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FOR PARTICIPANTS ONLY
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REPORT ON AMENDMENTS TO THE TYPHOON COMMITTEE OPERATIONAL MANUAL

(submitted by the Rapporteur)

Summary and Purpose of Document**:**

This document presents draft amendments to the Typhoon Committee Operational Manual - Meteorological Component (TOM) proposed by the RSMC Tokyo – Typhoon Center and the Members.

ACTION REQUIRED:
The Committee is invited to review and approve the proposed amendments to the TOM.

APPENDIXES:
A) DRAFT TEXT FOR INCLUSION AT SESSION REPORT
B) UPDATE OF THE TYPHOON COMMITTEE OPERATIONAL MANUAL

APPENDIX A:

DRAFT TEXT FOR INCLUSION IN THE SESSION REPORT

x.x Review of Typhoon Committee Operational Manual (TOM)

1. The Session noted that the Typhoon Committee Operational Manual (TOM) rapporteur requests WMO to publish and upload the 2020 edition of TOM on the Tropical Cyclone Programme (TCP) Website as submitted by the Rapporteur, with the amendments given in Appendix XX.

2. The Committee expressed its appreciation to the rapporteur for update of TOM.

APPENDIX B:

UPDATE OF THE TYPHOON COMMITTEE OPERATIONAL MANUAL

1. The Typhoon Committee Operational Manual - Meteorological Component (TOM) has been reviewed and updated every year since its first issue in 1987. The 2019 edition was completed and posted on the WMO website in March 2019 in accordance with the approval of amendments to the 2018 edition by the Typhoon Committee 51st session (26 February to 1 March 2019, Guangzhou, China).

2. At the 51st session, the Committee decided that the rapporteur of the RSMC Tokyo - Typhoon Center in Japan Meteorological Agency (JMA) continues arrangements for updating the TOM. In this connection, on 10 July 2019 in advance of the annual revision of TOM, the rapporteur, Dr. EITO Hisaki of the RSMC Tokyo - Typhoon Center requested the focal points of the meteorological component of the Members not only input on tropical cyclone analysis and forecast procedure by the NMSs as attached in Annex 1, which was approved at the Typhoon Committee 51st session, but confirmation of description on geostationary meteorological satellites which Typhoon Committee members operate, which was drafted by the rapporteur as attached in Annex 2.

3. Input on analysis and forecast procedure were submitted by six focal points of China; Hong Kong, China; Macao, China; Malaysia; Philippines and Republic of Korea. Proposal for revision of draft on geostationary meteorological satellites were also submitted by two focal points of China and Republic of Korea.

4. On 17 December 2019, the rapporteur proposed some revisions, including reflection of the inputs on TC analysis and forecast procedure from the members and proposal for revision of draft on geostationary meteorological satellites, to the focal points of the meteorological component of the Members and invited them to provide comments for the revision and proposals for updates.

5. Proposed revisions by the RSMC Tokyo - Typhoon Center are attached in Annex 3. The major points of the revisions are given below:

- Revision of the information on Tropical Cyclone warnings for the high seas (Section 4.4) and modification of the contents (Section 1.3, 1.4, Appendix 1-B) to go along with the WMO Manual on Marine Meteorological Services (WMO No.558).
- Revision of description on operational procedure for the assignment of names of TCs (Appendix 1-B)
- Amendments of the draft on geostationary meteorological satellites operated by TC members according to the proposals by two focal points of China and Republic of Korea. (Appendix 2-F).
- Addition of information on SAREP report by China (Appendix 2-H)
- Update of the list of the products and addition of example of the products provided by

RSMC Tokyo - Typhoon Center available at the Numerical Typhoon Prediction Website (Appendix 3-A).

- Addition of the list of NWP models and Ensemble Prediction Systems used in the Numerical Typhoon Prediction Website (Appendix 3-A).
- Addition of the information on tropical cyclone analysis and forecast procedure by the NMSs of Typhoon Committee Members (Section 3-3, Appendix 3-B).
- Proposal of new format for satellite imagery receiving facilities for 2021 edition as shown in Annex 4 (Appendix 2-G)

6. Proposals for updates and amendments to the revised TOM were submitted by the five focal points of Hong Kong, China; Japan; Macao, China; Republic of Korea and Thailand as attached in Annex 5. The major points of the amendments are given below:

- Revision of the description on tropical cyclone passage report (Section 2.6)
- Revision of the description on forecast at RSMC Tokyo -Typhoon Center (Section 3.2)
- Revision of the description on tropical cyclone warnings for the high seas (Section 4.4)
- Revision of the description on tropical cyclone SIGMET and advisory information for international aviation (Section 4.5)
- Update of the information on surface observation stations (Appendix 2-A)
- Update of the distribution map of the radar stations (Appendix 2-D)
- Update of the information on the radar stations (Appendix 2-E)
- Update of the information on the meteorological geostationary satellite (Appendix 2-F)
- Update of the information on the satellite imagery receiving facilities (Appendix 2-G)
- Update of the information on NWP products provided by RSMC Tokyo - Typhoon Center and revision of the information on NWP models used in Numerical Typhoon Prediction website (Section 3-A)
- Update of the information on the analysis methods, forecasting methods and NWP (Appendix 3-B)
- Update of the information on the broadcasting stations on cyclone warnings for ships on the high seas(Appendix 4-C)
- Update of the information on the meteorological telecommunication network (Appendix 5-B)
- Update of the contact details (Appendix 5-C)
- Update of the list of collection and distribution of information related to tropical cyclones (Appendix 5-E)

Annex 1

Format of tropical cyclone analysis and forecast procedure by the NMSs of Typhoon Committee Members

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APPENDIX 3-B

Analysis methods, forecasting methods and NWP system for forecasting currently used by the NMSs of Typhoon Committee Members

Name of the Member: **[***Please specify***]**

1 Tropical Cyclone Analysis

[Please describe analyzed Tropical Cyclone (TC) parameters and methods used for analysis by filling out the below table.]

Parameter	Time	Methods	Other Sources
[Please specify analyzed TC parameters (e.g. position, speed, central pressure, maximum sustainable wind)]	*[Please specify analysis time]*	*[Please describe both satellite-based and non satellite-based methods used for analysis of respective parameters (e.g. satellite imagery and radar image for position, Dvorak technique for intensity estimate.).]*	*Although TC analysis including Dvorak technique is still challenging for some Members, analytical results made by other centers, including those by RSMCs, are available via GTS and/or the Internet on a real-time basis. If your Service refers to such products by other centers, please specify them.*

2 Tropical Cyclone Forecasting

[Please describe forecasted Tropical Cyclone (TC) parameters and methods used for forecast by filling out the below table.]

Parameter	Issuance Time	Lead Time	Methods
[Please specify forecast TC parameters (e.g. track, central pressure, maximum sustainable wind, strong wind areas, cyclogenesis).]	*[Please specify issuance time]*	*[Please specify lead time]*	*[Nowadays, operational TC track forecasts are generally based on numerical weather prediction (NWP) guidance. Such NWP guidance products of major numerical centers are available for WMO Members (e.g. JMA provides numerical track guidance of major numerical centers for Western North Pacific to Typhoon Committee Members at JMA's Numerical Typhoon Prediction Website (https://tynwp-web.kishou.go.jp/)). If your Service refers to such numerical track guidance products of other centers, please specify sources and how you use them for your forecasts.* *As for TC Intensity forecasting, it still remains a difficult task, while TC track forecasts have been steadily improved because of advances in NWP guidance. If your Service issues intensity forecasts, please describe how they are produced. If your Service refers to TC intensity forecasts of other centers, please specify them.*

			If you issue any forecasts such as cyclogenesis other than track and intensity, please specify them.]

3 NWP Systems in Operational Use

[Please describe NWP systems in operational use at your Service. In the rightmost column, please specify whether your Service runs NWP model/EPS on your own or uses systems provided by other centers.]

System	Domain	Horizontal Resolution	Number of Vertical Level	Forecast Range (Initial Time)	Number of Ensemble Members	Run by (own/other centers)

Reference

[If any, please specify]

Annex 2

Draft of technical information on geostationary meteorological satellites Typhoon Committee members operate

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APPENDIX 2-G

TECHNICAL SPECIFICATIONS OF SATELLITE OPERATED BY TYPHOON COMMITTEE MEMBERS

1. FY-2F (operational since 2012) / FY-2G (operational since 2015) / FY-2H (operational since 2019) [China]

(a) Observations

(i) Full-Disk Observations (FY-2G/H): Every hour

(ii) Regional Observations (FY-2F): Every 6 minutes

(iii) [if any other observation (e.g. request-based observation), please specify]

(b) Products

(i) Full-Disk Observation Data (FY-2G/H): Every hour

(ii) Regional Observation Data (FY-2F): Every 6 minutes

(iii) Full-Disk AMV Product:

(iv) [if any other product, please specify]

(c) Dissemination ways

(i) Direct Broadcast Services

(ii) CMAcast (communication satellite dissemination service)

(iii) Internet Services

[National Satellite Meteorological Center Portal Site]
http://www.nsmc.gov.cn/en

[FengYun Satellite Data Center Site]
http://satellite.nsmc.org.cn

(iv) [if any other service, please specify]

2. FY-4A (operational since 2018) [China]

(a) Observations

(i) Full-Disk Observations: Every hour

(ii) 3 Continuous Full-Disk Observations: Every 3 hours

(iii) China Area Observations: Every 5 minutes

(iv) [if any other observation (e.g. request-based observation), please specify]

(b) Products

(i) Full-Disk Observation Data: Every hour

(ii) 3 Continuous Full-Disk Observation Data: Every 3 hours

(iii) China Area Observation Data: Every 5 minutes

(iv) [if any other product, please specify]

(c) Dissemination ways

(i) Direct Broadcast Service

(ii) CMACast (communication satellite dissemination service)

(iii) Internet Services

[FTP-based Service]
http://fy4.nsmc.org.cn/data/en/data/realtime.html

[National Satellite Meteorological Center Portal Site]
http://www.nsmc.gov.cn/en

[FengYun Satellite Data Center Site]
http://satellite.nsmc.org.cn

(iv) [if any other service, please specify]

3. Himawari-8 (operational since 2015) / Himawari-9 (operational since 2017)[1] [Japan]

(a) Observations

(i) Full-Disk Observations: Every 10 minutes

(ii) Japan Area Observations: Every 2.5 minutes

(iii) Target Area Observations including those Based on Request by NMHSs (HimawariRequest)[2]: Every 2.5 minutes

(b) Products

(i) Full-Disk Observation Data: Every 10 minutes

(ii) Japan Area Observation Data: Every 2.5 minutes

(iii) Target Area Observation Data: Every 2.5 minutes

(iv) Full-Disk AMV: Every hour

(v) Full-Disk Clear Sky Radiance (CSR): Every hour

[1] More information available on https://www.jma-net.go.jp/msc/en/support/index.html
[2] More information available on https://www.jma.go.jp/jma/jma-eng/satellite/HimawariRequest.html

(c) Dissemination ways

(i) HimawariCloud (Internet Cloud Service)
Service which distributes full-spec imagery derived from the Himawari-series satellites
(https://www.data.jma.go.jp/mscweb/en/himawari89/cloud_service/cloud_service.html)

(ii) HimawariCast (communication satellite dissemination service)
Service which disseminates primary sets of imagery from the Himawari-series satellites via a communication satellite
(https://www.data.jma.go.jp/mscweb/en/himawari89/himawari_cast/himawari_cast.html)

(iii) Internet Services for National Meteorological and Hydrological Services (NMHSs)
[JMA real-time satellite imagery webpage]
https://www.jma.go.jp/en/gms/

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

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

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

4. COMS (operational since 2011) [Republic of Korea]

(a) Observations

(i) Full-Disk Observations: Every 3 hours
(ii) Extended North Hemisphere Observations: Every 15 minutes
(iii) [if any other observation, please specify]

(b) Products

(i) Full-Disk Observation Data: Every 3 hours
(ii) Extended North Hemisphere Observation Data: Every 15 minutes
(iii) Full-Disk AMV: Every 3 hours
(iv) [if any other observation, please specify]

(c) Dissemination ways

(i) Direct Broadcast Service
(http://nmsc.kma.go.kr/html/homepage/en/ver2/static/selectStaticPage.do?view=datacenter.dataService)

(ii) Internet Services
[National Meteorological Satellite Center website]
http://nmsc.kma.go.kr/jsp/homepage/eng/main.do

[Data Collection or Production Centre website]
http://dcpc.nmsc.kma.go.kr/openwis-user-portal/srv/en/main.home

(iii) *[if any other service, please specify]*

5. GEO-KOMPSAT-2A (operational since 2019) [Republic of Korea]

(a) Observations

(i) Full-Disk Observations: Every 10 minutes
(ii) Extended Local Area Observations: Every 2 minutes
(iii) Local Area Observations: Every 2 minutes
(iv) [if any other observation (e.g. request-based observation), please specify]

(b) Products

(i) Full-Disk Observation Data: Every 10 minutes
(ii) Extended Local Area Observation Data: Every 2 minutes
(iii) Local Area Observation Data: Every 2 minutes
(iv) [if any other product, please specify]

(c) Dissemination ways

(i) Direct Broadcast Service
(http://nmsc.kma.go.kr/html/homepage/en/ver2/static/selectStaticPage.do?view=satellites.gk2a.dataServicePlan)

(ii) Internet Services
[FTP-based Service]
All sixteen channels data of full-disk image will be put on KMA's FTP server designated for GEO-KOMPSAT-2A data dissemination in every 10 minutes.

[National Meteorological Satellite Center website]
http://nmsc.kma.go.kr/jsp/homepage/eng/main.do

[Data Collection or Production Centre website]
http://dcpc.nmsc.kma.go.kr/openwis-user-portal/srv/en/main.home

(iii) [if any other service, please specify]

Annex 3

Draft Revisions to
the Typhoon Committee Operational Manual – Meteorological Component (TOM)
proposed by the RSMC Tokyo – Typhoon Center (except for editorial changes)

Page	Line	Proposed Revision	Comments
Section 1.3			
4	L13	Gale-force wind warning: 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. Hurricane force: Average wind speed of 64 knots (32.7 m/s, 118 km/h) and above, or wind force 12 in the Beaufort scale. Hurricane-force wind warning: Meteorological message intended to warn those concerned of the occurrence or expected occurrence of hurricane-force wind.	Modification of the description in accordance with the WMO Manual on Marine Meteorological Services (WMO No.558)
4	L35	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-force wind warning: Meteorological message intended to warn those concerned of the occurrence or expected occurrence of storm force wind. 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.~~	Modification of the description in accordance with the WMO Manual on Marine Meteorological Services (WMO No.558)
Section 1.4			

6	L9	(a) The following units/indicators are used for marine (WWMIWS) purposes, in accordance with the WMO Manual on Marine Meteorological Services (WMO No.558): (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~~ e.g. "12.2S, 168.4E"; (iii) Direction of motion to the nearest sixteen points of the compass or in degree to the nearest ten, given in ~~words~~ figures, e.g. "SOUTHSOUTHEAST" or "160 DEGREES"; (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; (vi) Pressure in hectopascals (hPa), the unit being stated; (vii) Time in Universal Time Co-ordinated (UTC), the unit being stated.	Modification of the description in accordance with the WMO Manual on Marine Meteorological Services (WMO No.558)
Section 3.3			
12	L27	The NMSs of Typhoon Committee Members are performing analysis and forecasting development and movement of tropical cyclones in the region. The analysis methods, the forecasting methods and NWP systems for forecasting currently used by the NMSs of Typhoon Committee Members are given in Appendix 3-B. The final responsibility for the operational analysis and forecasting will be with the NMSs of each of the Members.	Addition of description related to Appendix 3-B
Section 4.4			
14	L1	4.4 Tropical cyclone warnings for the high seas (WWMIWS) The IMO/WMO Worldwide Met-Ocean Information and Warning Service (WWMIWS) is the internationally coordinated service for the promulgation of meteorological warnings and forecasts. The WWMIWS produces marine meteorological maritime safety information messages for issuance on Enhanced Group Call (EGC) satellite systems	Revision of the information on Tropical Cyclone warnings for the high seas in accordance with the WMO Manual on Marine Meteorological Services (WMO No.558)

		(SafetyNET), NAVTEX and High-frequency Narrow-band Direct Printing (HF NBDP) communication systems covering the following areas: ● warnings and forecasts for the High Seas; ● warnings and forecasts for coastal, offshore and local waters (including ports, lakes and harbour areas). Operational guidance for handling and formatting meteorological information is given in detail in the Annex IV of the WMO Technical Regulations (Manual on Marine Meteorological Services - WMO-No. 558). The provision of warnings for weather systems that produce average wind speeds of 34 knots and greater are a mandatory requirement of the WWMIWS. In relation to international marine requirements, the WWMIWS coordinates the broadcast of forecasts and warnings to vessels at sea through the Global Maritime Distress and Safety System (GMDSS), which includes SafetyNET EGC satellite communications. As part of the WWMIWS coordination, there are the following types of Centres: Issuing service means a National Meteorological Service which has accepted responsibility for ensuring that meteorological warnings and forecasts for shipping are disseminated through approved EGC satellite systems to the designated area (METAREA) for which the Service has accepted responsibility under the WWMIWS. Preparation service means a National Meteorological Service which has accepted responsibility for the preparation of warnings and forecasts for parts of or an entire designated area (METAREA) in the WMO system for the dissemination of meteorological forecasts and warning to shipping under the WWMIWS and for their transfer to the relevant Issuing Service for broadcast. The METAREA Coordinator is responsible for ensuring that Tropical Cyclone warnings for the WWMIWS in their METAREA are issued onto the appropriate GMDSS communication system. Areas of responsibility Members having official responsibility as an Issuing Service within the WWMIWS for issuing warnings on approved EGC satellite systems are Japan (METAREA	

XI North) and China (METAREA XI South).

~~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; WMO-181, 1966) and Res.10 (IV-RA V; WMO-187, 1966)). Weather forecast areas fixed nationally by individual Typhoon Committee Members are shown in WMO Publication No. 9, Weather Reporting Volume D - Information for Shipping.

Format and content of bulletins

The format and content of warnings issued for the WWMIWS, as outlined below, has been derived from guidance provided in the Manual on Marine Meteorological Services (WMO No.558).

Tropical Cyclone warnings for the WWMIWS shall use the following wind warning category labels:

- Gale force wind warning (Beaufort force 8 or 9);
- Storm-force wind warning (Beaufort force 10 or 11);
- Typhoon-force/Hurricane-force wind warning (Beaufort force 12 or over).

Any Tropical Cyclone related wind warning issued for the WWMIWS should include the following content (excluding any relevant system metadata requirements):

(a) Header label for marine radio broadcast purposes ("SECURITE")

Note: This label needs to be visible on any product provided to mariners with the potential to be read out on marine radio systems.

(b) Type of wind warning (GALE-FORCE, STORM-FORCE, TYPHOON-FORCE/HURRICANE-FORCE WIND WARNING)

(c) Name of the issuing centre

(d) Name of the system and name of the basin

(e) Date and time of reference in UTC

(f) Type of disturbance (Tropical cyclone)

(g) Location of disturbance (latitude and longitude)

(h) Central pressure (hPa)

(i) Intensity (maximum 10-minute average winds in knots)

		(j) Direction and speed of movement of the disturbance (k) Extent of affected area in nautical miles (l) Wind speed (knots) and direction in the affected areas (m) Sea and swell condition in affected areas (in qualitative terms) (n) Expected location and intensity at 12 and 24 hour time periods. (o) Indication of when next warning will be issued. When no warnings are to be issued, that fact shall be stated in the bulletins.	
Appendix 1-B			
26	L7	(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 IMO/WMO Worldwide Met-Ocean Information and Warning Service (WWMIWS), ~~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.	Modification of the description in accordance with the WMO Manual on Marine Meteorological Services (WMO No.558)
26	L22	(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 or 100°E 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 and RSMC New Delhi 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 or 100°E from east to west, respectively.	Update of the description of naming procedure for TCs crossing the border line of responsible area of RSMCs
Appendix 1-C			
24		To be updated by Annex 3-1.	Revision of list of acronyms related to procedure of analysis and forecast of TCs etc.
Appendix 2-F			

59		To be replaced by Annex 3-2	Revision of the description according to the comments from members.
Appendix 2-G			
60		To be replaced by Annex 3-3	Update the list of satellite imagery receiving system
60		To be replaced in the future by Annex 4	Revision of the list of satellites
Appendix 2-H			
62		To be replaced by Annex 3-4	Update of the list of SAREP reports
Appendix 3-A		List of other products provided by RSMC Tokyo - Typhoon Center	
70		To be replaced by Annex 3-5	Update of the list of products available at Numerical Typhoon Prediction Website:
Appendix 3-A			
After 71		To be added by Annex 3-6	Addition of "Example of the products provided by RSMC Tokyo - Typhoon Center", "Deterministic NWP models used in the Numerical Typhoon Prediction website" and "EPS used in the Numerical Typhoon Prediction website"
Appendix 3-B			
After 71		To be added by Annex 3-7	Addition of explanation about products and NWP/EPS at available at NTP web site.
Appendix 4-C			
77		To be replaced by Annex 3-8	Revision of the area name
Appendix 5-B			
80	29	Operated by China: ~~Asiasat-4 (122.2°E)~~CMAcast Operational observations, warnings, NWP products, satellite image and fax distribution	Revision of the satellite name to service name

Annex 3-1

APPENDIX 1-C

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

AFTN	Aeronautical Fixed Telecommunication Network
AIREP	Air-report
AMeDAS	Automated Meteorological Data Acquisition System
AMV	Atmospheric Motion Vector
APT	Automatic Picture Transmission
ASCAT	Advanced SCATterometer
~~ASDAR~~	~~Aircraft to Satellite Data Relay~~
BoOM	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
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EPS	Ensemble Prediction System
ESCAP	Economic and Social Commission for Asia and the Pacific
FAX	Facsimile
FTP	File Transfer Protocol
FY	Feng-Yun
FY-ESM	Feng-Yun Emergency Support Mechanism
GEO-KOMPSAT	Geostationary Korea Multi-Purpose Satellite
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
HWRF	Hurricane Weather Research and Forecast System
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 Center
KMA	Korea Meteorological Administration
METAR	Aerodrome/aviation routine meteorological report
MPLS	Multi-Protocol Label Switching
MSTP	Multiple Spanning Tree Protocol
MTI	Moving Target Indicator
~~MTSAT~~	~~Multi-functional Transport Satellite~~
MWO	Meteorological Watch Office
NCEP	National Centers for Environmental Prediction
NESDIS	National Environmental Satellite, Data and Information Service

NHM	Non-Hydrostatic Model
NMC	National Meteorological Centre
NMHS	National Meteorological and Hydrological Service
NMS	National Meteorological Service
NOAA	National Oceanic and Atmospheric Administration
NRL	Naval Research Laboratory
NWP	Numerical Weather Prediction
OLR	Outgoing Longwave Radiation
OPMET	Operational Meteorological information
OSCAT	OceanSat Scatterometer
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PBL	Planetary Boundary Layer
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
SHIP	Report of surface observation from a sea station
SHIPS	Statistical Hurricane Intensity Prediction Scheme
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
TCAC	Tropical Cyclone Advisory Centre
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
TIFS	Typhoon Intensity Forecast scheme based on SHIPS
TOPEX	Typhoon Operational Experiment
TRAMS	Tropical Regional Atmosphere Model for the South China Sea
TS	Tropical Storm
TWRF	Typhoon Weather Research and Forecast System
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
WWMIWS	IMO/WMO Worldwide Met-Ocean Information and Warning Service

Annex 3-2

APPENDIX 2-F
TECHNICAL SPECIFICATIONS OF SATELLITE OPERATED BY TYPHOON COMMITTEE MEMBERS

1. FY-2F (operational since 2012) / FY-2G (operational since 2015) / FY-2H (operational since 2019) [China]

(d) Observations

(i) Full-Disk Observations (FY-2G/H): Every hour

(ii) Regional Observations (FY-2F):Every 6 minutes

(iii) Regional Observations based on request (FY-ESM[3]): Every 6 minutes

(e) Products

(i) Full-Disk Observation Data (FY-2G/H): Every hour

(ii) Regional Observation Data (FY-2F): Every 6 minutes

(iii) Regional Observation Data based on request (FY-ESM[3]): Every 6 minutes

(iv) Full-Disk AMV Product:

(f) Dissemination ways

(i) Direct Broadcast Services

(ii) CMAcast (communication satellite dissemination service)

(iii) Internet Services

[National Satellite Meteorological Center Portal Site]
http://www.nsmc.gov.cn/en

[FengYun Satellite Data Center Site]
http://satellite.nsmc.org.cn

2. FY-4A (operational since 2018) [China]

(a) Observations

(i) Full-Disk Observations: Every hour

(ii) China Area Observations: Every 5 minutes

(iii) Regional Observations based on request (FY-ESM[3]): Every 5 minutes

(b) Products

(i) Full-Disk Observation Data: Every hour

(ii) China Area Observation Data: Every 5 minutes

(iii) Regional Observations Data based on request (FY-ESM[3]): Every 5 minutes

[3] More information available on http://fy4.nsmc.org.cn/service/en/emergency/index.html

(c) Dissemination ways

(i) Direct Broadcast Service

(ii) CMACast (communication satellite dissemination service)

(iii) Internet Services

[FTP-based Service]

http://fy4.nsmc.org.cn/data/en/data/realtime.html

[National Satellite Meteorological Center Portal Site]

http://www.nsmc.gov.cn/en

[FengYun Satellite Data Center Site]

http://satellite.nsmc.org.cn

3. Himawari-8/9 (operational since 2015) / Himawari-9 (operational since 2017) [Japan]

(a) Observations

(i) Full-Disk Observations: Every 10 minutes

(ii) Japan Area Observations: Every 2.5 minutes

(iii) Target Area Observations including those Based on Request by NMHSs (HimawariRequest)[4]: Every 2.5 minutes

(b) Products

(i) Full-Disk Observation Data: Every 10 minutes

(ii) Japan Area Observation Data: Every 2.5 minutes

(iii) Target Area Observation Data: Every 2.5 minutes

(iv) Full-Disk AMV: Every hour

(v) Full-Disk Clear Sky Radiance (CSR): Every hour

(c) Dissemination ways

(i) HimawariCloud (Internet Cloud Service)

Service which distributes full-spec imagery derived from the Himawari-series satellites

(https://www.data.jma.go.jp/mscweb/en/himawari89/cloud_service/cloud_service.html)

(ii) HimawariCast (communication satellite dissemination service)

Service which disseminates primary sets of imagery from the Himawari-series satellites via a communication satellite

(https://www.data.jma.go.jp/mscweb/en/himawari89/himawari_cast/himawari_cast.ht

[4] More information available on https://www.jma.go.jp/jma/jma-eng/satellite/HimawariRequest.html

ml)

(iii) Internet Services for National Meteorological and Hydrological Services (NMHSs)
[JMA real-time satellite imagery webpage]
https://www.jma.go.jp/en/gms/

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

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

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

4. COMS (operational since 2011) [Republic of Korea]

(a) Observations

(i) Full-Disk Observations: Every 3 hours
(ii) Extended North Hemisphere Observations: Every 15 minutes
(iii) Local Area Observations: Every 15 minutes

(b) Products

(i) Full-Disk Observation Data: Every 3 hours
(ii) Extended North Hemisphere Observation Data: Every 15 minutes
(iii) Full-Disk AMV: Every 3 hours

(c) Dissemination ways

(i) Direct Broadcast Service
(http://nmsc.kma.go.kr/html/homepage/en/ver2/static/selectStaticPage.do?view=datacenter.dataService)
(ii) Internet Services
[National Meteorological Satellite Center website]
http://nmsc.kma.go.kr/jsp/homepage/eng/main.do

[Data Collection or Production Centre website]
http://dcpc.nmsc.kma.go.kr/openwis-user-portal/srv/en/main.home

5. GEO-KOMPSAT-2A (operational since 2019) [Republic of Korea]

(a) Observations

(i) Full-Disk Observations: Every 10 minutes
(ii) Extended Local Area Observations: Every 2 minutes

(iii) Local Area Observations: Every 2 minutes

(b) Products

(i) Full-Disk Observation Data: Every 10 minutes
(ii) Extended Local Area Observation Data: Every 2 minutes
(iii) Local Area Observation Data: Every 2 minutes

(c) Dissemination ways

(i) Direct Broadcast Service
(http://nmsc.kma.go.kr/html/homepage/en/ver2/static/selectStaticPage.do?view=satellites.gk2a.dataServicePlan)

(ii) Internet Services
[FTP-based Service]
All sixteen channels data of full-disk image will be put on KMA's FTP server designated for GEO-KOMPSAT-2A data dissemination in every 10 minutes.

[National Meteorological Satellite Center website]
http://nmsc.kma.go.kr/jsp/homepage/eng/main.do

[Data Collection or Production Centre website]
http://dcpc.nmsc.kma.go.kr/openwis-user-portal/srv/en/main.home

Annex 3-3

APPENDIX 2-G
SATELLITE IMAGERY RECEIVING FACILITIES AT TYPHOON COMMITTEE MEMBERS

Member	Station		Himawari 1. HimawariCloud 2. HimawariCast	NOAA 1. HRPT 2. APT	Meteosat 1. P-DUS
Cambodia			1, 2		
China	Beijing	39.9°N, 116.4°E	1	1~~, 2~~	
	~~Shanghai~~	~~31.1°N, 121.4°E~~		~~2~~	
	~~Shenyan~~	~~41.8°N, 123.6°E~~			
	~~Guangzhou~~	~~23.1°N, 113.3°E~~			
	~~Cheng-chou~~	~~34.7°N, 113.7°E~~			
	~~Cheng-tu~~	~~31.2°N, 114.0°E~~			
	~~Lan-chou~~	~~36.1°N, 103.9°E~~			
	~~Kunming~~	~~25.0°N, 102.7°E~~			
	~~Changsh~~	~~28.2°N, 113.1°E~~			
	~~Nanjin~~	~~32.0°N, 118.8°E~~			
	~~Harbin~~	~~45.8°N, 126.8°E~~			
DPR Korea	Pyongyang	39.0°N, 125.8°E		1	
Hong Kong, China[5]	Kowloon	22.3°N, 114.2°E	1, 2	1	
Japan	Minamitorishima	24.3°N, 154.0°E	2		
Lao PDR			2		
Macao, China[6]	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	14.7°N, 121.0°E	1, 2	1	
	Cagayan de Oro City	8.5°N, 124.6°E			
	Pasay City	14.5°N, 121.0°E			
	Cebu	10.3°N, 124.0°E			

[5] Hong Kong, China receives AQUA (MODIS), SNPP (CrIs, VIIRS, ATMS), FY-2 (S-VISSR), and TERRA (MODIS), METOP-A and METOP-B (AMSU-A, AVHRR, HIRS, MHS).
[6] Macao, China receives FY-2D, FY-2E (S-VISSR) Stretched VISSR.

Member	Station		Himawari 1. HimawariCloud 2. HimawariCast	NOAA 1. HRPT 2. APT	Meteosat 1. P-DUS
Republic of Korea[7]	Seoul	37.6°N, 127.0°E	1	1	
	Incheon Int. Airport	37.3°N, 126.3°E			
	Munsan	37.9°N, 126.8°E			1
	Seosan	36.8°N, 126.5°E		1	
	Pusan	35.1°N, 129.0°E			
	Pusan Kimhae Air	35.2°N, 126.9°E			
	Kwangju	35.2°N, 126.9°E			
	Taejon	36.4°N, 127.4°E			
	Kangnung	37.5°N, 130.9°E			
	Cheju	33.5°N, 126.5°E			
	Taegu	35.9°N, 128.6°E			
	Taegu/Air Traffic	35.9°N, 128.7°E			
	Chonju	35.8°N, 127.2°E			
	Chongju	36.6°N, 127.4°E			
	Ullung-Do	37.5°N, 130.9°E			
	Mokpo	34.8°N, 126.4°E			
	Chunchon	37.9°N, 127.7°E			
	Masan	35.2°N, 128.6°E			
	Tongyong	34.9°N, 128.4°E			
	Inchon	37.5°N, 126.6°E			
	Huksando	34.7°N, 125.5°E			
	Suwon	37.3°N, 127.0°E			
	Sokcho	38.3°N, 128.6°E			
	Pohang	36.0°N, 129.4°E			
	Kunsan	36.0°N, 126.7°E			
	Baengnyeong-do	37.9°N, 124.6°E			
Singapore[8]	Changi Airport	1.4°N, 104.0°E	1, 2	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	21.0°N, 105.5°E	1, 2	2	
	Ho Chi Ming City	10.5°N, 106.4°E		2	

[7] Republic of Korea receives AQUA (MODIS, AIRS, AMSU, AMSR-E) and TERRA (MODIS).
[8] Singapore receives AQUA (MODIS), FY-2B (S-VISSR) and TERRA (MODIS).

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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 10°N to 30°N and 105°E to 125°E.
China	8 times/day	TCPQ40 BABJ	When a tropical cyclone is located within 0°N to 50°N and 105°E to 180°E.

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APPENDIX 3-A

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
RSMC Advisories		
RSMC TC Advisory ~~Prognostic Reasoning~~	At least 8 times/day ~~4 times/day~~	• RSMC Tokyo - Typhoon Center's TC analysis, track forecast and intensity forecast up to 120-hours (linked to JMA's website: https://www.jma.go.jp/en/typh/) ~~• RSMC Tokyo Tropical Cyclone Prognostic Reasoning (WTPQ)~~
Storm Wind Probability Map ~~RSMC TC Advisory~~	4 times/day ~~At least 8 times/day~~	• Probabilistic forecast map for sustained wind upward of 50-kt with forecast time of 1, 2, 3, 4 and 5 days ~~• RSMC Tokyo – Typhoon Center's TC analysis, track forecast up to 120-hours and intensity forecast up to 72-hours (linked to JMA's website: https://www.jma.go.jp/en/typh/)~~
Prognostic Reasoning ~~Graphical TC Advisory~~	4 times/day	• RSMC Tokyo Tropical Cyclone Prognostic Reasoning (WTPQ) ~~• Graphical TC Advisory including RSMC Tokyo – Typhoon Center's TC analysis, track and intensity forecast up to 24-hours and horizontal extent of cumulonimbus cloud and cloud top height associated with TCs potentially affecting aviation safety (linked to Tropical Cyclone Advisory Center Tokyo Website: https://www.data.jma.go.jp/fcd/tca/data/index.html)~~
Advance notice ~~Operational Remarks~~		• Advance notice on TC status change from RSMC Tokyo – Typhoon Center
Graphical TC Advisory ~~Track Bulletin~~	4 times/day	• Graphical TC Advisory including RSMC Tokyo - Typhoon Center's TC analysis, track and intensity forecast up to 24-hours and horizontal extent of cumulonimbus cloud and cloud top height associated with TCs potentially affecting aviation safety (linked to Tropical Cyclone Advisory Center Tokyo Website: https://www.data.jma.go.jp/fcd/tca/data/index.html) ~~• RSMC Tokyo Tropical Cyclone Track Forecast Bulletin~~ ~~- Track forecast by deterministic GSM (FXPQ2X)~~ ~~- Track forecast by GEPS (FXPQ3X)~~
Remote sensing ~~Observation/Analysis~~		
Satellite 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 imagery ~~Satellite Microwave Products~~	Up to 142 times/day	• Satellite imagery of Himawari-8/9 (inked to JMA's website: https://www.jma.go.jp/en/gms/smallc.html?area=6&element=0&mode=UTC) ~~• 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~~
Satellite Microwave Products ~~Radar~~	~~Every hour~~	• 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 composite imagery of the Typhoon Committee Regional Radar Network~~
Sea-surface AMV ~~Weather Maps~~	Every 10 / 30 minutes ~~4 times/day~~	• AMV-based Sea-surface Wind in the vicinity of TC (linked to Meteorological Satellite Center's web site: http://www.data.jma.go.jp/mscweb/en/product/product/aswind/monitor/aswind.php) ~~• Weather maps for surface analysis, 24- and 48-hour forecast (linked to JMA's website: https://www.jma.go.jp/en/g3/)~~
Radar Composite Imagery	Every hour ~~4 times/day~~	• Radar composite imagery of the Typhoon Committee Regional Radar Network ~~• Upper-air analysis based on GSM initial field data~~ ~~- Streamlines at 850 and 200 hPa~~

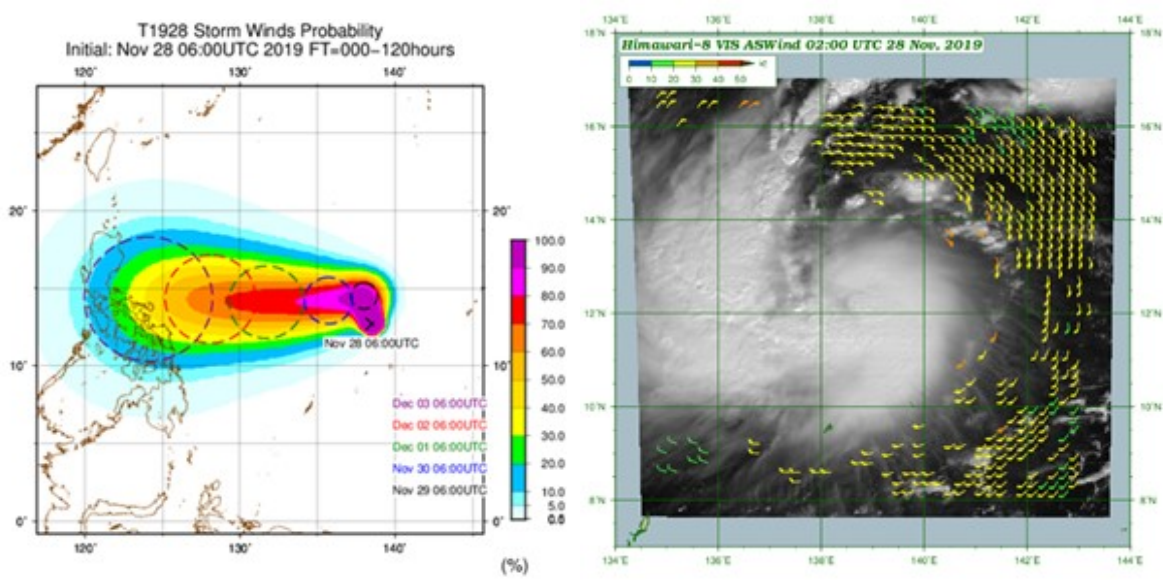
Products	Frequency	Details
~~Upper-Air Analysis~~		~~- Vertical wind shear between 200 and 850 hPa~~ ~~- Divergence at 200 hPa~~ ~~- Vorticity at 850 hPa~~
~~Ocean Analysis~~	~~Once/day~~	~~• Sea surface temperature and difference from 24 hours ago~~ ~~• Tropical cyclone heat potential and difference from 24 hours ago~~
Atmospheric Circulation ~~Forecasting/NWP~~		
Weather Charts ~~TC Track Prediction~~	4 times/day	• Weather maps for surface analysis, 24- and 48-hour forecast (linked to JMA's website: https://www.jma.go.jp/en/g3/) ~~• 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 Multi Center Weather ~~Maps~~ Charts	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)
JMA GSM Analysis and Forecast ~~TC Activity Prediction~~	4 times/day ~~Twice/day~~	• Upper-air analysis and forecast data based on JMA-GSM - Streamlines at 850, 500 and 200 hPa - Divergence at 200 hPa - Velocity potential at 200 hPa - Vertical Velocity in Pressure Coordinate at 500 hPa - Dew Point Depression at 600 hPa - Curvature Vorticity at 850 hPa - Vertical wind shear between 200 and 850 hPa - Sea Level Pressure - Genesis Potential Index ~~• Two- and five-day TC activity prediction maps based on ensemble NWP models from four centers (ECMWF, UKMO, NCEP and JMA) and a related consensus~~
MJO phase diagram	Monthly	• MJO phase and amplitude diagram and MJO Havmoller diagram (linked to JMA's web sites)
Asian Monsoon Monitoring Indices	Daily	• Time series of vertical wind shear, OLR and other indices associated with SW Asian Monsoon (linked to JMA's web sites)
Ocean Condition ~~Storm Surge/Waves~~		
SST ~~Storm Surge Forecasts~~	Once/day ~~4 times/day~~	• Sea surface temperature and its difference from 24 hours ago ~~• 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)~~
TCHP ~~Ocean Wave Forecasts~~	Once/day ~~Twice/day~~	• Tropical cyclone heat potential and its difference from 24 hours ago ~~• Distribution maps of ensemble mean, maximum, probability of exceeding various thresholds and ensemble spread of wave height and period based on Wave Ensemble System (WENS) (up to 264 hours ahead)~~ ~~• Time-series of box-and-whisker plots of wave height and period, and probability of exceeding various thresholds of wave height and period based on WENS (up to 264 hours ahead)~~
Numerical TC Prediction		
Track Forecast Bulletin	4 times/day	• RSMC Tokyo Tropical Cyclone Track Forecast Bulletin - Track forecast by deterministic GSM (FXPQ2X) - Track forecast by GEPS (FXPQ3X)
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,

Products	Frequency	Details
		NCEP, UKMO and JMA)
TC Activity Prediction	Twice/day	• Two- and five-day TC activity prediction maps based on ensemble NWP models from four centers (ECMWF, UKMO, NCEP and JMA) and a related consensus
Marine Forecast		
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)
Ocean Wave Forecasts	Twice/day	• Distribution maps of ensemble mean, maximum, probability of exceeding various thresholds and ensemble spread of wave height and period based on Wave Ensemble System (WENS) (up to 264 hours ahead) • Time-series of box-and-whisker plots of wave height and period, and probability of exceeding various thresholds of wave height and period based on WENS (up to 264 hours ahead)

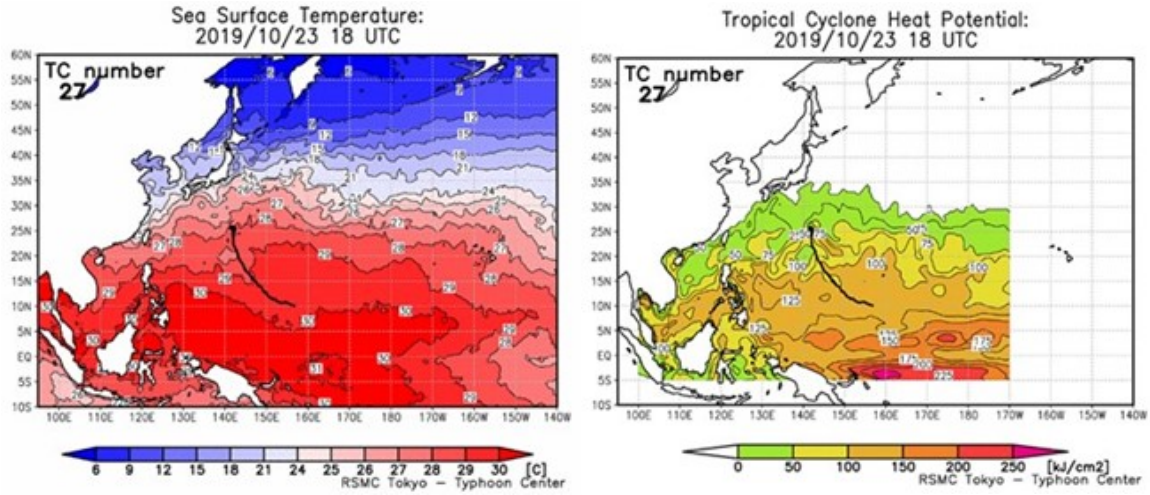
Annex 3-6

APPENDIX 3-A

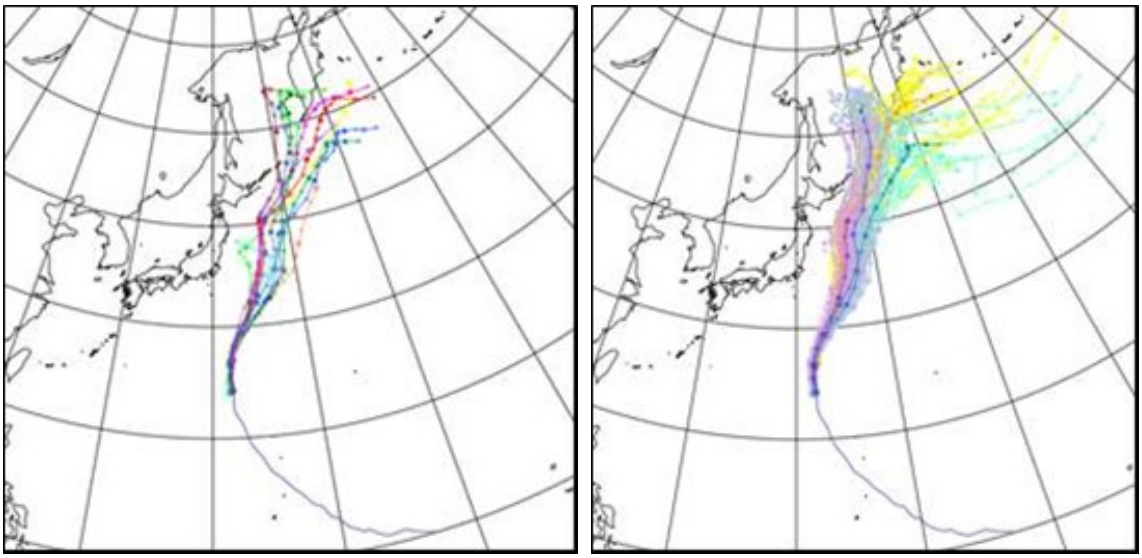
Example of the products provided by RSMC Tokyo - Typhoon Center



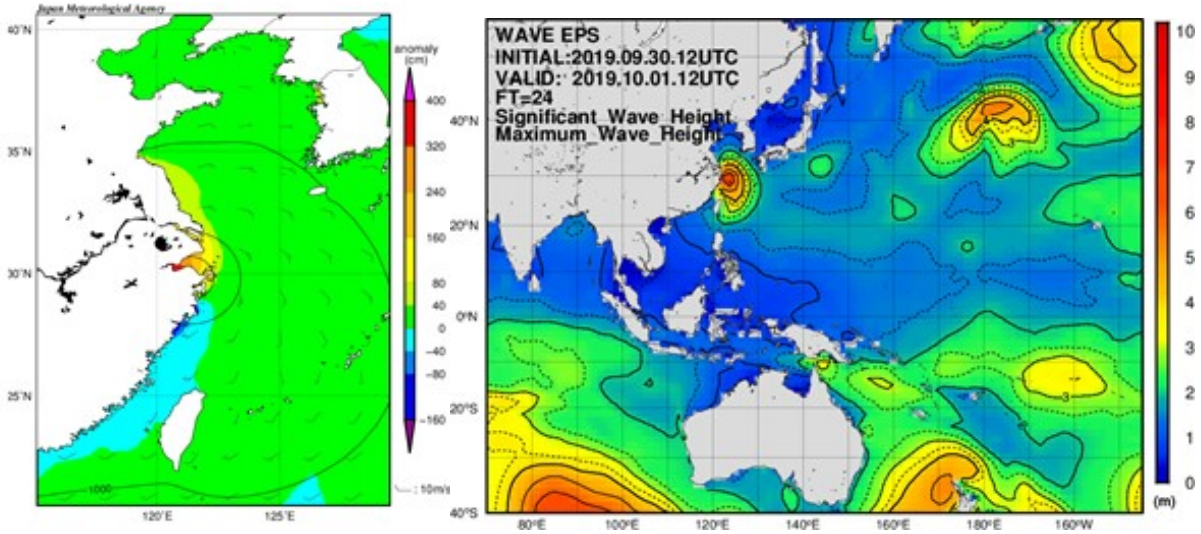
(Left) Storm Wind Probability Map: Probabilistic forecast map for sustained wind upward of 50-kt with forecast time of 1, 2, 3, 4 and 5 days, to grasp the possible impact for areas of interest. (Right) Sea-surface AMV: AMV-based sea-surface wind in the vicinity of TCs estimated from Himawari-8/9 low-level AMVs. Data are available every 30 minutes for full-disk observation and every 10 minutes for Target Area observation, respectively.



(Left) Sea Surface Temperature analysed with observation data of satellites, buoys, ships. "SST > 26°C to a depth of 60 m" is one of the necessary conditions for TC development and genesis. (Right) Tropical cyclone heat potential: Total heat contents from sea surface down to the depth of the 26°C isotherm, operationally used as TC intensity guidance. Minimum threshold for rapid intensification of TC in the western North Pacific is around 40 kJ/cm^2.



(Left) Deterministic Track Prediction of global NWP model of BoM, MSC, CMA, DWD, KMA, UKMO, NCEP, ECMWF and JMA. Track prediction of specific NWP models can be selected for display. (Right) Ensemble Track Prediction of NCEP, UKMO, ECMWF and JMA.



(Left) Storm surge forecast derived from EPS for storm surge caused by TCs. The EPS runs for 6 possible TC tracks (RSMC Tokyo - Typhoon Center's official track forecast and five selected ensemble members that cover a major set of TC track scenarios). (Right) Ocean Wave Height produced by Wave Ensemble System of JMA.

Deterministic NWP models used in the Numerical Typhoon Prediction website

System	Domain	Horizontal Resolution	Number of Vertical Levels	Forecast Range (Initial Time)	Specification of (Model/Data)
JMA deterministic Global model (GSM)	Global	TL959 (~20 km)	100	132 hours (00, 06, 18 UTC) 264 hours (12 UTC)	Model
BoM deterministic Global model (ACCESS-G)	Global	Lon: 0.35° Lat: 0.23°	-	240 hours (00, 12UTC)	Data
CMA deterministic Global model (GRAPES_GFS)	Global	0.28°	-	120 hours (00, 12, UTC)	Data
CMC deterministic Global model (GDPS)	Global	1.0°	-	144 hours (00, 12UTC)	Data
DWD deterministic Global model (GME)	Global	0.25°	-	174 hours (00, 12UTC)	Data
ECMWF deterministic Global model (IFS-HRES)	Global	0.5°	-	240 hours (00, 12 UTC)	Data
KMA deterministic Global model (GDAPS)	Global	Lon: 0.23° Lat: 0.16°	-	168 hours (00, 12UTC),	Data
NCEP deterministic Global model (GFS)	Global	0.5°	-	192 hours (00, 06, 12, 18 UTC)	Data
UKMO deterministic Global model	Global	Lon: 0.83° Lat: 0.56°	-	120 hours (00, 12 UTC)	Data

EPS used in the Numerical Typhoon Prediction website

System	Domain	Horizontal Resolution	Number of Vertical Levels	Forecast Range (Initial Time)	Number of Ensemble Members	Specification of (Model/ Data)
JMA Global EPS (GEPS)	Global	TL479 (~40 km)	100	132 hours[9] (06, 18 UTC) 264 hours (00, 12 UTC)	27	Model
ECMWF Global EPS	Global	Only track data	-	240 hours (00, 12 UTC)	52	Data
NCEP Global EPS	Global	1.0°	-	384 hours (00, 06, 12, 18 UTC)	21	Data
UKMO Global EPS	Global	Only track data	-	168 hours (00, 06, 12, 18 UTC)	36	Data

[9] Forecasts from initial times at 06 and 18 UTC are operated when any of the following conditions is satisfied at the initial times: (i) A tropical cyclone (TC) of tropical storm (TS) intensity or higher is present in the RSMC Tokyo-Typhoon Center's area of responsibility (0°-60°N, 100°-180°E). (ii) A TC is expected to reach TS intensity or higher in the area within the next 24 hours. (iii) A TC of TS intensity or higher is expected to move into the area within the next 24 hours.

Annex 3-7

APENDIX 3-B
Analysis methods, forecasting methods and NWP for forecasting currently used by the NMSs of Typhoon Committee Members

Name of the Member: **[China]**

1 Tropical Cyclone Analysis

Parameter	Time	Methods	Other Sources
Dvorak Intensity (CI, T, DT, PT, MET number)	00, 06, 12, 18 UTC	Dvorak EIR method (Dvorak, 1984)	Satellite observational data from FY-4 (AGRI images, GIIRS sounding data) and FY-3 (Atmospheric vertical temperature profile), other available satellite microwave and sounding data
Center Position, Accuracy of center position, Direction and speed of movement	00, 03, 06, 09, 12, 15, 18, 21 UTC	Satellite images and other estimation methods which utilize surface observations	
Central Pressure (CP), Maximum Sustained Wind speed (MSW), Maximum Gust Wind speed (MGW), 50 kt radii (R50), 30 kt radii (R30)	00, 03, 06, 09, 12, 15, 18, 21 UTC	(1) Conversion from Dvorak method (Dvorak, 1984) (for CP, MSW and MGW) (2) Weather map analysis with full utilization of all observational data available (SYNOP, SHIP, BUOY, ASCAT, AMV including sea surface wind estimated from low-level AMV) (3) Statistical relationship between MSW and R50 selected by TC size	

2 Tropical Cyclone Forecasting

Parameter	Issuance Time	Lead Time	Methods
Likelihood of development of organized convective cloud systems into TSs	00, 06, 12, 18 UTC	24 hours	(1) Dvorak Intensity (2) 850 hPa and 200 hPa streamlines of deterministic Global NWP models and Ensemble Prediction Systems (EPSs) of major centers (e.g. GRAPES, ECMWF, NCEP and UKMO) (3) 850 hPa and 200 hPa streamlines of deterministic regional NWP models and EPS of GRAPES
Center position, Direction and speed of movement, Radius of probability circle	00, 06, 12, 18 UTC	24, 48, 72, 96, 120 hours	Center position, Direction and speed of movement: (1) Simple consensus method using deterministic Global NWP models of GRAPES and other major centers such as ECMWF, NCEP and UKMO (2) Global EPSs of GRAPES, ECMWF, NCEP and UKMO as reference (3) Deterministic regional NWP models of GRAPES_TYM, Shanghai GRAPES Typhoon Model (SGTM), STI - Typhoon Ensemble Data Assimilation and Prediction System (STI-TEDAPS) as reference (4) OBEST method (a consensus method using EPSs of ECMWF, NCEP and UKMO (Dong and Zhang; 2016,Qi et al, 2014), STI Shanghai Selective Tropical Cyclone (STI-SSTC) , STI- western North Pacific tropical cyclone intensity prediction scheme (STI-WIPS) Radius of probability circle: Verification results of past TC track errors according to the ensemble spread of the Global EPSs of GRAPES, ECMWF, NCEP and UKMO (Chen et al, 2018).

Parameter	Issuance Time	Lead Time	Methods
CP, MSW, MGW, R50	00, 06, 12, 18 UTC	24, 48, 72, 96, 120 hours	CP, MSW and MGW: (1) Statistical and dynamical guidance (Chen et al, 2018) (2) Deterministic Global NWP models of GRAPES and other major centers such as ECMWF, NCEP and UKMO as reference (3) Deterministic Regional NWP models of GRAPES as reference R50: MSW-R50 development curve determined by TC size

3 NWP Systems in Operational Use

System	Domain	Horizontal Resolution	Number of Vertical Levels	Forecast Range (Initial Time)	Number of Ensemble Members	Run by (own/other centers)
GRAPES-GFS	Global	0.25°	60	240h (00,06,12,18 UTC)	_	Own
GRAPES-GEPS	Global	0.5°	60	240h (00,12UTC)	31	Own
GRAPES_TYM	40-180.°E; 15°S-60.0°N	0.09°	68	120h (00,06,12,18 UTC)	_	Own
GRAPES-REPS	70-145°E;15-65°N	0.1°	50	84h (00,12UTC)	15	Own
GRAPES-MESO-3km	70-145°E 10-60°N	0.03°	50	36h (00,06,12,18 UTC)	_	Own
Shanghai GRAPES Typhoon Model (SGTM)	West Pacific Ocean and South China Sea	0.1°	50	up to 72h, interval is 6h	_	Own
STI - Typhoon Ensemble Data Assimilation and Prediction System (STI-TEDAPS)	West Pacific Ocean and South China Sea	27 km	35	up to 72h, interval is 6h	21	Own
TRAMS	Longitude: (70°E-160°E) Latitude: (0.8N-54.8°N)	0.09° (horizontal grids: 1001 x 601)	65	168hours (00,12 UTC) 72hours (06,18 UTC)	_	Own

Reference

Chen G. M., Lei X T, Zhang X P, 2018. Verification of tropical cyclone operational forecast in 2017[R]. Ha Noi : UNESCAP/WMO Typhoon Committee:19.

Dong L and Zhang F Q, 2016. OBEST: an observation based ensemble sub-setting technique for tropical cyclone track prediction [J]. Wea Forecasting, 31(1): 57-70.

Dvorak V. F., 1984: Tropical cyclone intensity analysis using satellite data, NOAA Technical Report, 11.

Qi L b, Yu H and Chen P Y 2014. Selective ensemble-mean technique for tropical cyclone track forecast by using ensemble prediction systems [J]. Q. J. R. Meteorol. Soc.140, 805-813.

Name of the Member: **[Hong Kong, China]**

1 Tropical Cyclone Analysis

Parameter	Time	Methods	Other Sources
1. Position, direction and speed of movement 2. Intensity (maximum sustained 10-minute mean wind near TC centre) 3. Central pressure, Wind radii (of strong, gale, storm and hurricane force winds) 4. Wind radii (of strong, gale, storm and hurricane force winds)	Synoptic hour in general (also subject to observation reception time)	1. Position, direction and speed of movement: • Satellite imagery • Radar imagery (reflectivity, zero-isodop on Doppler velocity) • Weather observation from synoptic stations, automatic weather stations, oil rigs and weather buoys 2. Intensity: • Dvorak analysis on satellite imagery • Radar imagery (Doppler wind) • Weather observation from synoptic stations, automatic weather stations, oil rigs and weather buoys • Dropsonde observations from reconnaissance flight 3. Central pressure: • Pressure observation from synoptic stations, automatic weather stations, oil rigs and weather buoys 4. Wind radii: • Weather observation from synoptic stations, automatic weather stations, oil rigs and weather buoys • Dropsonde observations from reconnaissance flight	(a) ASCAT observations for analysing position, intensity and wind radii. (b) NRL Microwave images for analysing position. (c) NOAA Multiplatform Tropical Cyclone Surface Winds Analysis for analysing intensity and wind radii.

2 Tropical Cyclone Forecasting

Parameter	Issuance Time	Lead Time	Methods
Track	Around 1 to 2 hour from the synoptic hour (T)	Forecast positions for: T + 24 h T + 48 h T + 72 h T + 96 h T + 120 h	Weighted ensemble forecast track is generated from 5 NWP guidance including JMA, UKMO, NCEP, ECMWF and ECMWF EPS. The ensemble forecast track forms the basis for formulating the operational TC forecast track. The operational TC forecast track may be slightly adjusted considering other NWP guidance (e.g. EPS products from CMC, KMA, JMA, NCEP and UKMO), real-time observations and past NWP performance.
Intensity (maximum sustained wind)	Around 1 to 2 hour from the synoptic hour (T)	Forecast intensity for: T + 24 h T + 48 h T + 72 h T + 96 h T + 120 h	The intensity forecast makes reference to the NWP intensity guidance products from ECMWF, JMA, NCEP, UKMO, NOAA HWRF, TWRF, and Meso-NHM of HKO. Factors such as rapid intensification chance deduced from statistical dynamical TC intensity forecast model, and environmental parameters such as sea surface temperature, wind shear, the ocean heat potential and land interactions are also considered in formulating the intensity forecast.

3 NWP Systems in Operational Use

System	Domain	Horizontal Resolution	Number of Vertical Levels	Forecast Range (Initial time)	Number of Ensemble Members	Run by (own/other centers)
ECMWF deterministic Global model	Global	0.1°	-	240 hours (00, 12 UTC) 90 hours (06, 18 UTC)	N. A.	Other
ECMWF Global EPS	Global	Only TC track and intensity data	-	240 hours (00, 12 UTC)	52	Other
ECMWF Global EPS	Global	Ensemble member forecasts on surface and isobaric levels with horizontal resolution of 0.25 / 0.5° covering selected domains	-	360 hours	52	Other
NCEP deterministic Global model	Global	0.25°	-	384 hours (00, 06, 12, 18 UTC)	N.A.	Other
NCEP Global EPS	Global	Only TC track and intensity data	-	384 hours (00, 06, 12, 18 UTC)	21	Other
NCEP deterministic regional model (HWRF)	Domain based on the initial position of the TC	Only TC track and intensity data	-	Up to 126 hours (00, 06, 12, 18 UTC)	N.A.	Other
JMA deterministic Global model	Global	0.25°	-	132 hours (00, 06, 18 UTC) 264 hours (12 UTC)	N.A.	Other
JMA Global EPS (GEPS)	Global	Only TC track and intensity data	-	132 hours	27	Other
UKMO deterministic Global model	Global	Lon: 0.23° Lat: 0.16°	-	144 hours (00, 12 UTC)	N.A.	Other
UKMO Global EPS	Global	Only TC track and intensity data	-	192 hours (00, 06, 12, 18 UTC)	36	Other
CMA deterministic Global model	Global	0.25°	-	240 hours (00, 12 UTC)	N.A.	Other
CMA Global EPS	Global	Only TC track and intensity data	-	240 hours (00, 12 UTC)	16	Other
CMC deterministic Global model	Global	0.24°	-	240 hours (00, 12 UTC)	N.A.	Other
CMC Global EPS	Global	Only TC track data	-	240 hours (00, 12 UTC)	21	Other
KMA deterministic Global model	Global	0.35°	-	240 hours (00, 12 UTC)	N.A.	Other

System	Domain	Horizontal Resolution	Number of Vertical Levels	Forecast Range (Initial time)	Number of Ensemble Members	Run by (own/other centers)
Meso-NHM	NW: 38.61°N 62.05°E NE: 37.48°N 168.13°E SW: 0.91°N 84.42°E SE: 0.39°N 145.23°E	10 km	50	72 hours	1	Own
RAPIDS-NHM	NW: 25.01°N 111.22°E NE: 25.01°N 117.13°E SW: 19.54°N 111.22°E SE: 19.54°N 117.13°E	2 km	60	15 hours	1	Own

Meso-NHM and RAPIDS-NHM

Name of the method:
Non-Hydrostatic Model (NHM)

Description of the method:

HKO operates the NHM system based on JMA-NHM (Saito *et al.* 2006) with horizontal resolution at 10-km and 2-km to provide forecasts up to 72 hours and 15 hours ahead respectively (Wong 2010).

In NHM, a 3-dimensional variational data assimilation (3DVAR) system is used to generate the initial condition on model levels using the following meteorological observations:

(A) GTS

SYNOP, SHIP and BUOY	synoptic stations, ship and buoy data
TEMP and PILOT	radiosonde and pilot data
AMDAR and AIREP	aircraft data
AMV	atmospheric motion vectors from Himarwai-8
ATOVS	retrieved temperature profiles from NOAA
Ocean surface wind	scatterometer wind retrieval data from ASCAT, RAPID-SCAT and HY2A
Dropsonde	tropical cyclone wind observations from DOTSTAR
IASI	temperature and humidity retrieval profile data from EUMETSAT Metop IASI (Infrared Atmospheric Sounding Interferometer)

(B) Regional data exchange
Data from automatic weather stations over the south China coastal areas

(C) Local data
(i) Automatic weather station data
(ii) Wind profiler data
(iii) Doppler weather radar data
(iv) Radar retrieved wind data (u and v) on 1-5 km levels based on multiple weather radars in Hong Kong and the Pearl River Delta region, China
(v) GNSS total precipitable water vapour

The 3DVAR analysis for 10-km NHM is produced eight times a day at 00, 03, 06, 09, 12, 15, 18, and 21 UTC. Hourly analysis is performed for the 2-km NHM.

Specifications of the forecast model are given in the following table:

Basic equations	Fully compressible non-hydrostatic governing equations
Vertical coordinates	Terrain following height coordinates system
Forecast parameters	wind (u,v,w), 3-dimensional pressure, potential temperature, specific humidity of water vapour, cloud water, cloud ice, rain water, hail/graupel and snow
Map projection	10-km NHM: Lambert Conformal 2-km NHM: Mercator
Number of grid points	10-km NHM: 841x515, 50 levels 2-km NHM: 305x305, 60 levels
Corners of the model domain	10-km NHM: NW: 38.61°N 62.05°E NE: 37.48°N 168.13°E SW: 0.91°N 84.42°E SE: 0.39°N 145.23°E 2-km NHM: NW: 25.01°N 111.22°E NE: 25.01°N 117.13°E SW: 19.54°N 111.22°E SE: 19.54°N 117.13°E
Forecast range	10-km NHM: 72 hours 2-km NHM: 15 hours
Initial condition	Analysis from NHM 3DVAR on model levels
Boundary condition	For 10-km NHM, 3-hourly interval boundary data including horizontal wind, temperature, relative humidity, geopotential height and surface pressure from ECMWF IFS forecast at horizontal resolution of 0.125 degree in latitude/longitude and on 25 pressure levels (1000, 950, 925, 900, 850, 800, 700, 600, 500, 400, 300, 250, 200, 150, 100, 70, 50, 30, 20, 10, 7, 5, 3, 2 and 1 hPa) For 2-km NHM, 3-hourly interval boundary data provided from ECMWF IFS forecasts
Nesting configuration	One-way nesting
Topography and land-use	USGS GTOPO30 (30 second data smoothed to 1.5 times of horizontal resolution) USGS Global Land Cover Characterization (GLCC) 30 second data
Dynamics	Non-hydrostatic governing equations solved by time-splitting horizontal-explicit-vertical-implicit (HEVI) scheme using 4-order centred finite difference in flux form
Moisture process	Tiedtke based bulk mass flux convective parameterization (HKO version) Three ice bulk microphysics scheme
Surface process	Flux and bulk coefficients: Land: Beljaars and Holtslag (1991) Sea: Wong, Sumdin and Lai (2010) Stomatal resistance and temporal change of wetness included 4-layer soil model to predict ground temperature and surface heat flux.
Turbulence closure model and planetary boundary layer process	Mellor-Yamada-Nakanishi-Niino Level 2.5 (MYNN-2.5) (Nakanishi and Niino, 2004) with partial condensation scheme (PCS) and implicit vertical turbulent solver. Height of PBL calculated from virtual potential temperature profile.

Radiation	Long wave radiation process follows Kitagawa (2000) Short wave radiation process using Yabu and Kitagawa (2005) Prognostic surface temperature included; Cloud fraction determined from PCS.

Reference

Beljaars, A. C. M., and A. A. M. Holtslag, 1991: Flux parameterization and land surfaces in atmospheric models. *J. Appl. Meteor.*, **30**, 327-341.

ECMWF, 2015: Convection. *IFS Documentation CY41R1*, Part IV, Chapter 6, ECMWF, 73-90. [Available at http://www.ecmwf.int/en/forecasts/documentation-and-support/changes-ecmwf-model/ifs-documentation]

Kitagawa, H., 2000: Radiation process. *NPD Report No. 46*, Numerical Prediction Division, JMA, 16-31. (in Japanese)

Nakanishi, M. and H. Niino, 2004: Improvement of the Mellor-Yamada level 3 model with condensation physics: Its de-sign and verification. *Bound.-Layer Meteor.*, **112**, 1-31.

Saito, K., T. Fujita, Y. Yamada, J. Ishida, Y. Kumagai, K. Aranami, S. Ohmori, R. Nagasawa, S. Kumagai, C. Muroi, T. Kato, H. Eito, and Y. Yamazaki, 2006: The Operational JMA Nonhydrostatic Mesoscale Model. *Mon. Wea. Rev.*, **134**, 1266-1298.

Wong, W.K., 2010: Development of Operational Rapid Update Non-hydrostatic NWP and Data Assimilation Systems in the Hong Kong Observatory, *3rd International Workshop on Prevention and Mitigation of Meteorological Disasters in Southeast Asia*, 1-4 March 2010, Beppu, Japan. [Reprint available at http://www.hko.gov.hk/publica/reprint/r882.pdf]

Wong, W.K., S. Sumdin and E.S.T. Lai, 2010: Development of Air-Sea Bulk Transfer Coefficients and Roughness Lengths in JMA Non-hydrostatic Model and Application in Prediction of an Intense Tropical Cyclone. *SOLA*, **6**, 065-068.

Yabu, S., S. Murai, and H. Kitagawa, 2005: Clear-sky radiation scheme. *NPD Report No. 51*, Numerical Prediction Division, JMA, 53-64. (in Japanese)

Name of the Member: **[Japan]**

1 Tropical Cyclone Analysis

Parameter	Time	Methods	Other Sources
Dvorak Intensity (CI, T, DT, PT, MET number)	00, 06, 12, 18 UTC	Dvorak EIR method (Dvorak, 1984) and Early Dvorak Analysis (EDA: Tsuchiya et al., 2001 and Kishimoto, 2008)	
Center Position, Accuracy of center position, Direction and speed of movement	00, 03, 06, 09, 12, 15, 18, 21 UTC	Satellite images and other estimation methods which utilize surface observations	
Central Pressure (CP), Maximum Sustained Wind speed (MSW), Maximum Gust Wind speed (MGW), 50 kt radii (R50), 30 kt radii (R30)	00, 03, 06, 09, 12, 15, 18, 21 UTC	(1) Conversion from Dvorak method (Koba et al., 1991) (for CP, MSW and MGW) (2) Weather map analysis with full utilization of all observational data available (SYNOP, SHIP, BUOY, ASCAT, AMV including sea surface wind estimated from low-level AMV (Nonaka et al., 2019), etc.) (3) Statistical relationship between MSW and R50 selected by TC size	CPs estimated from TC warm core intensities observed by the Advanced Microwave Sounding Unit-A (AMSU-A) (Oyama, 2014) and MSW estimated from multi-channel microwave imager data (Sakuragi et al., 2014, Hoshino and Nakazawa, 2007)

2 Tropical Cyclone Forecasting

Parameter	Issuance Time	Lead Time	Methods
Likelihood of development of organized convective cloud systems into TSs	00, 06, 12, 18 UTC	24 hours	(1) EDA (2) 850 hPa and 200 hPa streamlines of deterministic Global NWP models and Ensemble Prediction Systems (EPSs) of major centers (e.g. JMA, ECMWF, NCEP and UKMO) (3) 850 hPa and 200 hPa streamlines of deterministic regional NWP models and EPS of JMA
Center position, Direction and speed of movement, Radius of probability circle	00, 06, 12, 18 UTC	24, 48, 72, 96, 120 hours	Center position, Direction and speed of movement: (1) Simple consensus method using deterministic Global NWP models of JMA and other major centers such as ECMWF, NCEP and UKMO (2) Global EPSs of JMA, ECMWF, NCEP and UKMO as reference (3) Deterministic regional NWP models of JMA and NCEP as reference Radius of probability circle: Verification results of past TC track errors according to the ensemble spread of the Global EPSs of JMA, ECMWF, NCEP and UKMO (Fukuda and Yamaguchi, 2019).
CP, MSW, MGW, R50	00, 06, 12, 18 UTC	24, 48, 72, 96, 120 hours	CP, MSW and MGW: (1) Statistical and dynamical guidance (TIFS: Yamaguchi et al., 2018) (2) Deterministic Global NWP models of JMA and other major centers such as ECMWF, NCEP and UKMO as reference (3) Deterministic Regional NWP models of JMA and NCEP as reference R50: MSW-R50 development curve determined by TC size

3 NWP Systems in Operational Use

System	Domain	Horizontal Resolution	Number of Vertical Levels	Forecast Range (Initial Time)	Number of Ensemble Members	Run by (own/other centers)
JMA deterministic Global model	Global	TL959 (~20 km)	100	132 hours (00, 06, 18 UTC) 264 hours (12 UTC)	-	Own
JMA Global EPS	Global	TL479 (~40 km)	100	132 hours[10] (06, 18 UTC) 264 hours (00, 12 UTC)	27	Own
JMA deterministic regional model (Meso-scale Model: MSM)	Japan and its surrounding areas	5 km (horizontal grids: 817 x 661)	76	39 hours (03, 06, 09, 15, 18, 21 UTC) 51 hours (00, 12 UTC)	-	Own
JMA regional EPS	Japan and its surrounding areas	5 km (horizontal grids: 817 x 661)	76	39 hours (00, 06, 12, 18 UTC)	21	Own
JMA deterministic regional model (Local Forecast Model: LFM)	Japan and its surrounding areas	2 km (horizontal grids: 1531 x 1301)	58	10 hours (Every hour)	-	Own
ECMWF deterministic Global model	Global	0.5°	-	240 hours (00, 12 UTC)	-	Other
ECMWF Global EPS	Global	Only track data	-	240 hours (00, 12 UTC)	52	Other
NCEP deterministic Global model	Global	0.5°	-	192 hours (00, 06, 12, 18 UTC)	-	Other
NCEP Global EPS	Global	1.0°	-	384 hours (00, 06, 12, 18 UTC)	21	Other
NCEP deterministic regional model (HWRF)	Domain based on the initial position of the TC	Only track and intensity data	-	Up to 126 hours (00, 06, 12, 18 UTC)	-	Other
UKMO deterministic Global model	Global	Lon: 0.83° Lat: 0.56°	-	120 hours (00, 12 UTC)	-	Other
UKMO Global EPS	Global	Only track data	-	168 hours (00, 06, 12, 18 UTC)	36	Other

Reference

Dvorak V. F., 1984: Tropical cyclone intensity analysis using satellite data, *NOAA Technical Report*, **11**.

Fukuda, J. and M. Yamaguchi, 2019: Determining Probability-Circle Radii of Tropical Cyclone Track Forecasts with Multiple Ensembles, *RSMC Tokyo - Typhoon Center Technical Review*, No. **21**.

Hoshino, S. and T. Nakazawa, 2007: Estimation of Tropical Cyclone's Intensity Using TRMM/TMI Brightness Temperature Data, *Journal of the Meteorological Society of Japan*, Vol. **85**, No. 4, 437 - 454.

[10] Forecasts from initial times at 06 and 18 UTC are operated when any of the following conditions is satisfied at the initial times: (i) A tropical cyclone (TC) of tropical storm (TS) intensity or higher is present in the RSMC Tokyo-Typhoon Center's area of responsibility (0°-60°N, 100°-180°E). (ii) A TC is expected to reach TS intensity or higher in the area within the next 24 hours. (iii) A TC of TS intensity or higher is expected to move into the area within the next 24 hours.

Japan Meteorological Agency, 2019: Outline of the Operational Numerical Weather Prediction at the Japan Meteorological Agency, Appendix to WMO Technical Progress Report on the Global Data-processing and Forecasting System and Numerical Weather Prediction (http://www.jma.go.jp/jma/jma-eng/jma-center/nwp/outline2019-nwp/index.htm).

Kishimoto, K., 2008: Revision of JMA's Early Stage Dvorak Analysis and Its Use to Analyze Tropical Cyclones in the Early Developing Stage, *RSMC Tokyo - Typhoon Center Technical Review*, No. **10**, 1 - 12.

Kishimoto, K., M. Sasaki, and M. Kunitsugu, 2013: Cloud Grid Information Objective Dvorak Analysis (CLOUD) at the RSMC Tokyo - Typhoon Center, *RSMC Tokyo - Typhoon Center Technical Review*, No. **15**, 1 - 15.

Koba, H., T. Hagiwara, S. Osano and S. Akashi, 1991: Relationships between CI Number and Minimum Sea Level Pressure/Maximum Wind Speed of Tropical Cyclones, *Geophysical Magazine*, Vol. **44**, No. 1, 15 - 25.

Nonaka, K., S. Nishimura and Y. Igarashi, 2019: Utilization of Estimated Sea Surface Wind Data Based on Himawari-8/9 Low-level AMVs for Tropical CycloneAnalysis, *RSMC Tokyo - Typhoon Center Technical Review*, No. **21**.

Oyama, R., 2014: Algorithm and Validation of a Tropical Cyclone Central Pressure Estimation Method Based on Warm Core Intensity as Observed Using the Advanced Microwave Sounding Unit-A (AMSU-A), *RSMC Tokyo - Typhoon Center Technical Review*, No. **16**.

Sakuragi, T., S. Hoshino, N. Kitabatake, 2014: Development and Verification of a Tropical Cyclone Intensity Estimation Method Reflecting the Variety of TRMM/TMI Brightness Temperature Distribution, *RSMC Tokyo - Typhoon Center Technical Review*, No. **16**.

Tsuchiya, A., T. Mikawa and A. Kikuchi, 2001: Method of Distinguishing between Early Stage Cloud Systems that Develop into Tropical Storms and Ones that Do Not, *Geophysical Magazine Series 2*, Vol. **4**, Nos. 1 - 4, 49 - 59.

Yamaguchi, M., H. Owada, U. Shimada, M. Sawada, T. Iriguchi, K. D. Musgrave and M. DeMaria, 2018: Tropical Cyclone Intensity Prediction in the Western North Pacific Basin Using SHIPS and JMA/GSM., *Scientific Online Letters on the Atmosphere*, Vol. **14**, 138 - 143, doi:10.2151/sola.2018-024.

Name of the Member: **[Macao, China]**

1 Tropical Cyclone Analysis

Parameter	Time	Methods	Other Sources
Dvorak Intensity (CI, T, DT, PT, MET number)	00, 06, 12, 18 UTC	Dvorak EIR method (Dvorak, 1984)	/
Center Position, Direction and speed of movement	00, 06, 12, 18 UTC	Satellite images , radar observations and other estimation methods which utilize surface observations	/
Central Pressure (CP), Maximum Sustained Wind speed (MSW)	00, 06, 12, 18 UTC	(1) Conversion from Dvorak method (Koba et al., 1991) (for CP and MSW) (2) Weather map analysis with full utilization of all observational data available (SYNOP, BUOY)	/

2 Tropical Cyclone Forecasting

Parameter	Issuance Time	Lead Time	Methods
Center position, Direction and speed of movement	00, 06, 12, 18 UTC	24, 48, 72 hours	(1) Simple consensus method using deterministic NWP models of CMA, ECMWF, JMA and NCEP (2) Global EPSs of ECMWF, JMA and NCEP as reference

3 NWP Systems in Operational Use

System	Domain	Horizontal Resolution	Number of Vertical Levels	Forecast Range (Initial Time)	Number of Ensemble Members	Run by (own/other centers)
JMA deterministic Global model (GSM)	Global	TL959 (~50 km)	11	84 hours (00, 06, 18 UTC) 264 hours (12 UTC)	-	Other
ECMWF deterministic Global model	Global	0.25°	-	240 hours (00, 12 UTC)	-	Other
ECMWF Global EPS	Global	Only track data	-	240 hours (00, 12 UTC)	50 members 1 high resolution 1 control	Other
NCEP deterministic Global model	Global	0.25°	-	240 hours (00, 06, 12, 18 UTC)	-	Other
NCEP Global EPS	Global	Only track data	-	-	-	Other

Name of the Member: **[Malaysia]**

1 Tropical Cyclone Analysis

Parameter	Time	Methods	Other Sources
Center Position, Accuracy of center position, Direction & speed of movement	00, 03, 06, 09, 12, 15, 18, 21 UTC	Satellite images, NWP products and other estimation methods which utilize surface observations	TC information such as central pressure, maximum sustained wind speed, maximum gust wind speed, R50 (50 kt radii), R30 (30 kt radii) from RSMC Tokyo

2 Tropical Cyclone Forecasting

Parameter	Issuance Time	Lead Time	Methods
Track (center position, distance from nearest town, direction and speed of movement)	01, 04, 07, 10, 13, 16, 19, 22 UTC	6, 12, 18, 24 hours	Track (center position, distance from nearest town, direction and speed of movement) refer to RSMC-Tokyo, Japan for South China Sea and Northwest Pacific region, and RSMC-New Delhi, India for Bay of Bengal region.

3 NWP Systems in Operational Use

System	Domain	Horizontal Resolution	Number of Vertical Levels	Forecast Range (Initial Time)	Number of Ensemble Members	Run by (own/other centers)
Mesoscale Deterministic Model: WRF driven by NCEP GFS model	**[9 km]:** Lon: 82.27 - 135.18°E Lat: 5.60°S - 31.34°N **[3 km]:** Lon: 97.15 - 121.03°E Lat: 3.45°S - 8.39°N **[1 km]:** Lon: 99.55 - 119.39 °E Lat: 0.53 – 7.44 °N	**[9 km]:** 655 x 479 **[3 km]:** 886 x 442 **[1 km]:** 2197 x 772	51	168 hours (00, 06, 12, 18UTC)	-	Own
Mesoscale Deterministic Model: WRF driven by UKMO model	**[9 km]:** Lon: 82.27 - 135.18°E Lat: 5.60°S - 31.34°N **[3 km]:** Lon: 97.15 - 121.03°E Lat: 3.45°S - 8.39°N **[1 km]:** Lon: 99.55 -119.39°E Lat: 0.53 -7.44 °N	**[9 km]:** 655 x 479 **[3 km]:** 886 x 442 **[1 km]:** 2197 x 772	51	60 (00, 06, 12, 18UTC)	-	Own
Mesoscale Ensemble Prediction System: 10-member WRF driven by NCEP GFS	Lon: 97.93 -121.45°E Lat: 1.77°S - 11.95°N	**[12 km]:** 220 x 130	28	96 hours (00, 12UTC)	-	Own

System	Domain	Horizontal Resolution	Number of Vertical Levels	Forecast Range (Initial Time)	Number of Ensemble Members	Run by (own/other centers)
ECMWF deterministic Global model	Global	0.5°	-	240 hours (00, 12 UTC)	-	Other
NCEP deterministic Global model	Global	0.5°	-	192 hours (00, 06, 12, 18 UTC)	-	Other
JMA deterministic Global model (GSM)	Global	TL959 (~20 km)	100	132 hours (00, 06, 18 UTC) 264 hours (12 UTC)	-	Other

Name of the Member: **[Philippines]**

1 Tropical Cyclone Analysis

Parameter	Time	Methods	Other Sources
Dvorak Intensity (DT, PT, MET, FT and CI numbers)	00, 06, 12, 18 UTC	Dvorak EIR method (Dvorak 1984) Early-stage Dvorak Analysis (Tsuchiya et al. 2001; Kishimoto 2008)	Satellite fix bulletins from other NMSs via Numerical Typhoon Prediction website or GTS CIMSS Advanced Dvorak Technique (ADT) (Olander and Velden 2007)
Center Position (PSTN), Movement Speed and Direction (MOVE)	00, 03, 06, 09, 12, 15, 18, 21 UTC	Estimation of low-level circulation center using a combination of satellite images, weather radar scans, and surface observations (SYNOP, SHIP, BUOY).	▪ Satellite fix bulletins from other NMSs via Numerical Typhoon Prediction website or GTS CIMSS Automated Rotational Center Hurricane Eye Retrieval (ARCHER) (Wimmers and Velden 2010)
Central Pressure (PRES), Maximum Sustained Winds (MXWD), Maximum Gust (GUST),	00, 03, 06, 09, 12, 15, 18, 21 UTC	Conversion of CI number to PRES and MXWD (Koba et al. 1991) Conversion of MXWD to GUST (Harper et al. 2010) Weather map analysis using all available observation data (SYNOP, SHIP, BUOY, ASCAT)	PRES estimates from warm core intensity observations of Advanced Microwave Sounding Unit (AMSU) (Oyama 2014) via Numerical Typhoon Prediction website ▪ Weighted average of PRES analyses from Dvorak, AMSU and ATMS (Oyama et al. 2016) via Numerical Typhoon Prediction website CIMSS Satellite Consensus (SATCON) (Herndon and Velden 2018)
Radius of 30-kt, 50-kt and 64-kt Winds (R30, R50, R64)	00, 03, 06, 09, 12, 15, 18, 21 UTC	Weather map analysis using all available observation data (SYNOP, SHIP, BUOY, ASCAT)	Sea surface winds estimated from low-level AMV (Nonaka et al. 2019) via Numerical Typhoon Prediction website NOAA/NESDIS Multiplatform Tropical Cyclone Surface Winds Analysis (MTCSWA) (Knaff and DeMaria 2010) CIMSS real-time wind radii estimates based on Knaff et al. (2016)

2 Tropical Cyclone Forecasting

Parameter	Issuance Time	Lead Time	Methods
PSTN, MOVE	00, 06, 12, 18 UTC	24, 48, 72, 96, 120 hours	Simple and selective (subjective) consensus method using global deterministic and EPS models of major centers via Numerical Typhoon Prediction website Global EPSs of NCEP, ECMWF, JMA and UKMO via Numerical Typhoon Prediction website as reference Regional deterministic NWP models of PAGASA, NCEP, and HKO as reference Analysis of environmental steering using actual 00 and 12 UTC upper-air charts (single layer approach) and CIMSS satellite AMV-derived deep-layer mean streamlines (Velden and Leslie 1991; Velden 1993)
Category (i.e. TD, TS, STS, TY, STY, LOW, ETC)	00, 06, 12, 18 UTC	24, 48, 72, 96, 120 hours	Bias-corrected intensity prediction using weighted analog technique (Tsai and Elsberry 2014) as baseline intensity guidance Global deterministic models from major NWP centers via GTS as reference Regional deterministic NWP models of PAGASA, NCEP, and HKO as reference
Radius of 70% Probability Circle	00, 06, 12, 18 UTC	24, 48, 72, 96, 120 hours	Based on the direct positional error corresponding to cumulative ratio of 70% over the last 5 typhoon seasons.

If landfalling or passing to within 100 km of Philippine coastline, additional forecasts are made at 03, 09, 15, and 21 UTC.

3 NWP Systems in Operational Use

System	Domain	Horizontal Resolution	Number of Vertical Level	Forecast Range (Initial Time)	Number of Ensemble Members	Run by (own/other centers)
PAGASA Regional Deterministic Model (WRF-ARW)	3°N-25°N 115°E-135°E	12 km (182 x 214 grids)	42	144 hours (00, 03, 06, 09, 12, 15, 18, 21 UTC)	-	Own
PAGASA Regional Deterministic Model (WRF-ARW)	5°N-21°N 116°E-127°E	3 km (361 x 593 grids)	42	48 hours (00, 03, 06, 09, 12, 15, 18, 21 UTC)	-	Own
JMA Global Deterministic Model	Global	Track and intensity data only	-	132 hours (00, 06, 18 UTC) 264 hours (12 UTC)	-	Other
NCEP Global Deterministic Model	Global	Track data only	-	192 hours (00, 06, 12, 18 UTC)	-	Other
ECMWF Global Deterministic Model	Global	Track data only	-	240 hours (00, 12 UTC)	-	Other
UKMO Global Deterministic Model	Global	Track and intensity data only	-	120 hours (00, 12 UTC)	-	Other
KMA Global Deterministic Model	Global	Track and intensity data only	-	168 hours (00, 12 hours)	-	Other
BoM Global Deterministic Model	Global	Track and intensity data only	-	240 hours (00, 12 UTC)	-	Other
CMC Global Deterministic Model	Global	Track data only	-	144 hours (00, 12 UTC)	-	Other
CMA Global Deterministic Model	Global	Track data only	-	120 hours (00, 12 UTC)	-	Other
DWD Global Deterministic Model	Global	Track data only	-	84 hours (00, 12 UTC)	-	Other
JMA Global EPS	Global	Track and intensity data only	-	132 hours (06, 18 UTC) 264 hours (00, 12 UTC)	27	Other
NCEP Global EPS	Global	Track data only	-	384 hours (00, 06, 12, 18 UTC)	21	Other
ECMWF Global EPS	Global	Track data only	-	240 hours (00, 12 UTC)	52	Other
UKMO Global EPS	Global	Track data only	-	168 hours (00, 06, 12, 18 UTC)	36	Other
NCEP Regional Deterministic Model (HWRF)	Based on the initial position of the TC	Track and intensity data only	-	126 hours (00, 06, 12, 18 UTC)	-	Other
HKO Regional Deterministic Model (NHM)	8°N-46.5°N 85°E-148°E	Track and intensity data only	-	72 hours (00, 06, 12, 18 UTC)	-	Other

Note: Apart from HWRF, deterministic and EPS model forecasts from other centers are made available via the JMA Numerical Typhoon Prediction website (https://tynwp-web.kishou.go.jp/) or the WMO Global Telecommunication System (GTS). HWRF forecasts are available via the HWRF Forecast Guidance website (https://www.emc.ncep.noaa.gov/gc_wmb/vxt/HWRF/index.php)

References

Dvorak, V., 1984: Tropical cyclone intensity analysis using satellite data. *NOAA Tech. Rep*. NESDIS, **11**, 47 pp.

Harper, B.A., J.D. Kepert, and J.D. Ginger, 2010: Guidelines for Converting Between Various Wind Averaging Periods in Tropical Cyclone Conditions. *WMO Tech. Doc*. TD-No. **1555**, 54 pp.

Herndon, D. and C.S. Velden, 2018: An Update on the SATellite CONsensus (SATCON) Algorithm for Estimating Tropical Cyclone Intensity. *33rd Conf. Hurr. Trop. Meteor.* Ponte Vedra, FL, Amer. Meteor. Soc., **284**, https://ams.confex.com/ams/33HURRICANE/webprogram/Paper340235.html.

Kishimoto, K., 2008: Revision of JMA's Early Stage Dvorak Analysis and Its Use to Analyze Tropical Cyclones in the Early Developing Stage. *RSMC Tokyo - Typhoon Center Technical Review* No. **10**, 12 pp.

Knaff, J.A. and M. DeMaria, 2010: NOAA/NESDIS Multiplatform Tropical Cyclone Surface Wind Analysis. User Manual, 25 pp.

Knaff, J.A., C.J. Slocum, K.D. Musgrave, C.R. Sampson, and B.R. Strahl, 2016: Using Routinely Available Information to Estimate Tropical Cyclone Wind Structure. *Mon. Wea. Rev.*, **144,** 1233–1247, https://doi.org/10.1175/MWR-D-15-0267.1

Koba, H., T. Hagiwara, S. Osano and S. Akashi, 1991: Relationships between CI Number and Minimum Sea Level Pressure/Maximum Wind Speed of Tropical Cyclones. *Geophysical Magazine*, **44**, 15 - 25.

Olander, T.L. and C.S. Velden, 2007: The Advanced Dvorak Technique: Continued Development of an Objective Scheme to Estimate Tropical Cyclone Intensity Using Geostationary Infrared Satellite Imagery. *Wea. Forecasting,* **22**, 287–298, https://doi.org/10.1175/WAF975.1

Tsai, H.C. and R.L. Elsberry, 2014: Applications of situation-dependent intensity and intensity spread predictions based on a weighted analog technique. *Asia-Pacific J. Atmos. Sci.*, **50**, 507–518, https://doi.org/10.1007/s13143-014-0040-7

Velden, C.S. and L.M. Leslie, 1991: The Basic Relationship between Tropical Cyclone Intensity and the Depth of the Environmental Steering Layer in the Australian Region. *Wea. Forecasting,* **6,** 244–253, https://doi.org/10.1175/1520-0434(1991)006<0244:TBRBTC>2.0.CO;2

Velden, C.S., 1993: The relationship between tropical cyclone motion, intensity and the vertical extent of the environmental steering layer in the Atlantic basin. *20th Conf. Hurr. Trop. Meteor.,* San Antonio, TX., Amer. Meteor. Soc.

Tsuchiya, A., T. Mikawa and A. Kikuchi, 2001: Method of Distinguishing between Early Stage Cloud Systems that Develop into Tropical Storms and Ones that Do Not. *Geophysical Magazine Series 2*, **4**, 49 - 59.

Wimmers, A.J. and C.S. Velden, 2010: Objectively Determining the Rotational Center of Tropical Cyclones in Passive Microwave Satellite Imagery. *J. Appl. Meteor. Climatol.,* **49**, 2013-2034, https://doi.org/10.1175/2010JAMC2490.1

Name of the Member: **[Republic of Korea]**

1 Tropical Cyclone Analysis

Parameter	Time	Methods	Other Sources
Center Position, Central pressure, Maximum sustained wind speed, Direction and speed of movement, 15 m/s radii, 25 m/s radii	00, 06, 12, 18 UTC	(1) Satellite images (ASCAT, OSCAT etc) and other estimation methods which utilize surface observations (SYNOP, SHIP, BUOY, AWS, Radar) (2) Dvorak technique for center pressure and maximum sustained wind speed estimates (Dvorak, 1984, Koba et al., 1991)	

2 Tropical Cyclone Forecasting

Parameter	Issuance Time	Lead Time	Methods
Likelihood of development of organized convective cloud systems into TSs	00, 06, 12, 18 UTC	24 hours	EDA Consensus method using deterministic Global NWP model (GDAPS, ECMWF, NECP, JMA etc.) 850 hPa and 200 hPa streamlines and steering flow of NWP models as reference
Center position, Direction and speed of movement, Radius of probability circle, Central pressure , Maximum sustained wind speed, 15 m/s radii, 25 m/s radii	00, 06, 12, 18 UTC	12, 24, 36, 48, 72, 96, 120 hours	Center position, direction and speed of movement : (1) Consensus method using KMA Global Data Assimilation and Prediction System (GDAPS) and other deterministic Global model (ECMWF, JMA, NCEP, etc.) (2) Global EPS (EPSG, ECMWF, JMA, NCEP, etc.) as reference (3) Steering flow and Synoptic field as reference Radius of probability circle: Expected TC locations with a probability of 70% at each lead time for the latest 3 years Central pressure, maximum sustained wind speed: (1) KMA Global Data Assimilation and Prediction System (GDAPS) , other deterministic Global model (ECMWF, JMA, NCEP, etc.), Global EPS (EPSG, ECMWF, JMA, NCEP, etc.) and NCEP deterministic regional model (HWRF) as reference (2) Analysis of Sea Surface Temperature and Ocean heat content (3) Wind shear of NWP model

3 NWP Systems in Operational Use

System	Domain	Horizontal Resolution	Number of Vertical Levels	Forecast Range (Initial Time)	Number of Ensemble Members	Run by (own/other centers)
KMA Global Data Assimilation and Prediction System (GDAPS)	Global	~10 km	70	288 hours (00,12 UTC) 87 hours (06, 18 UTC)	-	Own
KMA Global EPS (EPSG)	Global	~32 km	70	288 hours (00,12 UTC)	48	Own
ECMWF deterministic Global model	Global	16 km	-	240 hours (00, 12 UTC)	-	Other
ECMWF Global EPS	Global	track data and intensity data	-	240 hours (00, 12 UTC)	51	Other
JMA deterministic Global model (GSM)	Global	~20 km	100	132 hours (00, 06, 18 UTC) 264 hours (12 UTC)	-	Other
JMA Global EPS (GEPS)	Global	~40 km	100	132 hours (06, 18 UTC) 264 hours (00, 12 UTC)	27	Other

System	Domain	Horizontal Resolution	Number of Vertical Levels	Forecast Range (Initial Time)	Number of Ensemble Members	Run by (own/other centers)
NCEP deterministic Global model (GFS)	Global	1.0°	-	168 hours (00, 06, 12, 18 UTC)	-	Other
NCEP Global EPS	Global	1.0°	-	240 hours (00, 06, 12, 18 UTC)	21	Other
NCEP deterministic regional model (HWRF)	Regional	track and intensity data	-	Up to 126 hours (00, 06, 12, 18 UTC)	-	Other
Navy Global Environmental Model (NavGEM)	Global	track and intensity data		144 hours (00,12 UTC)		Other

Annex 3-8

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, South China ~~Nanhai~~ Sea and Beibu Wan Gulf
Hong Kong, China	Hong Kong	Broadcast via NAVTEX on 518 kHz[11]	Waters inside the boundary line: 30°N 105°E to 30°N 125°E to 10°N 125°E, to 10°N 105°E, to 30°N 105°E
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	Klang	SSB 5	Strait of Malacca
	Labuan	SSB 16	South China Sea
	Kuching	SSB 5	South China Sea
Philippines	Manila	DZR, DZG, DSP, DZD, DZF, DFH, DZO, DZN, DZS	Pacific waters inside the boundary line: 25°N 12°0E to 25°N 135°E, to 5°N 135°E, to 5°N 115°E, to 15°N 115°E, to 21°N 120°E, to 20°N 120°E
	San Miguel	NPO	North Pacific waters east of 160°E; 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*

[11] Coast station VRX closed on 1 October 2006.

Annex 4

Proposed new format for satellite imagery receiving facilities (Appendix 2-G) for 2021 edition

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APPENDIX 2-G

SATELLITE IMAGERY RECEIVING FACILITIES AT TYPHOON COMMITTEE MEMBERS

Member	Station		FengYun-2	FengYun-3	FengYun-4	FengYun-2/3/4	Himawari-8/9		GEO-KOMPSAT-2A	NOAA/JPSS	AQUA/TERRA	METOP
			Direct Broadcast	Direct Broadcast	Direct Broadcast	CMAcast	HimawariCast	HimawariCloud	Direct Broadcast	Direct Broadcast	Direct Broadcast	Direct Broadcast
Cambodia							✓					
China	Beijing	39.9°N, 116.4°E	✓	✓	✓	✓		✓		✓		
DPR Korea	Pyongyang	39.0°N, 125.8°E								✓		
Hong Kong, China	Kowloon	22.3°N, 114.2°E	✓				✓			✓	✓	
Japan	Minamitorishima	24.3°N, 154.0°E					✓					
Lao PDR							✓					
Macao, China	Macao	22.2°N, 113.5°E	✓				✓			✓		
Malaysia	Petaling Jaya	3.1°N, 101.7°E					✓			✓		
Philippines	Quezon City	14.7°N, 121.0°E					✓			✓		
	Cagayan de Oro City	8.5°N, 124.6°E										
	Pasay City	14.5°N, 121.0°E										
	Cebu	10.3°N, 124.0°E										
Republic of Korea	Seoul	37.6°N, 127.0°E					✓			✓	✓	
	Incheon Int. Airport	37.3°N, 126.3°E										
	Munsan	37.9°N, 126.8°E										
	Seosan	36.8°N, 126.5°E								✓		
	Pusan	35.1°N, 129.0°E										
	Pusan Kimhae Air	35.2°N, 126.9°E										
	Kwangju	35.2°N, 126.9°E										
	Taejon	36.4°N, 127.4°E										
	Kangnung	37.5°N, 130.9°E										
	Cheju	33.5°N, 126.5°E										
	Taegu	35.9°N, 128.6°E										
	Taegu/Air Traffic	35.9°N, 128.7°E										
	Chonju	35.8°N, 127.2°E										
	Chongju	36.6°N, 127.4°E										
	Ullung-Do	37.5°N, 130.9°E										
	Mokpo	34.8°N, 126.4°E										
	Chunchon	37.9°N, 127.7°E										
	Masan	35.2°N, 128.6°E										
	Tongyong	34.9°N, 128.4°E										
	Inchon	37.5°N, 126.6°E										
	Huksando	34.7°N, 125.5°E										
	Suwon	37.3°N, 127.0°E										
	Sokcho	38.3°N, 128.6°E										

Member	Station		FengYun-2	FengYun-3	FengYun-4	FengYun-2/3/4	Himawari-8/9		GEO-KOMPSAT-2A	NOAA/JPSS	AQUA/TERRA	METOP
			Direct Broadcast	Direct Broadcast	Direct Broadcast	CMAcast	HimawariCast	HimawariCloud	Direct Broadcast	Direct Broadcast	Direct Broadcast	Direct Broadcast
	Pohang	36.0°N, 129.4°E										
	Kunsan	36.0°N, 126.7°E										
	Baengnyeong-do	37.9°N, 124.6°E										
Singapore	Changi Airport	1.4°N, 104.0°E			✓		✓			✓	✓	
Thailand	Bangkok	13.7°N, 100.6°E					✓			✓		
USA	Guam	13.4°N, 144.6°E					✓			✓		
Viet Nam	Hanoi	21.0°N, 105.5°E					✓					
	Ho Chi Ming City	10.5°N, 106.4°E								✓		

Annex 5

Draft Amendments to
the Typhoon Committee Operational Manual – Meteorological Component (TOM)
proposed by the Members (except for editorial changes)

Page	Line	Proposed Revision	Comments
Section 2.6			
10	L46	Each Member's tropical cyclone forecast center should compile reliable passage, landfall, near station passage, 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	Revision of description on passage report
Section 3.2			
11	L42	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) (WMO-No.485). These products should be made available to Members in real-time, and should include the following	Addition of document number
Section 4.4			
14	L9	Operational guidance for handling and formatting meteorological information is given in detail in the Annex ~~IV~~ VI of the WMO Technical Regulations (Manual on Marine Meteorological Services - WMO-No. 558).	Correction of the description
15	L38	(n) Expected location and intensity at 12 ~~and~~ or 24 hour time periods.	Correction of the description
16	L9	The ICAO Asia and Pacific Regions Air Navigation Plan (~~Doc 9673~~ APAC ANP) describes the FIRs in the Asia and Pacific Regions and lists the designated MWOs and the requirements for the issuance of SIGMET information (including for tropical cyclone)	Correction of the description
Appendix 2-A			
30		To be replaced by Annex 5-1	Update of stations which enable enhanced surface observation in Thailand
Appendix 2-D			
35		To be replaced by Annex 5-2	Update of the distribution of the radar stations in Thailand
Appendix 2-E			
36		To be replaced by Annex 5-3	Update of information on radar stations in Hong Kong, China; Republic of Korea and Thailand

Appendix 2-F			
61	L21	(b) Products (i) Full-Disk Observation Data: Every 10 minutes (ii) Japan Area Observation Data: Every 2.5 minutes (iii) Target Area Observation Data: Every 2.5 minutes (iv) Full-Disk AMV: Every hour (v) Full-Disk Clear Sky Radiance (CSR): Every hour (vi) AMV-based Sea-surface Wind data (ASWind) (Full-Disk) : Every 30 minutes (vii) AMV-based Sea-surface Wind data (ASWind) (Target Area) : Every 10 minutes (c) Dissemination ways (i) HimawariCloud (Internet Cloud Service) Service which distributes full-spec imagery derived from the Himawari-series satellites (https://www.data.jma.go.jp/mscweb/en/himawari89/cloud_service/cloud_service.html) (ii) HimawariCast (communication satellite dissemination service) Service which disseminates primary sets of imagery from the Himawari-series satellites via a communication satellite (https://www.data.jma.go.jp/mscweb/en/himawari89/himawari_cast/himawari_cast.html) (iii) Internet Services for National Meteorological and Hydrological Services (NMHSs) [JMA real-time satellite imagery webpage] https://www.jma.go.jp/en/gms/ [MSC (Meteorological Satellite Center) real-time satellite imagery webpage] https://www.data.jma.go.jp/mscweb/data/himawari/ [SATAID (Satellite Animation and Interactive Diagnosis) Service] https://www.wis-jma.go.jp/cms/sataid/ [JDDS (JMA Data Dissemination Service)] https://www.jma.go.jp/jma/jma-eng/satellite/jdds.html ~~https://www.data.jma.go.jp/mscweb/en/himawari89/JDDS_service/JDDS_service.html~~	Revision of information on Himawari-8/9 products and dissemination way
62	L17	4. COMS (operational since 2011 to March 2020) [Republic of Korea] (a) Observations (i) Full-Disk Observations: Every 3 hours (ii) Extended North Hemisphere Observations: Every 15 minutes (iii) Local Area Observations: Every 15 minutes	Update of information on COMS

		(b) Products (i) Full-Disk Observation Data: Every 3 hours (ii) Extended North Hemisphere Observation Data: Every 15 minutes (iii) Full-Disk AMV: Every 3 hours (c) Dissemination ways (i) Direct Broadcast Service It is not available, GK2A succeeded direct service mission. ~~(http://nmsc.kma.go.kr/html/homepage/en/ver2/static/selectStaticPage.do?view=datacenter.dataService)~~ (ii) Internet Services [National Meteorological Satellite Center website] ~~http://nmsc.kma.go.kr/jsp/homepage/eng/main.do~~ http://datasvc.nmsc.kma.go.kr/datasvc/html/main/main.do?lang=en	
63	L10	(c) Dissemination ways (i) Direct Broadcast Service ~~(http://nmsc.kma.go.kr/html/homepage/en/ver2/static/selectStaticPage.do?view=satellites.gk2a.dataServicePlan)~~ Request application form for receiving station (http://datasvc.nmsc.kma.go.kr/datasvc/html/base/cmm/selectPage.do?page=static.reqStation) (ii) Internet Services [FTP-based Service] All sixteen channels data of full-disk image will be put on KMA's FTP server designated for GEO-KOMPSAT-2A data dissemination in every 10 minutes. (Account policy: 1 account per 1 country) Need personal contact (hyunjong.oh@korea.kr) [National Meteorological Satellite Center website] ~~http://nmsc.kma.go.kr/jsp/homepage/eng/main.do~~ http://datasvc.nmsc.kma.go.kr/datasvc/html/main/main.do?lang=en	Update of information on dissemination method of GEO-KOMPSAT-2A products
Appendix 2-G			
64		To be replaced by Annex 5-4	Update of information on satellite imagery receiving facilities at Hong Kong, China; Macao, China; Republic of Korea and

			Thailand
Appendix 3-A			
69		To be replaced by Annex 5-5	Update of the NWP products and correction of the description
Appendix 3-B		3 NWP Systems in Operational Use	
79		To be replaced by Annex 5-6	Update of the information on KMA's Global EPS
Appendix 4-C			
102		To be replaced by Annex 5-7	Update of the information on the area of broadcasting cyclone warnings for ships on the high seas
Appendix 5-B			
104		To be replaced by Annex 5-8	Update of the information on telecommunicatio n networks
Appendix 5-C			
106		To be replaced by Annex 5-9	Update of the contact details of Hong Kong, China; Macao, China; Republic of Korea and Thailand
Appendix 5-E			
106		To be replaced by Annex 5-10	Update of the list of collection and distribution of information related to tropical cyclones by Hong Kong

Annex 5-1

APPENDIX 2-A

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, 302,~~ 303, ~~304, 307, 310, 315, 324, 325, 327, 328, 329, 330, 331, 333, 334, 350,~~ 351, 352, 353, ~~354, 355, 356,~~ 357, ~~358, 360, 372, 373, 374, 375, 376, 377,~~ 378, ~~379, 380, 381, 382,~~ 383, ~~384, 385, 386, 387, 390, 400, 401, 402, 403, 404, 405,~~ 407, ~~408, 409, 410, 413, 415, 416, 417, 418, 419, 420, 421, 425, 426, 427, 429, 430, 431,~~ 432, ~~433, 434, 435, 436,~~ 437, ~~438, 439, 440, 450, 451, 453, 455, 456, 458, 459, 460, 461,~~ 462, ~~464,~~ 465, ~~474, 475, 477, 478, 479,~~ 480, ~~481,~~ 500, 501, 517, ~~520, 532, 550,~~ 551, 552, ~~554, 555, 556, 557,~~ 560, ~~561, 563, 564, 565, 566, 567,~~ 568, ~~569, 570, 571, 574,~~ 580, ~~581,~~ 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

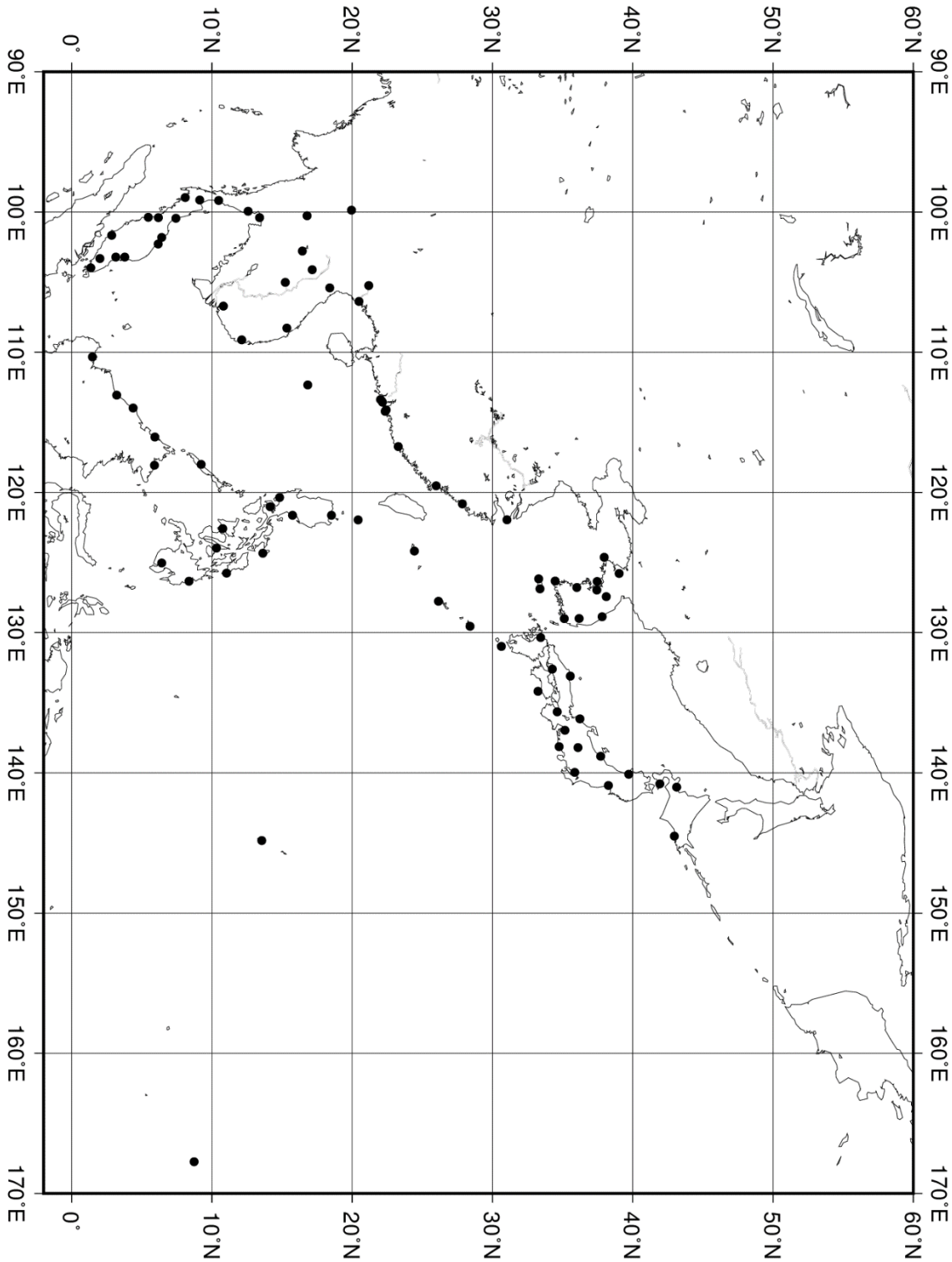
(48): 820, 826, 839, 845, 848, 855, 870, 877, 900, 914, 917, 918, 920

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

Annex 5-2

APPENDIX 2-D

DISTRIBUTION OF THE RADAR STATIONS OF TYPHOON COMMITTEE MEMBERS



Annex 5-3

TECHNICAL SPECIFICATIONS OF RADARS OF TYPHOON COMMITTEE MEMBERS

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	μs	1.0/2.0	1.0/2.0			
Sensitivity minimum of receiver	dBm	109/-112 ~~-117~~	-111/-114			
Beam width (Width of over -3dB antenna gain of maximum)	deg	0.9(H) 0.9(V)	0.9(H) 0.9(V)			
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 **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~~ 33.294329°N ~~126° 09′E~~ 126.163073° E	~~33° 23′N~~ 33.387103°N ~~126° 52′E~~ 126.879986° E	~~37° 49′N~~ 37.817669°N ~~128° 51′E~~ 128.865647° E	~~36° 00′N~~ 36.012700°N ~~126° 47′E~~ 126.784168° E	~~37° 58′N~~ 37.967549°N ~~124° 37′E~~ 124.630307° E
Antenna elevation	m	103 ~~101~~	68	99	234 ~~231~~	185 ~~188~~
Wave length	cm	10.61 ~~10.9~~	10.88	10.50	10.96	10.45 ~~5.3~~
Peak power of transmitter	kW	850 ~~750~~	850 ~~750~~	850 ~~750~~	850 ~~750~~	850 ~~250~~
Pulse length	μs	0.5, 1.0~~,~~, 2.0, 4.5	0.5, 1.0~~,~~, 2.0, 4.5	0.5, 1.0~~,~~, 2.0, 4.5	0.5, 1.0~~,~~, 2.0, 4.5	0.5, 1.0~~,~~ 2.0, 4.5
Sensitivity minimum of receiver	dBm	-114 ~~-112~~	-114 ~~-112~~	-114 ~~-112~~	-114 ~~-112~~	-114 ~~-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	240, 480 ~~250 (volume), 500 (lowest tilt)~~	240, 480 ~~250, 500~~	240, 480 ~~280, 500~~	240, 480	240 ~~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		1 ~~2~~	1 ~~2~~	1 ~~2~~	1 ~~2~~	1 ~~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 (5-minutely ~~continuous~~)	3 (5-minutely ~~continuous~~)	3 (5-minutely ~~continuous~~)	3 (5-minutely ~~continuous~~)	3 (5-minutely ~~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~~ 34.472553°N ~~126° 19′E~~ 126.323994° E	~~38° 07′N~~ 38.117316°N ~~127° 26′E~~ 127.433708° E	~~36° 10′N~~ 36.179323°N ~~128° 59′E~~ 128.997319° E	~~37° 26′N~~ 37.444119°N ~~126° 57′E~~ 126.963994° E	~~35° 07′N~~ 35.118694°N ~~128° 59′ E~~128.999744°E
Antenna elevation	m	497	1066 ~~1064~~	1136 ~~1127~~	641 ~~640~~	549 ~~547~~
Wave length	cm	10.37	10.38	10.99 ~~5.3~~	11.03	11.05
Peak power of transmitter	kW	850 ~~750~~	850 ~~750~~	850 ~~250~~	850	850
Pulse length	μs	0.5, 1.0, 2.0, 4.5 ~~1.0; 2.5~~	0.5, 1.0, 2.0, 4.5 ~~1.0; 4.5~~	0.5, 1.0 2.0, 4.5 ~~0.83; 2.5~~	0.5, 1.0, 2.0, 4.5 ~~1.0; 4.5~~	0.5, 1.0, 2.0, 4.5 ~~1.0; 4.5~~
Sensitivity minimum of receiver	dBm	-114 ~~-112~~	-114 ~~-112~~	-114 ~~-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	240, 480 ~~250, 500~~	240, 480 ~~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		1 ~~2~~	1 ~~2~~	1 ~~2~~	1 ~~2~~	1 ~~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 (5-minutely ~~continuous~~)	3 (5-minutely ~~continuous~~)	3 (5-minutely ~~continuous~~)	3 (5-minutely~~c~~ ~~ontinuous~~)	3 (5-minutely ~~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	μs	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	130, 428 ~~30, 480~~				
Scan mode in observation 1. Fixed elevation 2. CAPPI 3. Manually controlled		1, 2				
DATA PROCESSING						
MTI processing 1.Yes, 2.No		1 ~~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 **Thailand - 1**

NAME OF STATION		Chiang Rai	Sakol Nakon ~~Lamphun~~	Phitsanulok ~~Sakol Nakon~~	Khon Khaen ~~Phitsanulok~~	Ubon Ratchathani ~~Khon Khaen~~
SPECIFICATIONS	Unit					
Index number		48303	~~48356~~ ~~48329~~	48378 ~~48356~~	48378 ~~48378~~	48407 ~~48381~~
Location of station		19° 57′ N 99° 52′ E	17° 09′ N ~~18° 34′ N~~ 104° 07′ E ~~99° 02′ E~~	16° 47′ N ~~17° 09′ N~~ 100° 16′ E ~~104° 07′ E~~	16° 27′ N ~~16° 47′ N~~ 102° 47′ E ~~100° 16′ E~~	15° 14′ N ~~16° 27′ N~~ 105° 01′ E ~~102° 47′ E~~
Antenna elevation	m	440	198 ~~337~~	56 ~~198~~	215 ~~56~~	155 ~~215~~
Wave length	cm	5	5	5	5	5
Peak power of transmitter	kW	300	300	300	300	300
Pulse length	μs	0.8&2	0.8&2	0.8&2	0.8&2	0.8&2
Sensitivity minimum of receiver	dBm	-110	-110	-110	-106 ~~-110~~	-108 ~~-106~~
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	240	240	240	240
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		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

Name of the Member **Thailand - 2**

NAME OF STATION		Samut Songkram ~~Chainat~~	Hua Hin ~~Ubon Ratchathani~~	Chumporn ~~Samut Songkram~~	Surat Thani ~~Hua Hin~~	Krabi ~~Chumporn~~
SPECIFICATIONS	Unit					
Index number		48438 ~~48402~~	48475 ~~48407~~	48517 ~~48438~~	48551 ~~48475~~	48563 ~~48517~~
Location of station		13° 24´ N ~~15° 09´ N~~ 100° 24´ E ~~100° 41´ E~~	12° 35´ N ~~15° 14´ N~~ 99° 57´ E ~~105° 01´ E~~	10° 29´ N ~~13° 24´ N~~ 99° 11´ E ~~100° 24´ E~~	9° 08´ N ~~12° 35´ N~~ 99° 09´ E ~~99° 57´ E~~	8° 06´ N ~~10° 29´ N~~ 98° 58´ E ~~99° 11´ E~~
Antenna elevation	m	29 ~~45~~	30 ~~155~~	28 ~~29~~	33 ~~30~~	51 ~~28~~
Wave length	cm	5	10 ~~5~~	5	5 ~~10~~	5
Peak power of transmitter	kW	300	500 ~~300~~	300	300 ~~500~~	300
Pulse length	μs	0.8&2	0.8&2	0.8&2	0.8&2	0.8&2
Sensitivity minimum of receiver	dBm	-110	-106 ~~-108~~	-110	-110 ~~-106~~	-106 ~~-110~~
Beam width (Width of over -3dB antenna gain of maximum)	deg	1.0	2.1 ~~1.0~~	1.0	1.0 ~~2.1~~	1.0
Detection range	km	240	240	240	240	240
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		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

Name of the Member **Thailand - 3**

NAME OF STATION		Sathing Pra (Songkla) ~~Surat Thani~~	Narathiwat ~~Krabi~~	~~Phuket~~	~~Sathing Pra (Songkla)~~	~~Narathiwat~~
SPECIFICATIONS	Unit					
Index number		48568 ~~48551~~	48583 ~~48563~~	~~48565~~	~~48568~~	~~48583~~
Location of station		7° 26′ N ~~9° 08′ N~~ 100° 27′ E ~~99° 09′ E~~	6° 25′ N ~~8° 06′ N~~ 101° 49′ E ~~98° 58′ E~~	~~8° 08′ N~~ ~~98° 19′ E~~	~~7° 26′ N~~ ~~100° 27′ E~~	~~6° 25′ N~~ ~~101° 49′ E~~
Antenna elevation	m	30 ~~33~~	29 ~~51~~	~~281~~	~~30~~	~~29~~
Wave length	cm	5	5	~~5~~	~~5~~	~~5~~
Peak power of transmitter	kW	300	300	~~300~~	~~300~~	~~300~~
Pulse length	μs	0.8&2	0.5&1 ~~0.8&2~~	~~0.8&2~~	~~0.8&2~~	~~0.5&1~~
Sensitivity minimum of receiver	dBm	-115 ~~-110~~	-110 ~~-106~~	~~-106~~	~~-115~~	~~-110~~
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	120 ~~240~~	~~240~~	~~240~~	~~120~~
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		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~~

Annex 5-4

Appendix 2-G
SATELLITE IMAGERY RECEIVING FACILITIES AT TYPHOON COMMITTEE MEMBERS

Member	Station		Himawari 1. HimawariCloud 2. HimawariCast	NOAA 1. HRPT 2. APT	Meteosat 1. P-DUS
Cambodia			1, 2		
China	Beijing	39.9°N, 116.4°E	1	1	
DPR Korea	Pyongyang	39.0°N, 125.8°E		1	
Hong Kong, China[12]	Kowloon	22.3°N, 114.2°E	1, 2	1	
Japan	Minamitorishima	24.3°N, 154.0°E	2		
Lao PDR			2		
Macao, China[13]	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	14.7°N, 121.0°E	1, 2	1	
	Cagayan de Oro City	8.5°N, 124.6°E			
	Pasay City	14.5°N, 121.0°E			
	Cebu	10.3°N, 124.0°E			
Republic of Korea[14]	Jinchoen ~~Seoul~~	36.7°N, 127.4°E ~~37.6°N, 127.0°E~~	1, 2	1	1
	~~Incheon Int. Airport~~	~~37.3°N, 126.3°E~~			
	~~Munsan~~	~~37.9°N, 126.8°E~~			~~1~~
	~~Seosan~~	~~36.8°N, 126.5°E~~		~~1~~	
	~~Pusan~~	~~35.1°N, 129.0°E~~			
	~~Pusan Kimhae Air~~	~~35.2°N, 126.9°E~~			
	~~Kwangju~~	~~35.2°N, 126.9°E~~			
	~~Taejon~~	~~36.4°N, 127.4°E~~			
	~~Kangnung~~	~~37.5°N, 130.9°E~~			
	~~Cheju~~	~~33.5°N, 126.5°E~~			
	~~Taegu~~	~~35.9°N, 128.6°E~~			
	~~Taegu/Air Traffic~~	~~35.9°N, 128.7°E~~			
	~~Chonju~~	~~35.8°N, 127.2°E~~			
	~~Chongju~~	~~36.6°N, 127.4°E~~			
	~~Ullung-Do~~	~~37.5°N, 130.9°E~~			
	~~Mokpo~~	~~34.8°N, 126.4°E~~			
	~~Chunchon~~	~~37.9°N, 127.7°E~~			
	~~Masan~~	~~35.2°N, 128.6°E~~			
	~~Tongyong~~	~~34.9°N, 128.4°E~~			
	~~Inchon~~	~~37.5°N, 126.6°E~~			
	~~Huksando~~	~~34.7°N, 125.5°E~~			
	~~Suwon~~	~~37.3°N, 127.0°E~~			
	~~Sokcho~~	~~38.3°N, 128.6°E~~			
	~~Pohang~~	~~36.0°N, 129.4°E~~			
	~~Kunsan~~	~~36.0°N, 126.7°E~~			
	~~Baengnyeong-do~~	~~37.9°N, 124.6°E~~			
Singapore[15]	Changi Airport	1.4°N, 104.0°E	1, 2	1	1

[12] Hong Kong, China receives AQUA (MODIS), SNPP (CrIs, VIIRS, ATMS), FY-2 (S-VISSR), FY3B (VIRR, MERSI), FY3C (VIRR, MWHS, MWRI) and FY3D (MERSI-2, MWHS, MWTS, MWRI), FY4A (GIIRS, LMI, AGRI), GeoKompSAT-2A (AMI), GOES-E and GOES-W (ABI), Meteosat-8 (SEVIRI), and Meteosat-11 (SEVIRI) and TERRA (MODIS), METOP-A ,~~and~~ METOP-B and METOP-C (AMSU-A, AVHRR, HIRS, MHS).

[13] Macao, China receives FY-2G ~~FY-2D, FY-2E~~ (S-VISSR) Stretched VISSR.

[14] Republic of Korea receives AQUA (MODIS, AIRS, AMSU, AMSR-E) and TERRA (MODIS).

[15] Singapore receives AQUA (MODIS), FY-2B (S-VISSR) and TERRA (MODIS).

Thailand[16]	Bangkok	13.7°N, 100.6°E	1, 2	~~1~~	
USA	Guam	13.4°N, 144.6°E	1	1	
Viet Nam	Hanoi	21.0°N, 105.5°E	1, 2	2	
	Ho Chi Ming City	10.5°N, 106.4°E		2	

[16] Thailand receives FY-2C

Annex 5-5

APPENDIX 3-A

PRODUCTS PROVIDED BY RSMC TOKYO - TYPHOON CENTER

NWP products (GSM and GEPS) provided by RSMC Tokyo - Typhoon Center
(Available at https://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	GEPS	GEPS
Area and resolution	Whole globe, 2.5°×2.5°	Whole globe, 1.25°×1.25
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	250 hPa: μU, σU, μV, σV, μW,σW 500 hPa: μZ, σZ 850 hPa: μU, σU, μV, σV, μT, σT, μW, σW ,Probability of temperature anomalies [±1, ±1.5, ±2σ] 1000 hPa: μZ, σZ Surface: μP, σP, Probability of 10 m sustained wind and gusts [10,15,25 m/s]†, Probability of precipitation [1,5,10,25,50,100 mm/24hour]†
Forecast hours	0 - 192 every 12 hours	0 - 264 every 12 hours † Except analysis
Initial times	00, 12UTC	00, 12 UTC

Model	GSM	GSM	GSM
Area and resolution	5°S-90°N and 30°E-165°W, Whole globe 0.25° × 0.25°	5°S-90°N and 30°E-165°W, Whole globe 0.5° × 0.5°	Whole globe, 1.25°×1.25°
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	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, ζ, Div 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, ζ, Div 850 hPa: Z, U, V, T, H, ω, ψ, χ 925 hPa: Z, U, V, T, H, ω, ζ, Div 1000 hPa: Z, U, V, T, H, ω Surface: P, U, V, T, H, R†
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	0 - 132 every 6 hours and 144 - 264 every 12 hours for 12UTC initial † Except analysis
Initial times	00, 06, 12, 18 UTC	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)
Div: divergence W:wind speed

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.

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
RSMC Advisories		
RSMC TC Advisory	At least 8 times/day	• RSMC Tokyo - Typhoon Center's TC analysis~~, track forecast~~ and ~~intensity~~ forecasts up to 120-hours (linked to the JMA~~'s~~ website~~:~~ at https://www.jma.go.jp/en/typh/)
Storm Wind Probability Map	4 times/day	• Probabilistic forecast map for sustained wind upward of 50-kt ~~with forecast time of~~ for 1, 2, 3, 4 and 5 days ahead
Prognostic Reasoning	4 times/day	• RSMC Tokyo Tropical Cyclone Prognostic Reasoning (WTPQ3X)
Operational Remarks ~~Advance notice~~		• Advance notice on TC status change from RSMC Tokyo – Typhoon Center
Graphical TC Advisory	4 times/day	• Graphical TC Advisory including RSMC Tokyo - Typhoon Center's TC analysis, track and intensity forecasts up to 24-hours and horizontal extents of cumulonimbus cloud and cloud top height associated with TCs potentially affecting aviation safety (linked to the Tropical Cyclone Advisory Center Tokyo ~~W~~website at~~:~~ https://www.data.jma.go.jp/fcd/tca/data/index.html)
Remote S~~s~~ensing		
Satellite 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 l~~i~~magery	Up to 142 times/day	• Satellite imagery of Himawari-8/9 (linked to the JMA~~'s~~ website~~:~~ at https://www.jma.go.jp/en/gms/smallc.html?area=6&element=0&mode=UTC)
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
Sea-surface AMV (ASwind)	Every 10 / 30 minutes	• AMV-based Sea-surface Wind in the vicinity of TC (linked to the Meteorological Satellite Center~~'s~~ web site~~:~~ at http://www.data.jma.go.jp/mscweb/en/product/product/aswind/monitor/aswind.php)
Radar Composite Imagery	Every hour	• Radar composite imagery of the Typhoon Committee Regional Radar Network
Atmospheric Circulation		
Weather Charts	4 times/day	• Weather maps for surface analysis, 24- and 48-hour forecasts (linked to the JMA~~'s~~ website~~:~~ at https://www.jma.go.jp/en/g3/)
NWP Multi Center Weather Charts	Twice/day	• Mean sea level pressure and 500 hPa Geopotential height (up to 168 hours) of deterministic NWP models from nine centers (BoM, CMA, CMC, DWD, ECMWF, KMA, NCEP, UKMO and JMA)
JMA GSM Analysis and Forecast	4 times/day	• Upper-air analysis and forecast data based on JMA-GSM - Streamlines at 850, 500 and 200 hPa - Divergence at 200 hPa - Velocity potential at 200 hPa - Vertical Velocity in Pressure Coordinate at 500 hPa - Dew Point Depression at 600 hPa - Curvature Vorticity at 850 hPa - Vertical wind shear between 200 and 850 hPa - Sea Level Pressure - Genesis Potential Index
MJO phase diagram	~~Monthly~~ Daily	• MJO phase and amplitude diagram and MJO Hovmöller~~Havmoller~~ diagram (linked to the Tokyo Climate Center ~~JMA's~~ web sites: https://ds.data.jma.go.jp/tcc/tcc/products/clisys/mjo/monitor.html

Products	Frequency	Details
		https://ds.data.jma.go.jp/tcc/tcc/products/clisys/ASIA_TCC/mjo_cross.html)
Asian Monsoon Monitoring Indices	Daily, only during Apr. - Oct.	• Time series of vertical wind shear, OLR and other indices associated with SW Asian Monsoon (linked to the Tokyo Climate Center web site: https://ds.data.jma.go.jp/tcc/tcc/products/clisys/ASIA_TCC/monsoon_index.html ~~JMA's web sites~~)
Ocean Condition		
SST	Once/day	• Sea surface temperature and related ~~its~~ related differences from 24 hours ago
TCHP	Once/day	• Tropical cyclone heat potential and ~~its~~ related differences from 24 hours ago
Numerical TC Prediction		
Track Forecast Bulletin	4 times/day	• RSMC Tokyo Tropical Cyclone Track Forecast Bulletin - Track forecast by ~~deterministic~~ GSM (FXPQ2X) - Track forecast by GEPS (FXPQ3X)
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~~ EPS models from four centers (ECMWF, NCEP, UKMO and JMA)
TC Activity Prediction	Twice/day	• Two- and five-day TC activity prediction maps based on ~~ensemble NWP~~ EPS models from four centers (ECMWF, UKMO, NCEP and JMA) and a related consensus
Marine Forecast		
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~~)
Ocean Wave Forecasts	Twice/day	• Distribution maps for ~~of~~ ensemble mean, maximum, probability of exceeding various thresholds and ensemble spread of wave height and period based on the Wave Ensemble System (WENS) (up to 264 hours ~~ahead~~) • Time-series representations with ~~of~~ box-and-whisker plots for ~~of~~ wave height/ ~~and~~ period~~,~~ and probability of exceeding various ~~thresholds of~~ wave height/ ~~and~~ period thresholds based on the WENS (up to 264 hours ~~ahead~~)

Deterministic NWP models used in the Numerical Typhoon Prediction website

System	Domain	Horizontal Resolution	Number of Vertical Levels	Forecast Range (Initial Time)	Specification of (Model/Data)
JMA deterministic Global model (GSM)	Global	TL959 (~20 km)	100	132 hours (00, 06, 18 UTC) 264 hours (12 UTC)	Model
BoM deterministic Global model (ACCESS-G)	Global	Lon: 0.35° Lat: 0.23°	-	240 hours (00, 12UTC)	Data
CMA deterministic Global model (GRAPES_GFS)	Global	0.28°	-	120 hours (00, 12, UTC)	Data
CMC deterministic Global model (GDPS)	Global	1.0°	-	144 hours (00, 12UTC)	Data
DWD deterministic Global model (ICON~~GME~~)	Global	0.25°	-	174 hours (00, 12UTC)	Data
ECMWF deterministic Global model (IFS-HRES)	Global	0.5°	-	240 hours (00, 12 UTC)	Data
KMA deterministic Global model (GDAPS)	Global	Lon: 0.23° Lat: 0.16°	-	168 hours (00, 12UTC),	Data
NCEP deterministic Global model (GFS)	Global	0.5°	-	192 hours (00, 06, 12, 18 UTC)	Data
UKMO deterministic Global model	Global	Lon: 0.83° Lat: 0.56°	-	120 hours (00, 12 UTC)	Data

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APPENDIX 3-B

Analysis methods, forecasting methods and NWP for forecasting currently used by the NMSs of Typhoon Committee Members

Name of the Member: **[Republic of Korea]**

3 NWP Systems in Operational Use

System	Domain	Horizontal Resolution	Number of Vertical Levels	Forecast Range (Initial Time)	Number of Ensemble Members	Run by (own/other centers)
KMA Global Data Assimilation and Prediction System (GDAPS)	Global	~10 km	70	288 hours (00,12 UTC) 87 hours (06, 18 UTC)	-	Own
KMA Global EPS (EPSG)	Global	~32 km	70	288 hours (00,12 UTC)	~~2548~~	Own
ECMWF deterministic Global model	Global	16 km	-	240 hours (00, 12 UTC)	-	Other
ECMWF Global EPS	Global	track data and intensity data	-	240 hours (00, 12 UTC)	51	Other
JMA deterministic Global model (GSM)	Global	~20 km	100	132 hours (00, 06, 18 UTC) 264 hours (12 UTC)	-	Other
JMA Global EPS (GEPS)	Global	~40 km	100	132 hours (06, 18 UTC) 264 hours (00, 12 UTC)	27	Other
NCEP deterministic Global model (GFS)	Global	1.0°	-	168 hours (00, 06, 12, 18 UTC)	-	Other
NCEP Global EPS	Global	1.0°	-	240 hours (00, 06, 12, 18 UTC)	21	Other
NCEP deterministic regional model (HWRF)	Regional	track and intensity data	-	Up to 126 hours (00, 06, 12, 18 UTC)	-	Other
Navy Global Environmental Model (NavGEM)	Global	track and intensity data		144 hours (00,12 UTC)		Other

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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, South China Sea and Beibu Wan Gulf
Hong Kong, China	Hong Kong	Broadcast via NAVTEX on 518 kHz[17]	Waters inside the boundary line: 30°N 105°E to 30°N 125°E to 10°N 125°E, to 10°N 105°E, to 30°N 105°E
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	Klang	SSB 5	Strait of Malacca
	Labuan	SSB 16	South China Sea
	Kuching	SSB 5	South China Sea
Philippines	Manila	DZR, DZG, DSP, DZD, DZF, DFH, DZO, DZN, DZS	Pacific waters inside the boundary line: 25°N 12°0E to 25°N 135°E, to 5°N 135°E, to 5°N 115°E, to 15°N 115°E, to 21°N 120°E, to 20°N 120°E
	San Miguel	NPO	North Pacific waters east of 160°E; 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 Waters inside the boundary line: 43°N 120°E to 43°N 132°E to 27°N 132°E, to 27°N 120°E, to 43°N 120°E
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

[17] Coast station VRX closed on 1 October 2006.

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*

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APPENDIX 5-B

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

1. Main Telecommunication Network	Present Operational Status
Beijing - Tokyo	Cable (MPLS), WMO FTP Beijing 16 Mbps/Tokyo 10 Mbps
Beijing - Offenbach	Cable (MPLS), TCP/IP Beijing 16 Mbps/Offenbach 50 Mbps
Washington - Tokyo	Internet, TCP/IP ~~Cable (MPLS), TCP/IP~~ ~~Washington 50 Mbps/Tokyo 10 Mbps~~
2. Main regional circuit	
Tokyo - Bangkok	Cable (MPLS), TCP/IP Tokyo 6 Mbps/Bangkok 3 Mbps ~~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), 20 Mbps ~~4 Mbps~~ TCP/IP CMACast (Satellite broadcast)
Beijing - Macao	20 Mbps 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) and Mobile leased line
Tokyo - Hong Kong	Cable (MPLS), WMO FTP ~~TCP/IP~~ Tokyo 6 Mbps/Hong Kong 1 Mbps
Tokyo - Seoul	Cable (MPLS), WMO FTP 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
Tokyo - Manila	Cable (MPLS), TCP/IP Tokyo 6 Mbps/Manila 64 kbps

5. RTH radio broadcast

Bangkok	1 FAX
Tokyo	1 FAX

6. Satellite broadcast

Operated by China: CMACast	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

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APPENDIX 5-C

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

Centre	Mailing address	Telex/cable, Telephone, fax numbers
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	Pochentong	Tel/Fax: (+855) 23 66193 66192 NMC 66191 Airport
China		
National Meteorological Center China Meteorological Adm. (Director: Wang Jianjie)	No. 46 Zhongguancun Nandajie, Beijing 100081	Tel.: (+86) (10) 5899 3198 Cable: 2894 Fax: (+86) (10) 6217 2909 E-mail: wangjj@cma.gov.cn
Democratic People's Republic of Korea		
Mr Ko Sang Bok Director Central Forecast Research Institute 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~~Ms. M.K. Song)	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: mksong~~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, VIENTIANE	P.O. Box 811 Vientiane	Telex: 4306 ONU VTELS Cable: UNDEVPRO
Macao, China		
Meteorological and Geophysical Bureau (Acting Director: Leong Weng Kun ~~Tang Iu Man~~)	Rampa do Observatório, Taipa Grande, Macau, China ~~P.O. Box 93 Macao, China~~	Tel.: (+853) 88986173 Fax: (+853) 28850773 E-mail: meteo@smg.gov.mo
Malaysia		
Malaysian Meteorological Department (National Weather & Geophysics Operation Centre) (Director: Dr. Mohd. Hisham)	Jalan Sultan 46667 Petaling Jaya Selangor Malaysia	Tel.: (+60) (3) 7967 8118 (+60) (3) 7967 8119 Fax: (+60) (3) 7955 0964 E-mail: hisham@met.gov.my

Centre	Mailing address	Telex/cable, Telephone, fax numbers
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)
Typhoon Committee Secretariat		
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 (Dong Jin KIM, Meteorologist in charge) ~~(Director: Deok Hwan JEONG)~~	2 Seoseongro 810-gil, Namwon-eup, eogwipo, Jeju, 63614, Republic of Korea	Tel.: (+82) (70) 7850-6365 ~~Tel.: (+82) (70) 7850-6351~~ Fax: (+82) (64) 805-0368
Thailand		
Thai Meteorological Department (Group Cptain: Somsak Khaosuwan) ~~(Director-General: Dr. Phuwieng Prakhammintara)~~	4353 Sukhumvit Road Bangna, Bangkok 10260	Tel&FAX: (+66) (2) 398 9875 E-mail: tmd_inter@tmd.go.th
Weather Forecast Division Thai Meteorological Department (Director: Mr. Maytee Mahayosananta ~~Dr. Sugunyanee Yavinchan)~~	4353 Sukhumvit Road Bangna, Bangkok 10260	Tel&Fax: (+66) (2) 399 4001 E-mail: m_maytee9@yahoo.com ~~sugunyanee@hotmail.com~~
South East Asia Meteorological Telecommunication Center ~~Telecommunications Division~~ Thai Meteorological Department (Director: Mrs. Wattana Singtuy) ~~(Director: Mr. Sumreang Monkong)~~	4353 Sukhumvit Road Bangna, Bangkok 10260	Tel.: (+66) (2) 399 4555 Fax: (+66) (2) 398 9861 E-mail: gtsbkk@metnet.tmd.go.th ~~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

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APPENDIX 5-E

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	
	IUDC01	VHHH	HH	HH	HH	O							
	IUDC02	VHHH	HH	HH	HH	O							
	IUDC03	VHHH	HH	HH	HH	O							
	IUDC04	VHHH	HH	HH	HH	O							
	IUDC05	VHHH	HH	HH	HH	O							
	IUDC06	VHHH	HH	HH	HH	O							
	IUDC07	VHHH	HH	HH	HH	O							
	IUDC08	VHHH	HH	HH	HH	O							
	IUDC09	VHHH	HH	HH	HH	O							
	IUDC10	VHHH	HH	HH	HH	O							
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	
Continued to	SCCI60	BCGZ	HH	O	BJ				BB	BB	BB	BB	
the next page	SBHK20	VHHH	HH	HH	BJ	O	TD		BB	BB	BB	BB	HH

Type of Data	Heading		Receiving station										
			TD	BJ	BB	HH	MM	SL	NN	KK	IV	PP	MC
Enhanced	ISBC01	VHHH	HH	HH	HH	O	TD	TD		BB	BB	BB	
radar	ISBC01	RJTD	O	TD	TD	TD	TD	TD		BB	BB	BB	
observation	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	
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								
	FXPQ30	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	FXPQ31	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	FXPQ32	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	FXPQ33	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	FXPQ34	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	FXPQ35	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	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							
	FXPN03	RKSL				TD		O					

Type of Data	Heading		Receiving station										
			TD	BJ	BB	HH	MM	SL	NN	KK	IV	PP	MC
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	
	WTPQ20	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	WTPQ21	RJTD	O	TD	TD	TD	TD	TD	BB	BB	BB	BB	
	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 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