4. NUMERICAL WEATHER PREDICTION MODELS

4.1 Summary

JMA operates six NWP models to meet various kinds of requirements on weather forecasting. The suite of the NWP models covers a wide temporal range of forecast periods from several hours to two seasons providing a seamless sequence of products for the public.

The Global Spectral Model (GSM) produces 90-hour forecast twice a day (00, 12 UTC) to support the official short-range forecasting (day 3) and to provide the lateral boundary conditions for the Regional Spectral Model (RSM) and the Typhoon Model (TYM). At 06 and 18 UTC, 36-hour forecast is also executed to support the aviation services. The forecast at 12 UTC is extended to 9 days to support the official one-week forecasting.

Three ensemble prediction systems are in operation. The one-week ensemble forecast is performed with 51 ensemble members every day (12 UTC) supporting the official one-week forecasting. The one-month ensemble forecast with 50 members is carried out once a week (every Wednesday and Thursday) to support the official one-month forecasting, which is issued on Friday. The seasonal ensemble forecast with 31 members is carried out once a month to support the official seasonal forecasting.

RSM produces 51-hour forecast twice a day (00, 12 UTC) and supports the official short-range forecasting (day 1 and 2). It provides the lateral boundary conditions for the Mesoscale Model (MSM).

MSM is executed eight times a day (00, 03, 06, 09, 12, 15, 18 and 21 UTC). It produces 15-hour forecast to support very short-range forecasting to severe weather disturbances.

The Typhoon Model (TYM) runs four times a day (00, 06, 12 and 18 UTC) when typhoons exist or are expected to form in the western-north Pacific. If three or more typhoons are detected at the initial time, two of them are selected and the model runs twice for each. The model produces 84-hour forecast and supports activities of the RSMC Tokyo Typhoon Center.

JMA also operates a global atmospheric transport model to support the RSMC for Emergency Response activities. The model stands ready to run anytime when an environmental emergency situation occurs.

The Chemical Transport Models (CTM) produce 48-hour forecast once a day (12UTC) to support Kosa (Aeolian Dust) information and UV index information. The radiative transfer model is also used for UV index information.

Table 4.1.1 shows specifications of the NWP models. Details on the NWP models, the ensemble prediction systems, the atmospheric transport model and the chemical transport models are described particularly in the following sections (4.2 - 4.8). The operational verification procedure is explained in section 4.9.

Table 4.1.1 Specifications of the NWP models at JMA

	Global Spectral Model (GSM)	One-week Ensemble Prediction System (1W-EPS)	One-month Ensemble Prediction System (1M-EPS)
Forecast Range (Initial Time)	36 hours (06, 18UTC) 90 hours (00UTC) 216 hours (12UTC)	216 hours (12UTC)	34 days (12UTC; Wed & Thu)
Horizontal Grids #	640 x 320	320 x 160	
Truncation Wave #	T_L319	T_L159	
Grid Spacing	0.5625 deg.	1.125 deg.	
Vertical Layers	40		
Top Layer Pressure	0.4 hPa		
Ensemble Size	–	51	25
Perturbation generator	–	Breeding of Growing Mode (25 breeding cycles)	(12 breeding cycles)
Perturbed area	–	Northern hemisphere and tropics (20S-90N)	
Radiation process	Solar (every hour) Infrared (3 hourly)		
Precipitation process	Prognostic Arakawa-Schubert Prognostic cloud water content		
PBL and surface fluxes	Mellor-Yamada level 2 Monin-Obukhov similarity		
Gravity wave drag	Long wave drag Short wave drag		
Land surface model	Simple Biosphere (SiB)		

	Regional Spectral Model (RSM)	Meso-scale Model (MSM)	Typhoon Model (TYM)
Forecast Range	51 hours	15 hours	84 hours
Initial Time	00, 12 UTC	00, 03, 06, 09, 12, 15, 18, 21UTC	00, 06, 12, 18UTC
Forecast Domain	East Asia & North-West Pacific	Japan	Relocatable in NW Pacific
Map Projection	Lambert Conformal		Lambert Conformal or Mercator
Horizontal Grids #	325 x 257	721 x 577	271 x 271
Truncation Wave #	214 x 169	N/A	179 x 179
Grid Spacing	20 km	5 km	24 km
Vertical Layers	40	50	25
Top Layer Pressure / height	10 hPa	21,800m	17.5 hPa
Radiation process	Solar (every hour) Infrared (every hour)	Solar (every 15 minutes) Infrared (every 15 minutes)	Solar (every hour) Infrared (every hour)
Precipitation process	Prognostic Arakawa-Schubert Moist convective adjustment Large-scale condensation	Kain-Fritsch 3-ice bulk microphysics	Prognostic Arakawa-Schubert Prognostic cloud water content
PBL and surface fluxes	Mellor-Yamada level 2 Non-local PBL Monin-Obukhov similarity	Diagnostic form of Deardorff TKE 1.5 closure with non-local effect Monin-Obukhov similarity	Mellor-Yamada level 2 Monin-Obukhov similarity
Gravity wave drag	Short wave drag	N/A	Short wave drag