Specifications (as of 31 December 2020) – an excerpt from the Joint WMO Technical Progress Report on the Global Data Processing and Forecasting System and Numerical Weather Prediction Research Activities for 2020

4.7 Long range forecasts (LRF) (30 days up to two years)

4.7.1 Models

4.7.1.1 In operation

JMA operates its Seasonal Ensemble Prediction System (Seasonal EPS; JMA/MRI-CPS2) using a coupled atmosphere-ocean model. The current system was upgraded in June 2015. The 51-member ensemble is used for the three-month forecast issued every month and for the warm/cold season forecasts issued five times a year (in February, March, April, September and October). The El Niño outlook is also issued based on the same model results.

The JMA/MRI-CPS2 was developed by JMA including the Meteorological Research Institute (MRI). Its specifications are shown in Table 4.7.1.1-1.

4.7.1.2 Research performed in this field

JMA plans to upgrade the Seasonal EPS in February 2022. The new system, JMA/MRI-CPS3, will incorporate a wide range of research progress achieved at JMA and MRI (Table 4.7.1.1-1). The atmospheric model is from GSM2003, with additional improvements such as cloud and cumulus convection schemes (referred to here as GSM2003C). Atmospheric conditions are initialized with JRA-3Q for reforecasts, and Global Analysis (GA) allowing faster atmospheric update is also used in the operation to broaden its scope toward sub-seasonal forecasts. Land is initialized separately from this analyses, due to inconsistencies in lake/land treatment in the model, including GSM2003C's newly-developed lake scheme requiring initialization. To this end, the model's off-line land surface simulation will be used. Ocean and sea ice initial conditions are taken from MOVE/MRI.COM-G3 (see 4.5.1.1 (1) *), but with downscaling into the eddy-permitting ocean resolution (0.25 by 0.25°in longitude and latitude). The EPS will feature a combination of LAF and initial perturbation as with previous system. Five-member ensemble predictions are made every day, and atmospheric initial perturbations for each initial date are obtained using the BGM. Ocean initial perturbations are calculated using the 4DVAR minimization history to approximate the day's analysis error covariance.

* See Joint WMO Technical Progress Report on the Global Data Processing and Forecasting System and Numerical Weather Prediction Research Activities for 2020.

4.7.2 Operationally available EPS LRF products

JMA provides gridded data and map products for three-month forecasts every month. Warm-season (June-July-August; JJA) forecasts are issued in February, March and April, and cold-season (December-January-February; DJF) forecasts are issued in September and October.

A model systematic bias was estimated for use as an average forecast error calculated from hindcast experiments for the 30 years from 1981 to 2010. The bias is removed from geopotential height, sea

level pressure, temperature, and sea surface temperature in advance to produce ensemble forecast products such as ensemble means and spreads.

The following model output products for three-month, warm/cold-season (Tables 4.7.2-1, 4.7.2-2 and 4.7.2-3) and six-month (Tables 4.7.2-1) forecasts are provided via the Tokyo Climate Center (TCC) website (https://ds.data.jma.go.jp/tcc/tcc/index.html).

Table 4.7.1.1-1 Seasonal EPS specifications

1.system

System Name	JMA/MRI-CPS2	JMA/MRI-CPS3
Operation start	June 2015	February 2022

2.configuration

Atmospheric model	Model version	GSM1011C	GSM2003C
	Resolution	Global TL159 reduced Gaussian grid (~110km)	Global TL319 reduced Gaussian grid (~55 km)
	Vertical levels (model top)	60 levels (0.1 hPa)	100 levels (0.01 hPa)
Oceanic model	Model version	MRI.COM v3.2	MRI.COM v4.6
	Horizontal resolution	1 (longitude) × 0.3-0.5° (latitude)	0.25 (longitude) × 0.25° (latitude)
	Vertical levels	52 levels with a bottom boundary layer	60 levels
Forecast period		7 months	
Forecast frequency		13 ensemble members every 5 days	5 ensemble members every day
Initial conditions	Atmosphere	JRA-55	JRA-3Q (hindcasts + forecasts) the Global Analysis (GA; forecasts only)
	Land Surface	JRA-55	Off-line model runs forced by JRA-3Q and GA
	Ocean	MOVE/MRI.COM-G2 (3DVAR)	MOVE/MRI.COM-G3 (Low-res. 4DVAR+High-res downscaling)
	Sea ice		MOVE/MRI.COM-G3 (3DVAR)
Ensemble generation method	Initial condition perturbation	Breeding of growing mode (BGM) The Lagged Average Forecast (LAF)	BGM for the atmosphere Ocean perturbations calculated using 4DVAR minimization history LAF method
	Model perturbation (atmosphere)	A stochastic physics scheme	

Hindcast	Period	Two initial dates per month for the 36 years from 1979 to 2014	Two initial dates per month for the 30 years from 1991 to 2020
	Ensemble size	Five for each initial date	

Table 4.7.2-1 Gridded data products (GRIB2) for three-month, warm/cold-season and six-month forecasts provided via the TCC website

Details		Level (hPa)	Area	Base time & forecast time
Ensemble mean, its anomaly, and spread (standard deviation) values of forecast members	Sea level pressure*, its anomaly and spread	-	Global 2.5° × 2.5°	Base time: 00 UTC around the 15th of each month (three-month and warm/cold season forecasts) and 00UTC every 5 days (six-month forecasts) Forecast times: One- and three-month averages for targeted terms
	Daily mean precipitation, its anomaly and spread	-		
	Sea surface temperature* and its anomaly	-		
	Temperature*, its anomaly and spread	Surf, 850		
	Geopotential height*, its anomaly and spread	500		
	Wind (u, v), its anomaly and spread	850, 200		
Individual ensemble members	Sea level pressure* and its anomaly	-		Base time: 00 UTC on each initial date of prediction (every 5 days) Forecast times: One-month averages for targeted terms
	Daily mean precipitation and its anomaly	-		
	Sea surface temperature* and its anomaly	-		
	Temperature* and its anomaly	Surf, 850, 500, 200		
	Relative humidity and its anomaly	850		
	Specific humidity and its anomaly (only for three-month and warm/cold season forecasts)	850		
	Geopotential height* and its anomaly	850, 500, 300, 200, 100		
	Wind (u, v) and its anomaly	850, 500, 200		

* Geopotential height, sea level pressure, temperature and sea surface temperature are calibrated by subtracting the systematic error from the direct model output.

Table 4.7.2-2 Map products for three-month and warm/cold-season forecasts provided via the TCC website

<https://ds.data.jma.go.jp/tcc/tcc/products/model/map/4mE/index.html>

	Forecast time	Parameter
Ensemble mean, its anomaly and spread	Three-month forecast: Averages of first month, second month, third month, and three months Warm/cold season forecast: Averages of three months (JJA or DJF)	Geopotential height at 500 hPa, related anomaly and spread Temperature at 850 hPa, its anomaly and spread Sea level pressure, its anomaly and spread Stream function at 200 hPa, its anomaly and spread Stream function at 850 hPa, its anomaly and spread Wind (u, v) anomaly at 850 hPa Velocity potential at 200 hPa, its anomaly and spread

		Precipitation, its anomaly and spread Temperature at 2 m, its anomaly and spread Sea surface temperature and its anomaly

Table 4.7.2-3 SST Index Time Series
<https://ds.data.jma.go.jp/tcc/tcc/products/model/indices/3-mon/indices1/shisu_forecast.php>

Index	Description	Coordinates
NINO.1+2	Region off coasts of Peru and Chile	90°W – 80°W, 10°S – 0°
NINO.3	Eastern/Central Tropical Pacific	150°W – 90°W, 5°S – 5°N
NINO3.4	Central Tropical Pacific	170°W – 120°W, 5°S – 5°N
NINO.4	Western/Central Tropical Pacific	160°E – 150°W, 5°S – 5°N
NINO.WEST	Western Tropical Pacific	130°E – 150°W, 0°– 15°N
TNA	Tropical North Atlantic	55°W – 15°W, 5°N – 25°N
TSA	Tropical South Atlantic	30°W – 10°E, 20°S – 0°
TAD	Tropical Atlantic Dipole	TNA – TSA
IOBW	Indian Ocean Basin-Wide	40°E – 100°E, 20°S – 20°N
WTIO	Western Tropical Indian Ocean	50°E – 70°E, 10°S – 10°N
SETIO	Southeastern Tropical Indian Ocean	90°E – 110°E, 10°S – 0°
IOD	Indian Ocean Dipole	WTIO – SETIO