ECONOMIC AND SOCIAL COMMISSION
FOR ASIA AND THE PACIFIC
AND
WORLD METEOROLOGICAL ORGANIZATION

WRD/TC.43/5.1 Add. 1
18 January 2011

Typhoon Committee
Forty Third Session
17 to 22 January 2011
Jeju, Republic of Korea

# REPORT ON AMENDMENTS TO THE TYPHOON COMMITTEE OPERATIONAL MANUAL

(Item 5 of the Provisional Agenda)

Submitted by the Rapporteur

## Introduction

1. The Typhoon Committee Operational Manual - Meteorological Component (TOM) has been reviewed and updated every year since its first issue in 1987. The 2010 edition was completed and posted on the WMO website in March 2010 in accordance with the approval of amendments to the previous issue by the 42nd session of the Typhoon Committee (25 to 29 January 2010, Singapore).

2. At the 42nd session, the Committee decided that the rapporteur of the Japan Meteorological Agency (JMA) would continue arrangements for updating the TOM. In this connection, on 15 September 2010, the rapporteur, Mr Masashi Kunitsugu, Head of the JMA National Typhoon Center invited the focal points of the meteorological component of the Members to provide proposals for updates to the TOM.

3. As of the end of December 2010, proposals for updates to the TOM had been submitted by the five focal points of Hong Kong - China, Japan, Macao - China, Malaysia and Thailand.

4. Proposed amendments to the TOM are attached as Annex 1 and given below are the major points of the amendments:

- Inclusion of guidelines for converting between various wind averaging periods in tropical cyclone conditions (Chapter 1 and a new appendix 1-A)
- Update of information on RADOB and SAREP reports (Chapter 2)
- Update of information on telecommunication network (Chapter 5)
- Update of information on technical specifications of radars in Japan, Macao - China (Appendix 2-D)
- Update of outline of RSMC Tokyo tropical cyclone prediction models (Appendix 3-A)
- Update of information on operational typhoon track forecast methods of Hong Kong - China (Appendix 3-B)
- Update of outline of HKO models (Appendix 3-E)
- Adding weather forecast area of Malaysia (4-B)
- Update of contact list of Hong Kong – China, Japan and Malaysia (Appendix 5-A)
- Update of data distribution tables (Appendix 5-C)

## Action Proposed

5. The Committee is invited to:

(a) Note the information given in this document,

(b) Review and approve the proposed amendments to the TOM attached as Annex 1 with necessary modifications.

**Annex 1**

**Draft Amendments to**
**the Typhoon Committee Operational Manual – Meteorological Component (TOM)**
**proposed by the Members**

| Page | Line | Present Description | Proposed Amendment |
|---|---|---|---|
| Chapter 1 | | | |
| | | *<<Meaning of terms>>*<br>Maximum sustained wind: | Maximum sustained wind*:<br>* For converting the wind speeds of different averaging periods such as 1-min, 2-min, 3-min and 10-min, Tropical Cyclone Programme of WMO recommends to follow the guidelines as shown in the Appendix 1-B.<br>*<<New document to be inserted as Appendix 1-B (see Annex 1-1)>>* |
| Chapter 2 | | | |
| 8 | 8 | *<<Ship and buoy observations>>*<br>JPBN, JGQH, JDWX, JIVB and JCCX | JPBN and JGQH |
| 8 | 12 | JMA research vessels JGQH, JDWX, JIVB and JCCX | JMA research vessel JGQH |
| 8 | 33 | *<<Radar observations>>*<br>Reports will be coded in the RADOB code (FM 20-VIII) | Reports will be coded in the BUFR code (FM-94) with RADOB Template (TM316050) and/or the RADOB code (FM 20-VIII) |
| 9 | 14 | *<<SAREP reports>>*<br>2.4.2 SAREP reports | *<<to be replaced by>>*<br>New document (see Annex 1-2) |
| Chapter 3 | | | |
| 15 | Table 3.3 | *<<List of other RSMC products>>*<br>MTSAT-1R<br><br>(a) Surface data<br><br>(b) Upper-air data | MTSAT-2<br><br>(a) Surface data (TAC/TDCF)<br>(b) Upper-air data (TAC/TDCF) |
| Chapter 4 | | | |
| 18 | 25 | *<<Warnings and advisories for aviation>>*<br>In the special case of SIGMET messages for tropical cyclones, an outlook should be included, giving information for up to 24 hours ahead concerning the expected positions of the centre of the tropical cyclone. | *<<to be deleted>>* |
| 18 | 40 | , to be used in the preparation of the outlook part of the SIGMET messages for tropical cyclones | *<<to be deleted>>* |

| | | | |
|---|---|---|---|
| Chapter 5 | | | |
| 21 | Table 5.1 | *<<Telecommunication>>*<br>Beijing - Tokyo<br>Cable (MPLS), 1 Mbps TCP/IP<br>Beijing 2 Mbps/Tokyo 3 Mbps | Beijing - Tokyo<br>Cable (MPLS), TCP/IP<br>Beijing 3 Mbps/Tokyo 3 Mbps |
| 21 | | Bangkok - Beijing<br>Cable, 9600 bps X.25 | Bangkok - Beijing<br>Cable (IPLC), 64 kbps, FTP protocol |
| 21 | | Bangkok - Hanoi<br>Cable, 1200 bauds | Bangkok - Hanoi<br>Cable (IPLC), 64 kbps, FTP protocol |
| 21 | | Bangkok - Phnom Penh<br>Internet, IP VPN | Bangkok - Phnom Penh<br>Internet (VPN) |
| 21 | | Bangkok - Vientiane<br>DDN, 64 kbps, FTP Protocol | Bangkok - Vientiane<br>Cable (DDN), 64 kbps, FTP protocol |
| 22 | | Bangkok - Kuala Lumpur<br>Cable (FR), 64 kbps/CIR 16 | Bangkok - Kuala Lumpur<br>Cable (IP-VPN), 64 kbps, socket |
| 22 | | Bangkok - Singapore<br>Cable (FR), 16 kbps | Bangkok - Singapore<br>Cable (IP-VPN), 64 kbps, socket |
| Appendix 2-A | | | |
| 32 | 23 | *<<List of surface observations>>*<br>Thailand<br>432, 455, 456 | Thailand<br>432, 453, 456 |
| Appendix 2-B | | | |
| 33 | | *<<List of upper-air observations>>* | *<<to be replaced by>>*<br>New document (see Annex 1-3) |
| Appendix 2-D | | | |
| 40-42 | | *<<Technical Specs of Radars, Japan>>* | *<<to be replaced by>>*<br>New document (see Annex 1-4) |
| 43 | | *<<Technical Specs of Radars, Macao, China>>* | *<<to be replaced by>>*<br>New document (see Annex 1-5) |
| Appendix 2-E | | | |
| 60 | 33 | *<<Schedule of MTSAT Observations and Disseminations>>*<br>Technical specification of LRIT is given in JMA LRIT Mission Specification Implementation (Issue 6, 1 Jan. 2003). | *<<to be replaced by>>*<br>Visible imagery of full earth's disk of normalized geostationary projection has been disseminated via LRIT since 1 July, 2010. Technical specification of LRIT is given in JMA LRIT Mission Specification Implementation (Issue 7, 1 Jul. 2010). |
| 61-66 | | *<<MTSAT-1R Imaging and Dissemination Schedule>>*<br>Fig 2-E | *<<to be replaced by>>*<br>New document (see Annex 1-6) |
| Appendix 2-F | | | |
| 68 | footnote | *<<Satellite Imagery Receiving Facilities>>*<br>* Macao, China receives AQUA (MODIS), FY-1D (CHRPT), FY-2C&2D (S-VISSR) and TERRA (MODIS). | *<<to be replaced by>>*<br>* Macao, China receives AQUA (MODIS), FY-1D (CHRPT), FY-2 (S-VISSR) and TERRA (MODIS). |

| | | | |
|---|---|---|---|
| Appendix 3-A | | | |
| 70-71 | | *<<Outline of RSMC Tokyo - Tropical Cyclone Prediction Models>>* | *<<to be replaced by>>*<br>New document (see Annex 1-7) |
| Appendix 3-B | | | |
| 77 | | *<<Operation Typhoon Track Forecast Methods, Hong Kong, China>>* | *<<to be replaced by>>*<br>New document (see Annex 1-8) |
| Appendix 3-E | | | |
| 135 | | *<<Outline of HKO - Operational Regional Spectral Model>>*<br>*Operational Regional Spectral Model*<br>*(B) From FY-2C meteorological satellite of CMA*<br>*FY-2C IR1 brightness temperature data* | *<<to be replaced by>>*<br>*(1) Operational Regional Spectral Model*<br>New document (see Annex 1-9)<br>*(B) From FY-2E meteorological satellite of CMA*<br>*FY-2E IR1 brightness temperature data* |
| 137-138 | | | *<<to be inserted by>>*<br>New document (see Annex 1-10) |
| Appendix 5-A | | | |
| 154 | | *<<Hong Kong, China>>*<br>(Attn. Mr. Edwin S.T. Lai)<br>stlai@hko.gov.hk | (Attn. Mr. K.C. Tsui)<br>E-mail: kctsui@hko.gov.hk |
| 154 | | *<<Japan>>*<br>(Director: K. Takase) | (Director: A. Muranaka) |
| 155 | | *<<Malaysia>>*<br>Director: Mr. Low Kong Chiew<br>Tel.: (+60) (3) 7957 8116 (Office hours)<br>E-mail: cfo@kjc.gov.my | Director: Mr. Saw Bun Liong<br>Tel.: (+60) (3) 7967 8116<br>(+60) (3) 7967 8119<br>E-mail: cfo@met.gov.my |
| Appendix 5-C | | | |
| 161-162 | | *<<Collection and Distribution of Information>>* | *<<to be replaced by>>*<br>New document (see Annex 1-11) |
| Appendix 5-D | | | |
| 166 | | *<<TABLE of Abbreviated headings>>*<br>RADB reports (RADB) | *<<to be replaced by>>*<br>Radar reports |
| Appendix 6-B | | | |
| 168 | | *<<Procedures of Regular Monitoring>>*<br>iv) hourly radar observations (RADOB code) | iv) hourly radar observations (BUFR and/or RADOB codes) |
| 170 | | RADOB (PART A)<br>RADOB | RADAR<br>RADAR reports |

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

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

a) Why Convert Wind Speeds?

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

b) When to Convert Wind Speeds?

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

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

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

c) How to Convert Individual Point-Specific Wind Speeds

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

| | |
|---|---|
| $V_{600}$ | is a 10-min averaged mean wind estimate; |
| $V_{60}$ | is a 1-min averaged mean wind estimate; |
| $V_3$ | is a 3-sec averaged mean wind estimate. |

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

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

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

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

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

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

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

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

Some example applications of the above recommendations are:

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

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

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

This is a slightly different situation from converting a point specific wind estimate because the concept of a storm-wide maximum wind speed *Vmax* is a metric with an associated spatial context (i.e. anywhere within or associated with the storm) as well as a temporal fix context (at this moment in time or during a specific period of time). While it may be expressed in terms of any wind averaging period it remains important that it be unambiguous in terms of representing a mean wind or a peak gust. Agencies that apply the WMO standard 10-min averaged *Vmax* wind have always applied a wind-averaging conversion to reduce the maximum “sustained” 1-min wind value (a 1-min peak gust) that has been traditionally associated with the Dvorak method (Dvorak 1984, Atkinson and Holliday 1977)1. As noted in the previous section, it is technically not possible to convert from a peak gust back to a specific time-averaged mean wind – only to the estimated true mean wind speed. However, in Harper et al. (2010) a practical argument is made for nominal conversion between $Vmax_{60}$ and

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

*$Vmax_{600}$* values via an hourly mean wind speed reference, and the recommendations are summarised in Table 2.

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

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

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

e) References


Atkinson, G.D., and C. R. Holliday, 1977: Tropical cyclone minimum sea level pressure/maximum sustained wind relationship for the Western North Pacific. *Mon. Wea. Rev.,* **105**, 421-427.

Dvorak, V.F., 1984: Tropical cyclone intensity analysis using satellite data. NOAA Tech. Rep. NESDIS 11, *National Oceanic and Atmospheric Administration*, Washington, DC, 47 pp.

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

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

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

WMO 2008: Guide to meteorological instruments and methods of observation. *World Meteorological Organization* , WMO-No. 8, 7th Ed, 681pp.

2.4.2 SAREP reports

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

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

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

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

**Cambodia**

**China**

(54): 857
(57): 083, 494, 972
(58): 150, 457, 847
(59): 316, 758, 981

**Democratic People's Republic of Korea**

(47): 041, 058

**Hong Kong, China**

(45): 004
# radiosonde observations supplemented by wind profiler observations at 06 and 18 UTC when necessary

**Japan**

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

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**Lao People's Democratic Republic**

**Macao, China**

**Malaysia**

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

**Philippines**

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

**Republic of Korea**

(47): 090, 102, 122, 138, 158, 169, 185

**Thailand**

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

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Name of the Member **Japan - 2**

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

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Name of the Member **Japan - 3**

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

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Name of the Member **Japan - 4**

| NAME OF STATION | Unit | Fukuoka /Sefurisan | Tanegashima /Nakatane | Naze /Funchatoge | Naha /Itokazu | Ishigakijima /Omotodake |
|---|---|---|---|---|---|---|
| **SPECIFICATIONS** | Unit | | | | | |
| Index number | | 47806 | 47869 | 47909 | 47937 | 47920 |
| Location of station | | 33° 26´ N<br>130° 21´ E | 30° 38´ N<br>130° 59´ E | 28° 24´ N<br>129° 33´ E | 26° 09´ N<br>127° 46´ E | 24° 26´ N<br>124° 11´E |
| Antenna elevation | m | 982.7 | 290.5 | 315.7 | 208.2 | 535.5 |
| Wave length | cm | 5.60 | 5.60 | 5.66 | 5.60 | 5.61 |
| Peak power of transmitter | kW | 250 | 250 | 250 | 250 | 250 |
| Pulse length | μ s | 1.1/2.7 | 1.1/2.7 | 2.6 | 1.0/2.5 | 1.1/2.7 |
| Sensitivity minimum of receiver | dBm | -109/-112 | -108/-112 | -113 | -109/-113 | -107/-111 |
| Beam width (Width of over -3dB antenna gain of maximum) | deg | 1.0(H)<br>1.0(V) | 1.1(H)<br>1.0(V) | 1.1(H)<br>1.0(V) | 1.0(H)<br>1.0(V) | 1.1(H)<br>1.1(V) |
| Detection range | km | 400 | 400 | 400 | 400 | 400 |
| Scan mode in observation<br>1.Fixed elevation<br>2.CAPPI<br>3.Manually controlled | | 2 | 2 | 2 | 2 | 2 |
| **DATA PROCESSING** | | | | | | |
| MTI processing<br>1.Yes, 2.No | | 1 | 1 | 1 | 1 | 1 |
| Doppler processing<br>1.Yes, 2.No | | 1 | 1 | 2 | 1 | 1 |
| Display<br>1.Digital, 2.Analog | | 1 | 1 | 1 | 1 | 1 |
| OPERATION MODE (When tropical cyclone is within range of detection)<br>1.Hourly<br>2.3-hourly<br>3.Others | | 1 | 1 | 1 | 1 | 1 |
| PRESENT STATUS<br>1.Operational<br>2.Not operational(for research etc.) | | 1 | 1 | 1 | 1 | 1 |

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Name of the Member **Macao, China**

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

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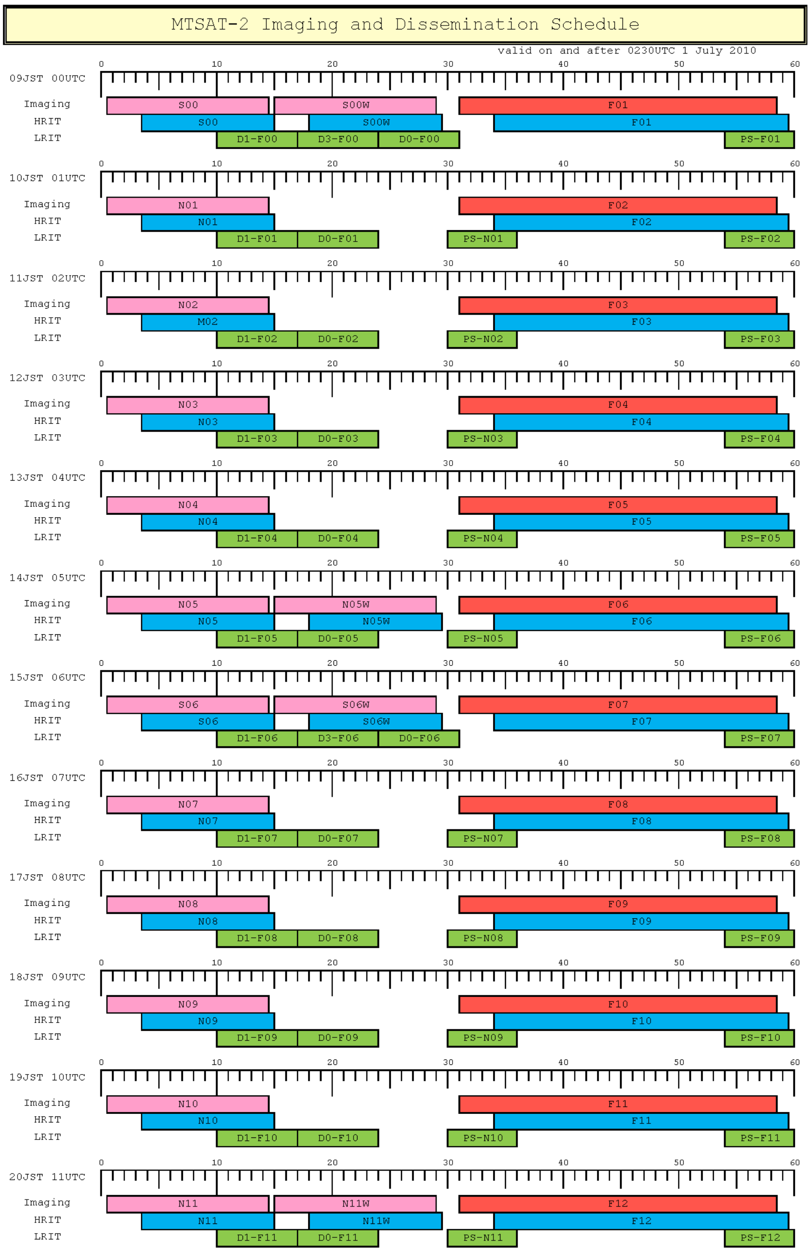


Figure 2-E.1 Time Table for Operation of MTSAT-2 (1/5)

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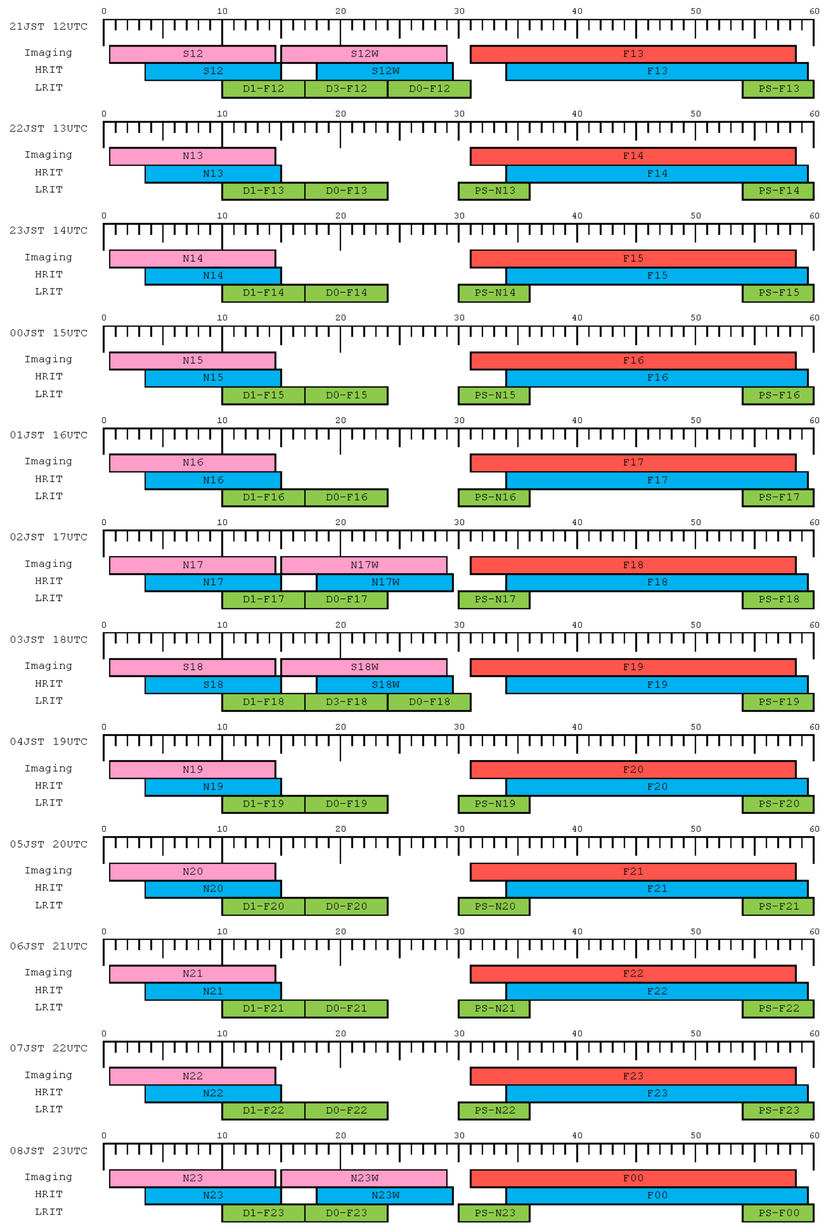


Figure 2-E.1 Time Table for Operation of MTSAT-2 (2/5)

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A. Notes

- This timetable is effective from 0230 UTC on 1 July 2010.

- For updated information on the dissemination timetable, please refer to MANAM, which is disseminated via MTSAT-1R and is also available on our web site.

Via MTSAT-1R
HRIT: MANAM is sent along with imagery of N02 and N08
(shown as “N02” or “N08” on a sky-blue ground in the timetable)
LRIT: MANAM is sent along with imagery of PS-N02 and PS-N08
(shown as “PS-N02” or “PS-N08” on a green ground in the timetable)

Website:
URL: http://mscweb.kishou.go.jp/operation/index.htm

Fig 2-E.1 Time Table for Operation of MTSAT-2 (3/5)

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## B. Legend

Observation (full disk/half disk)
HRIT
LRIT

## C. Symbols

hh: hours in UTC

### 1. Observation

| Symbol | Observation | Explanation of symbol |
|---|---|---|
| Fhh | Hourly full disk | F: hourly Full-disk observation |
| Nhh | Hourly Northern Hemisphere | N: hourly Northern-hemisphere observation |
| NhhW | Special observations for wind extraction | W: Wind extraction; S: Southern-hemisphere observation.<br>Every 6 hours (00, 06, 12, 18 UTC), two Northern-hemisphere and two Southern-hemisphere observations will be performed before and after the full-disk observation respectively. As an example, observations for wind extraction around 12 UTC are N11, N11W, F12, S12 and S12W. |
| Shh | | |
| ShhW | | |

### 2. HRIT Dissemination

| Symbol | Observation | Explanation of symbol |
|---|---|---|
| Fhh | Hourly full disk | F: hourly Full-disk observation |
| Nhh | Hourly Northern Hemisphere | N: hourly Northern-hemisphere observation |
| NhhW | Special observations for wind extraction | W: Wind extraction; S: Southern-hemisphere observation.<br>Every 6 hours (00, 06, 12, 18 UTC), two Northern-hemisphere and two Southern-hemisphere observations will be performed before and after the full-disk observation respectively. As an example, observations for wind extraction around 12 UTC are N11, N11W, F12, S12 and S12W. |
| Shh | | |
| ShhW | | |

### 3. LRIT Dissemination

| Symbol | Observation | Explanation of symbol |
|---|---|---|
| D1-Fhh | Full disk | D1: Full-Disk imagery, Infrared-ch1; F: hourly Full-disk observation |
| D3-Fhh | | D3: Full-Disk imagery, Infrared-ch3; F: hourly Full-disk observation |
| PS-Fhh | | PS: Polar-Stereographic imagery; F: hourly Full-disk observation; N: hourly Northern-hemisphere observation.<br>There are three different sets of polar-stereographic imagery covering East Asia, northeast Japan and southwest Japan. |
| PS-Nhh | Northern Hemisphere | |

Figure 2-E.1 Time Table for Operation of MTSAT-2 (4/5)

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## D. Data disseminated in LRIT

| Imagery / Observation | Polar-stereographic projection (PS-Fhh / PS-Nhh) | | | | | | Full disk | |
|---|---|---|---|---|---|---|---|---|
| | East Asia | | | | Northeast Japan | Southwest Japan | | |
| | Visible | Infrared-ch1 | Infrared-ch3 | Infrared-ch4 | Visible | Visible | Infrared-ch1 (D1-Fhh) | Infrared-ch3 (D3-Fhh) |
| F00 | D | D | D | | D | D | D | D |
| | | | | | | | | |
| F01 | D | D | D | | D | D | D | |
| N01 | D | D | D | | D | D | | |
| F02 | D | D | D | | D | D | D | |
| N02 | D | D | D | | D | D | | |
| F03 | D | D | D | | D | D | D | |
| N03 | D | D | D | | D | D | | |
| F04 | D | D | D | | D | D | D | |
| N04 | D | D | D | | D | D | | |
| F05 | D | D | D | | D | D | D | |
| N05 | D | D | D | | D | D | | |
| F06 | D | D | D | | D | D | D | D |
| | | | | | | | | |
| F07 | D | D | D | | D | D | D | |
| N07 | D | D | D | | D | D | | |
| F08 | (D) | D | D | (D) | (D) | (D) | D | |
| N08 | (D) | D | D | (D) | (D) | (D) | | |
| F09 | (D) | D | D | (D) | (D) | (D) | D | |
| N09 | (D) | D | D | (D) | (D) | (D) | | |
| F10 | | D | D | D | | | D | |
| N10 | | D | D | D | | | | |
| F11 | | D | D | D | | | D | |
| N11 | | D | D | D | | | | |
| F12 | | D | D | D | | | D | D |
| | | | | | | | | |
| F13 | | D | D | D | | | D | |
| N13 | | D | D | D | | | | |
| F14 | | D | D | D | | | D | |
| N14 | | D | D | D | | | | |
| F15 | | D | D | D | | | D | |
| N15 | | D | D | D | | | | |
| F16 | | D | D | D | | | D | |
| N16 | | D | D | D | | | | |
| F17 | | D | D | D | | | D | |
| N17 | | D | D | D | | | | |
| F18 | | D | D | D | | | D | D |
| | | | | | | | | |
| F19 | | D | D | D | | | D | |
| N19 | | D | D | D | | | | |
| F20 | | D | D | D | | | D | |
| N20 | | D | D | D | | | | |
| F21 | (D) | D | D | (D) | (D) | (D) | D | |
| N21 | (D) | D | D | (D) | (D) | (D) | | |
| F22 | (D) | D | D | (D) | (D) | (D) | D | |
| N22 | (D) | D | D | (D) | (D) | (D) | | |
| F23 | D | D | D | | D | D | D | |
| N23 | D | D | D | | D | D | | |

Legend

D: Dissemination

(D): Visible images are disseminated when the days are long enough, while infrared-ch4 images are disseminated when days are shorter. See MANAM for the latest information.

## E. Observation channels of the MTSAT-1R imager

| Channel | Wavelength |
|---|---|
| Infrared- | |
| ch1 | 10.3-11.3 μm |
| ch2 | 11.5-12.5 μm |
| ch3 | 6.5-7.0 μm |
| ch4 | 3.5-4.0 μm |
| Visible | 0.55-0.90 μm |

Figure 2-E.1 Time Table for Operation of MTSAT-2 (5/5)

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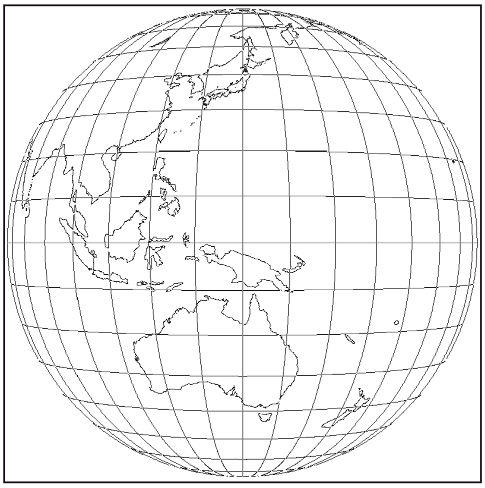
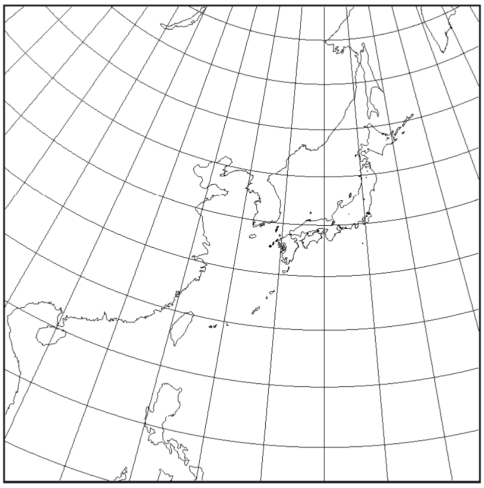
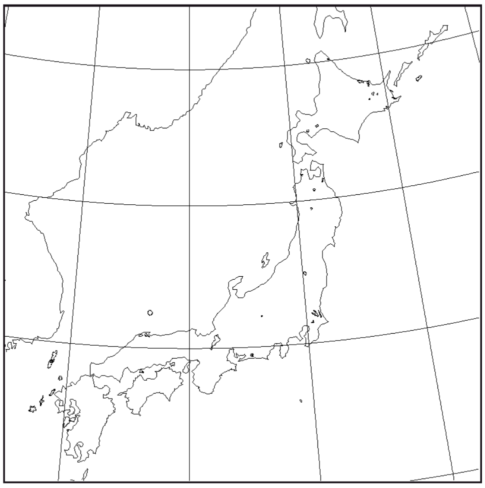


Full earth's Disk of normalized geostationary projection



Polar-stereographic projection covering East Asia



Polar-stereographic projection covering the north-east of Japan

Polar-stereographic projection covering the south-west of Japan

Figure 2-E. 2　LRIT Images

## OUTLINE OF RSMC TOKYO - TROPICAL CYCLONE PREDICTION MODELS

### (a) Global Spectral Model (GSM-1011)

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**Data Assimilation:**
- 4-D variational calculus (4D-VAR) with its own 3 to 9-hours prediction used as a first guess back ground (6-hours assimilation window)
- Data cut-off at 2.3 hours from synoptic time for prediction model, at 5.6 ~ 11.6 hours from synoptic time for assimilation cycle
- Dynamic quality control considering temporal and spatial variabilities
- Reduced Gaussian grid, roughly equivalent to 0.1875° x 0.1875° lat-lon
- Model p-sigma hybrid levels (60) + surface (1)

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**(bogusing of tropical cyclones)**
- Axis-symmetric structure based on Frank's (1977) empirical formula with parameters prescribed on forecasters' analysis mainly applying the Dvorak method to MTSAT imagery
- Asymmetric structure derived from first-guess field (prediction using GSM)
- Bogus structure is given as pseudo-observation data to the analysis for the prediction model

**Operation:**

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**(schedule)**
Four times a day (0000, 0600, 1200 and 1800 UTC)
**(integration time)**
84 hours from 0000, 0600 and 1800 UTC, and 216 hours from 1200 UTC

**Prediction model:**
**(dynamics)**
- Hydrostatic, primitive, semi-Lagrangian-form equations
- Semi-implicit time integration
- TL959 (~20km grid) spectral discretization in the horizontal direction
- Finite differencing on 60 p-sigma hybrid levels in the vertical direction
- Horizontal diffusion by linear second-order Laplacian

**(physics)**
- Arakawa-Schubert (1974) cumulus parameterization with modifications by Moorthi and Suarez (1992), Randall and Pan (1993) and Kuma and Cho (1994)
- Prognostic cloud water scheme by Smith (1990)
- Bulk formulae for surface fluxes with similarity functions by Louis (1982)
- Vertical diffusion with the level-2 closure model by Mellor and Yamada (1974) with moist effect included
- Gravity wave drag by Palmer et al. (1986) and Iwasaki et al. (1989)
- Simple Biospheric Model (SiB) by Sellers et al. (1986) and Sato et al. (1989a,b)

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**Deleted:** - Horizontal diffusion by linear second-order Laplacian

**Boundary conditions:**
**(SST)**
0.25° x 0.25° daily analysis with climatic seasonal trend



### (b) Typhoon Ensemble Prediction System (TEPS)

**Initial condition:**

Interpolation of the initial condition for GSM plus ensemble perturbations

**Methods to make ensemble perturbations:**

- Singular vector (SV) method
- Linearized model and its adjoint version based on those adopted in 4-D variational calculus, which consist of full dynamics of Eulerian integrations and full physical processes containing representations of vertical diffusion, gravity wave drag, large-scale condensation, long-wave radiation and deep cumulus convection
- T63 (~180 km grid) spectral discretization in the horizontal direction
- Finite differencing on 40 p-sigma hybrid levels in the vertical direction

**Ensemble size:**

11

**Operation:**

**(schedule)**

Four times a day (0000, 0600, 1200 and 1800 UTC)

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**(tropical cyclone conditions that can trigger model prediction)**

- a tropical cyclone of TS intensity or higher exists in the area of responsibility (0°N - 60°N, 100°E - 180°E)
- a tropical cyclone is expected to reach TS intensity or higher in the area within the next 24 hours
- a tropical cyclone of TS intensity or higher is expected to move into the area within the next 24 hours

**(maximum number of predictions)**

Three for each synoptic time (0000, 0600, 1200 and 1800 UTC)

**(integration time)**

132 hours

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**(domain)**

globe

**(Prediction model)**

- Lower-resolution version of the GSM
- TL319 (~55 km grid) spectral discretization in the horizontal direction
- Finite differencing on 60 p-sigma hybrid levels in the vertical direction

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

| Item | Method | Type of output |
|---|---|---|
| Name of the method<br><br><br>Description of the method | Operational Regional Spectral Model (ORSM)<br><br>Non-Hydrostatic Model (NHM)<br><br>See Appendix 3-E | Tropical cyclone position forecasts, surface and upper level prognoses up to 72 hours from 60-km ORSM and up to 42 hours from 20-km ORSM. Tropical cyclone forecast guidance bulletins based on the 60-km ORSM will be disseminated through the GTS when a tropical cyclone is within 10N to 30N and 105E to 125E.<br><br>Development is underway to generate tropical cyclone forecast guidance bulletins based on 10-km NHM to replace ORSM products. |

## (2) Non-Hydrostatic Model (NHM)

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

**Description of the method:**

HKO started to operate NHM system based on JMA-NHM (Saito *et al.* 2006) with horizontal resolution at 10-km and 2-km in June 2010 to provide forecasts up to 72 hours and 15 hours ahead respectively (Wong 2010). Development of TC track and intensity forecast products based on the 10-km NHM is underway to replace those from ORSM forecasts.

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 MTSAT-2/MTSAT-1R |
| ATOVS | retrieved temperature profiles from NOAA |

(B) Internet
(i) NCEP global high resolution daily sea surface temperature analysis at 0.083 degree resolution
(ii) Retrieved total precipitable water over ocean surface from SSM/I and AMSR-E

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

(D) Local data
(i) Tropical cyclone bogus data based on forecasters' analysis during TC situations
(ii) Automatic weather station data
(iii) Wind profiler data
(iv) Doppler weather radar data
(v) GPS 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 | Mercator |
| Number of grid points | 10-km NHM: 585x405, 50 levels<br>2-km NHM: 305x305, 60 levels |
| Forecast range | 10-km NHM: 72 hours<br>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 JMA Global Spectral Model forecast at horizontal resolution of 0.5 degree in latitude/longitude and on 21 pressure levels (1000, 975, 950, 925, 900, 850, 800, 700, 600, 500, 400, 300, 250, 200, 150, 100, 70, 50, 30, 20, and 10 hPa)<br><br>For 2-km NHM, hourly interval boundary data provided from 10-km NHM forecasts |
| Nesting configuration | One-way nesting |
| Topography and land-use | USGS GTOPO30 (30 second data smoothed to 1.5 times of horizontal resolution)<br>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 | Kain-Fritsch convective parameterization (JMA-NHM version)<br>Three ice bulk microphysics scheme |
| Surface process | Flux and bulk coefficients: Beljaars and Holtslag (1991)<br>Stomatal resistance and temporal change of wetness included<br>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 3 (MYNN-3) (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)<br>Short wave radiation process using Yabu and Kitagawa (2005)<br>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.

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.

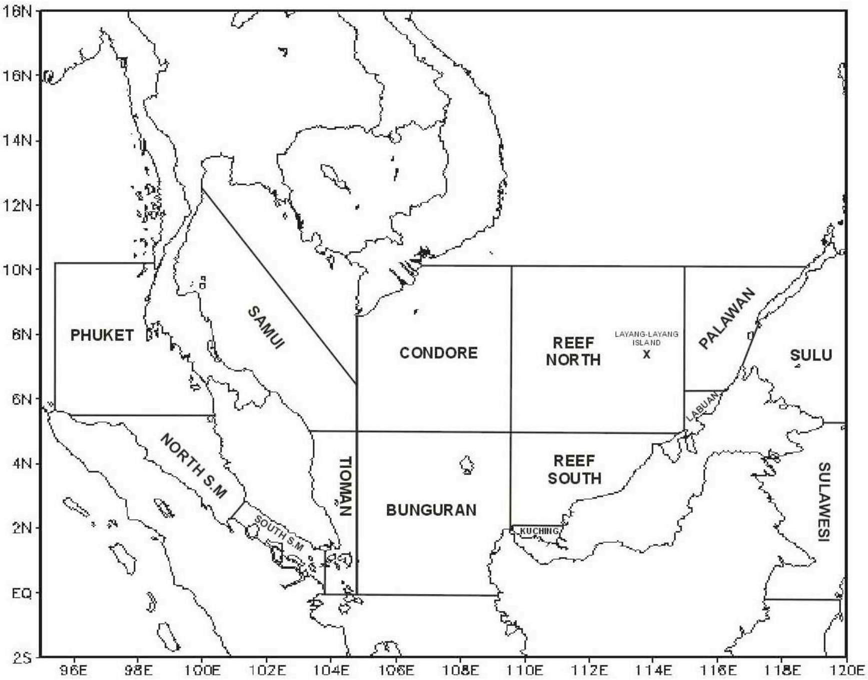
Saito, K., T. Fujita, Y. Yamada, J. Ishida, Y. Kumagai, K. Aranami, S. Ohmori, R. Nagasawa, S. Kumagai, C. Muroi, T. Kato, H. Eito, and Y. Yamazaki, 2006: The Operational JMA Nonhydrostatic Mesoscale Model. *Mon. Wea. Rev.*, **134**, 1266-1298.

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]

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

**MALAYSIA**

**WEATHER FORECAST AREAS**



## COLLECTION AND DISTRIIBUTION OF INFORMATION RELATED TO TROPICAL CYCLONES

| Type of Data | Heading | | Receiving station: TD | BJ | BB | HH | MM | SL | NN | KK | IV | PP | MC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Enhanced surface observation | SNCI30 | BABJ | BJ | O | BJ | BJ | TD | TD | BJ | BB | BB | BB | |
| | SNHK20 | VHHH | HH | HH | BJ | O | | TD | BB | BB | BB | BB | |
| | 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 upper-air observation | USCI01 | BABJ | BJ | O | BJ | BJ | TD | TD | BJ | BB | BB | BB | |
| | USCI03 | BABJ | BJ | O | BJ | BJ | TD | TD | BJ | BB | BB | BB | |
| | 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 | |
| | UKHK01 | VHHH | HH | HH | BJ | O | | TD | BB | BB | BB | BB | |
| | ULHK01 | VHHH | HH | HH | BJ | O | | TD | BB | BB | BB | BB | |
| | UEHK01 | VHHH | HH | HH | BJ | O | | TD | BB | BB | BB | BB | |
| | 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 | |
| *Continued to the next page* | USTH01 | VTBB | BB | TD | O | TD | TD | TD | BB | BB | BB | BB | |

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

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| Type of Data | Heading | | Receiving station TD | BJ | BB | HH | MM | SL | NN | KK | IV | PP | MC |
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| | | | * | | | | | | | | | | |
| Satellite guidance | TPPN10 | PGTW | | | TD | TD | | | BB | BB | BB | BB | |
| | 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 | |
| Tropical Cyclone Forecast | FXPQ01 | VHHH | **HH** | **HH** | BJ | O | | | BB | BB | BB | BB | |
| | FXPQ02 | VHHH | **HH** | **HH** | BJ | O | | | BB | BB | BB | BB | |
| | FXPQ03 | VHHH | **HH** | **HH** | BJ | O | | | BB | BB | BB | BB | |
| | FXPQ20 | VHHH | HH | HH | BJ | O | TD | TD | BB | BB | BB | BB | |
| | FXPQ20 | RJTD | O | TD | TD | TD | TD | TD | BB | BB | BB | BB | |
| | FXPQ21 | RJTD | O | TD | TD | TD | TD | TD | BB | BB | BB | BB | |
| | FXPQ22 | RJTD | O | TD | TD | TD | TD | TD | BB | BB | BB | BB | |
| | FXPQ23 | RJTD | O | TD | TD | TD | TD | TD | BB | BB | BB | BB | |
| | FXPQ24 | RJTD | O | TD | TD | TD | TD | TD | BB | BB | BB | BB | |
| | FXPQ25 | RJTD | O | TD | TD | TD | TD | TD | BB | BB | BB | BB | |
| | FXPQ29 | VTBB | | | O | | | | | | | | |
| | FXPH20 | RPMM | MM | TD | TD | TD | O | TD | BB | BB | BB | BB | |
| | FXSS01 | VHHH | **HH** | **HH** | BJ | O | | | BB | BB | BB | BB | |
| | FXSS02 | VHHH | **HH** | **HH** | BJ | O | | | BB | BB | BB | BB | |
| | FXSS03 | VHHH | **HH** | **HH** | BJ | O | | | BB | BB | BB | BB | |
| | FXSS20 | VHHH | HH | HH | BJ | O | TD | TD | BB | BB | BB | BB | |
| 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 | ~~HH~~ | ~~HH~~ | 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 | |
| | WTSS20 | VHHH | HH | HH | BJ | O | | | BB | BB | BB | BB | |
| | 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 | |
| *Continued to* | WTPQ23 | RJTD | O | TD | TD | TD | TD | TD | BB | BB | BB | BB | |
| *the next page* | WTPQ24 | RJTD | O | TD | TD | TD | TD | TD | BB | BB | BB | BB | |

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