports at RSMC Tokyo should be monitored. The types of reports to be monitored are:

(i) hourly surface observations (SYNOP code),

(ii) hourly ship and buoy observations (SHIP and BUOY codes),

(iii) 6-hourly upper-air observations (TEMP and PILOT codes),

(iv) hourly radar observations (BUFR and/or RADOB codes).

3. Format of monitoring results

Samples of format of monitoring results are shown in Fig. 6-B.1 to Fig 6-B.4.

4. Distribution of monitoring results

The monitoring results should be distributed once a year by RSMC Tokyo - Typhoon Center to Typhoon Committee Secretariat and its Members by the end of every year. A copy will be forwarded to WMO Secretariat. Members can also retrieve the data from the Internet server of JMA (http://www.wis-jma.go.jp/monitoring/data/monitoring/) by using HTTP.

RECEPTION TIME OF SYNOP REPORTS

NOV. 07 2001 PAGE : 1

Location	00 UTC	01 UTC	02 UTC	03 UTC	04 UTC	05 UTC	06 UTC	07 UTC	08 UTC	09 UTC	10 UTC	11 UTC	12 UTC	13 UTC	14 UTC	15 UTC	16 UTC	17 UTC	18 UTC	19 UTC	20 UTC	21 UTC	22 UTC	23 UTC
45007	0006			0307			0608			0909			1208			1507			1806			2111		
45011	0026						0646						1236						1833			2114		
47090	0012			0312			0612			0912			1212			1512			1812			2110		
47095	0012			0312			0612			0912			1212			1512			1812			2107		
47100	0012			0312			0612			0912			1212			1512			1812					
47101	0012			0312			0612			0912			1212			1512			1812					
47105	0012			0312			0612			0912			1212			1512			1812					
47108	0012			0312			0612			0912			1212			1512			1812					
47112	0012			0312			0612			0912			1212			1512			1812			2140		
47114	0012			0312			0612			0912			1212			1512			1812					
:																								
:																								

Fig. 6-B.1 Format of monitoring results for SYNOP

RECEPTION TIME OF SHIP/BUOY REPORTS

NOV. 11 2001 PAGE : 5

Location	00 UTC	01 UTC	02 UTC	03 UTC	04 UTC	05 UTC	06 UTC	07 UTC	08 UTC	09 UTC	10 UTC	11 UTC	12 UTC	13 UTC	14 UTC	15 UTC	16 UTC	17 UTC	18 UTC	19 UTC	20 UTC	21 UTC	22 UTC	23 UTC
JPBN																								
JCCX	0008	0105		0310	0404	0504	0609	0704	0804	0909	1005		1211	1307	1404	1516								
JDWX																								
JFDG																								
JGQH	0004	0101	0201	0304	0401	0501	0606	0701	0801	0904	1001	1101	1204	1301	1401	1505	1601	1701						
JIVB																								
21002																								
21004																								
22001																								
:																								
:																								

Fig. 6-B.2 Format of monitoring results for SHIP and BUOY

RECEPTION TIME OF UPPER-AIR REPORTS

NOV. 07 2001 T: TEMP/TEMP SHIP P: PILOT/PILOT SHIP

	00 UTC					06 UTC					12 UTC					18 UTC				
Location	PART	A	B	C	D	PART	A	B	C	D	PART	A	B	C	D	PART	A	B	C	D
JPBN																				
JPBN																				
JCCX																				
JCCX																				
JDWX																				
JDWX																				
JGQH																				
JGQH																				
JIVB																				
JIVB																				
45004		T0044	T0044	T0044	T0044							T1238	T1238	T1238	T1238					
45004		P0044	P0044	P0044	P0044		P0710	P0710	P0710	P0710		P1238	P1238	P1238	P1238		P1850	P1850		
47122		T0127	T0127	T0127	T0127		T0727	T0727	T0734	T0734		T1327	T1327	T1327	T1327		T1927	T1927	T1927	T1927
47122																				
47138		T0127	T0127	T0127	T0127							T1327	T1327	T1327	T1327					
47138																				
47158		T0127	T0127	T0127	T0127							T1327	T1327	T1327	T1327					
47158																				
47185		T0127	T0127	T0127	T0127							T1327	T1327	T1327	T1327					
47185																				
47401		T0024	T0025	T0057	T0059							T1233	T1235	T1259	T1259					
47401							P0616	P0618									P1814	P1815		
47412		T0027	T0029	T0104	T0106							T1237	T1239	T1253	T1254					
47412							P0618	P0618									P1824	P1826		
:																				
:																				

Fig. 6-B.3 Format of monitoring results for TEMP and PILOT

RECEPTION TIME OF RADAR REPORTS

NOV. 07 2001 PAGE : 1

	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Location	UTC	UTC	UTC	UTC	UTC	UTC	UTC	UTC	UTC	UTC	UTC	UTC	UTC	UTC	QUTC	UTC	UTC	UTC	UTC	UTC	UTC	UTC	UTC	UTC
45009																								
45010																								
47106																								
47116																								
47144																								
47160																								
47185																								
47415																								
47418																								
47419																								
:																								
:																								

Fig. 6-B.4 Format of monitoring results for Radar reports

APPENDIX 6-C

EXAMPLE OF BEST TRACK REPORT

AXPQ20 RJTD 060400
RSMC TROPICAL CYCLONE BEST TRACK
NAME 9009 TASHA (9009)
PERIOD FROM JUL2612UTC TO AUG0100UTC
2612 20.0N 119.6E 1002HPA //KT 2618 19.6N 120.0E 1000HPA //KT
2700 19.2N 120.2E 1000HPA //KT 2706 18.8N 120.2E 1000HPA //KT
2712 18.6N 119.8E 1000HPA //KT 2718 18.6N 119.2E 1000HPA //KT
2800 18.6N 118.3E 996HPA 35KT 2806 18.6N 118.0E 992HPA 40KT
2812 18.7N 117.6E 990HPA 45KT 2818 18.8N 117.4E 990HPA 45KT
2900 18.9N 117.2E 990HPA 45KT 2906 18.8N 116.5E 985HPA 50KT
2912 18.8N 116.0E 985HPA 50KT 2918 19.0N 116.0E 985HPA 50KT
3000 19.4N 115.5E 980HPA 55KT 3006 20.1N 115.8E 980HPA 55KT
3012 21.4N 115.8E 980HPA 55KT 3018 22.0N 116.0E 980HPA 55KT
3100 23.6N 115.1E 985HPA 50KT 3106 25.0N 114.7E 990HPA 45KT
3112 25.5N 114.4E 996HPA 35KT 3118 25.8N 114.3E 998HPA //KT
0100 26.2N 114.6E 1000HPA //KT
REMARKS
TD FROMATION AT JUL2612UTC
FROM TD TO TS AT JUL2800UTC
FROM TS TO STS AT JUL2906UTC
FROM STS TO TS AT JUL3106UTC
FROM TS TO TD AT JUL3118UTC
DISSIPATION AT AUG0106UTC=

APPENDIX 6-D

STANDARD PROCEDURES FOR THE VERIFICATION OF TYPHOON ANALYSIS AND FORECAST AT NATIONAL METEOROLOGICAL CENTRES

1. General

Each Member will verify each typhoon which affects it and summarize the verification made in a year

2. Basis for verification

The best initial typhoon position, central pressure and maximum sustained wind as determined from a post-analysis conducted by the RSMC.

3. Points for verification

(1) Error statistics in each method (bias and standard deviation) by using common work sheets as shown in Appendix 6-E. Statistical computations involve positioning of the centre, prediction of movement, and analysis and forecast of intensity of a tropical cyclone.

(2) Discussion of following points;

(i) relative merits of each technique,

(ii) effects of inaccuracies on the forecast,

(iii) effects of meagreness of available relevant real-time observations,

(iv) variation from one geographical area to another,

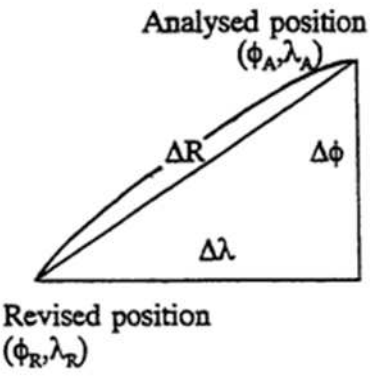
(v) climatological factors in climatological and/or statistical method,

(vi) large-scale circulation pattern for giving rise to extremely poor prediction performance.

Verification sheet for positioning of the centre, prediction of movement, and analysis and forecast of intensity of tropical cyclones

Typhoon ..... ( )
Method .....

Date	Analysed position		Revised position		Error		
	φ_A	λ_A	φ_R	λ_R	$\Delta\varphi$	$\Delta\lambda$	ΔR



$$\Delta R = a\sqrt{\left(\cos\phi_R \cdot \Delta\lambda \cdot \frac{\pi}{180}\right)^2 + \left(\Delta\phi \cdot \frac{\pi}{180}\right)^2} \quad \text{(km)}$$

ΔR ; Error in analysed position (km)
a ; Radius of the earth, 6371 km
ϕ, λ ; Latitude and longitude
ϕ, λ, $\Delta\phi$, $\Delta\lambda$ are measured in degree.

Remark ; For RADOB and RADAR position verification, interpolated position of reviced track at fixed observation time should be used.

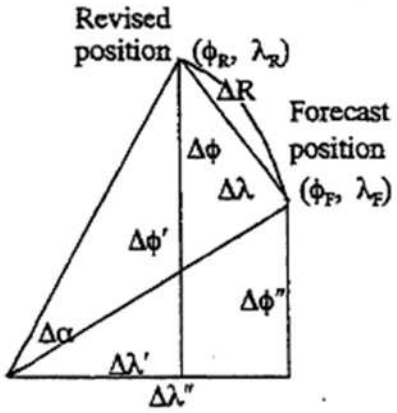
Note; ΔR can also be measured directly on the verification map.

Verification sheet for positioning of the centre, prediction of movement, and analysis and forecast of intensity of tropical cyclones

Typhoon ..... ( )
Method .....

Forecast period 24-hour (check one)
48-hour

Initial Date	Initial position		Forecast position		Revised position		Error				
	φ_I	λ_I	φ_F	λ_F	φ_R	λ_R	$\Delta\varphi$	$\Delta\lambda$	ΔR	$\Delta\alpha$	ΔSP



$$\Delta\lambda = \Delta\lambda'' - \Delta\lambda'$$
$$\Delta\varphi = \Delta\varphi' - \Delta\varphi''$$

$$\Delta R = a\sqrt{\left(\cos\phi_I \cdot \Delta\lambda \cdot \frac{\pi}{180}\right)^2 + \left(\Delta\phi \cdot \frac{\pi}{180}\right)^2} \quad \text{(km)}$$

$$\Delta\alpha = \tan^{-1}\frac{\Delta\phi''}{\cos\phi_I \cdot \Delta\lambda''} - \tan^{-1}\frac{\Delta\phi'}{\cos\phi_I \cdot \Delta\lambda'}$$

$$\Delta SP = a\left\{\sqrt{(\cos\phi_I \cdot \Delta\lambda'')^2 + (\Delta\phi'')^2} - \sqrt{(\cos\phi_I \cdot \Delta\lambda')^2 + (\Delta\phi')^2}\right\} / \Delta t \quad \text{(km/hour)}$$

ΔR ; Error in prediction position (km)
$\Delta\alpha$; error in predicted direction of movement in degrees in azimuth angle
ΔSP ; Error in the speed of movement
$\Delta\phi'$, $\Delta\phi''$, $\Delta\lambda'$, $\Delta\lambda''$ are measured in degrees.
Δt ; forecast period (hour)
$\Delta\alpha$ is positive if forecast is to the right of the actual path.

Note ; ΔR, $\Delta\alpha$ and ΔSP can also be measured directly on the verification map.

Verification sheet for positioning of the centre, prediction of movement, and analysis and forecast of intensity of tropical cyclones

Typhoon ..... (.....)

	Analysis	24-hour forecast	48-hour forecast
Method	.....	.....	.....

Date	P_a	P_r	ΔP_a	P_f	P_r	ΔP_f	P_f	P_r	ΔP_f

Note :

P_r : Revised central pressure

P_a : Analysed central pressure, $\Delta P_a = P_a - P_r$

P_f : Predicted central pressure, $\Delta P_f = P_f - P_r$

LIST OF DATA ARCHIVED BY RSMC TOKYO - TYPHOON CENTER

(a) Observation data (except for Himawari imagery data)

Kinds of data: SYNOP, AMeDAS, SHIP, BUOY, TEMP, PILOT, Aircraft, Wind Profiler, AMV, Scatterometer, MW Sounder, MW Imager, CSR, GNSS-RO, GNSS-PWV, Radar Reflectivity, Radial Velocity, R/A, Typhoon Bogus

(b) Himawari imagery data

Himawari Standard Data (HSD):

Kind of data: Himawari full-spec imagery data

Data format: Himawari Standard Format (http://www.data.jma.go.jp/mscweb/en/himawari89/space_segment/hsd_sample/HS_D_users_guide_en_v13.pdf)

Meteorological Satellite Center Monthly Report (DVD):

Kinds of data: Himawari images in SATAID and PNG formats. (http://www.data.jma.go.jp/mscweb/en/product/library/report/)

Area coverage:
SATAID: 115°E ~ 150°E and 15°N ~ 50°N
PNG: Full earth disk as seen from 140°E

(c) Objective Analysis data

Global Surface/Atmospheric Analysis data

Kinds of data: Grid point data of the objective surface/atmospheric analysis

Area coverage: Global area covered by 1.25 X 1.25 latitude-longitude grid system.

Time of analysis: 00, 06, 12 and 18 UTC

Element and layer:

Surface: Sea surface pressure (Ps), temperature (Ts), Dew point depression (Ts - Tds), wind (Us, Vs);

Specific pressure levels (1000 - 0.4 hPa):

Geopotential height (Z), temperature (T), wind (U, V), Dew point depression (T-Td)

Western North Pacific Sea Surface Temperature Analysis data

Kinds of data: Grid point data of the objective sea surface temperature analysis

Area coverage: Western North Pacific area (100°E ~ 180°E and 0° ~ 60°N) covered by 0.1 X 0.1 latitude-longitude grid system.

Time of analysis: 18 UTC

Element: SST, SST anomalies from the JMA climatology

GLOBAL TROPICAL CYCLONE TRACK AND INTENSITY DATA SET - REPORT FORMAT

Position	Content
1-9	Cyclone Identification code composed by 2 digit numbers in order within the cyclone season, area code and year code. 01SWI2000 shows the 1st system observer in South-West Indian Ocean basin during the 2000/2001 season. Area codes are as follows: ARB = Arabian Sea ATL = Atlantic Ocean AUB = Australian Region (Brisbane) AUD = Australian Region (Darwin) AUP = Australian Region (Perth) BOB = Bay of Bengal CNP = Central North Pacific Ocean ENP = Eastern North Pacific Ocean ZEA = New Zealand Region SWI = South-West Indian Ocean SWP = South-West Pacific Ocean WNP = Western North Pacific Ocean and South China Sea
10-19	Storm Name
20-23	Year
24-25	Month (01-12)
26-27	Day (01-31)
28-29	Hour-universal time (at least every 6 hourly position -00Z, 06Z, 12Z and 18Z)
	Latitude indicator: 1=North latitude; 2=South latitude
31-33	Latitude (degrees and tenths)
34-35	Check sum (sum of all digits in the latitude)
36	Longitude indicator: 1=West longitude; 2=East longitude
37-40	Longitude (degrees and tenths)
41-42	Check sum (sum of all digits in the longitude)
43	Position confidence* 1 = good (<30nm; <55km) 2 = fair (30-60nm; 55-110km) 3 = poor (>60nml >110km) 9 = unknown
Note*	Confidence in the center position: Degree of confidence in the center position of a tropical cyclone expressed as the radius of the smallest circle within which the center may be located by the analysis. “position good” implies a radius of less than 30nm, 55km; “position fair”, a radius of 30 to 60nm, 55 to 110km; and “position poor”, radius of greater than 60nm, 110km.
44-45	Dovorak T-number (99 for no report)
46-47	Dovorak CI-number (99 for no report)
48-50	Maximum average wind speed (whole values) (999 for no report)
51	Units 1=kt, 2=m/s, 3=km per hour.
52-53	Time interval for averaging wind speed (minutes for measured or derived wind speed, 99 if unknown or estimated).
54-56	Maximum Wind Gust (999 for noreport)
57	Gust Period (sedonds, 9 for unknown)
58	Quality code for wind reports: 1=Aircraft or Dropsonde observation 2=Over water observation (e.g. buoy) 3=Over land observation 4=Dvorak estimate 5=Other

59-62	Central pressure (nearest hectopascal) (9999 if unknown or unavailable)
63	Quality code for pressure report (same code as for winds)
64	Units of length: 1=nm, 2=km
65-67	Radius of maximum winds (999 for no report)
68	Quality code for RMW: 1=Aircraft observation 2=Radar with well-defined eye 3=Satellite with well-defined eye 4=Radar or satellite, poorly-defined eye 5=Other estimate
69-71	Threshold value for wind speed (gale force preferred, 999 for no report)
72-75	Radius in Sector 1: 315°-45°
75-79	Radius in Sector 2: 45°-135°
80-83	Radius in Sector 3: 135°-225°
84-87	Radius in Sector 4: 225°-315°
88	Quality code for wind threshold 1=Aircraft observations 2=Surface observations 3=Estimate from outer closed isobar 4=Other estimate
89-91	Second threshold value for wind speed (999 for no report)
92-95	Radius in Sector 1: 315°-45°
95-99	Radius in Sector 2: 45°-135°
100-103	Radius in Sector 3: 135°-225°
104-107	Radius in Sector 4: 225°-315°
108	Quality code for wind threshold (code as for row 88)
109-110	Cyclone type: 01= tropics; disturbance (no closed isobars) 02= <34 knot winds, <17m/s winds and at least one closed isobar 03= 34-63 knots, 17-32m/s 04= >63 knots, >32m/s 05= extratropical 06= dissipating 07= subtropical cyclone (nonfrontal, low pressure system that comprises initially baroclinic circulation developing over subtropical water) 08= overland 09= unknown
111-112	Source code (2 – digit code to represent the country or organization that provided the data to NCDC USA. WMO Secretarist is authorized to assign number to additional participating centers, organizations) 01 RSMC Miami-Hurricane Center 02 RSMC Tokyo-Typhoon Center 03 RSMC-tropical cyclones New Delhi 04 RSMC La Reunion-Tropical Cyclone Centre 05 Australian Bureau of Meteorology 06 Meteorological Service of New Zealand Ltd. 07 RSMC Nadi-Tropical Cyclone Centre 08** Joint Typhoon Warning Center, Honolulu 09** Madagascar Meteorological Service 10** Mauritius Meteorological Service 11** Meteorological Service, New Caledonia 12 Central Pacific Hurricane Center, Honolulu
Note**	no longer used
Headings	1-19 Cyclone identification code and name; 20-29 Date time group; 30-43 Best track positions; 44-110 Intensity, Size and Type; 111-112 Source code.