

Grid Point Values (GPV) Manual

March 31, 2011

1. Introduction

The Center for Computational Sciences (CCS) of University of Tsukuba began to obtain grid point values (GPV) data provided by the Japan Meteorological Agency (JMA) in April 2005 and since then has been downloading and storing them on a daily basis. The total accumulated data size for six years has reached 6.4 TB as of this publication. We publish the data through our data server for educational and research purposes only. This manual describes the details about the published data and how to use them by providing a simple, practical example.

2. Published Data

The published data that CCS obtains from the Japan Meteorological Business Support Center are of the following four types.

- Global Spectral Model (GSM)
- Regional Spectral Model (RSM)
- Meso-Spectral Model (MSM)
- Weekly Ensemble Numerical Weather Prediction Model

2.1 Global Spectral Model (GSM)

JMA's GSM employs the primitive equations in which the hydrostatic equilibrium is assumed. Forecasting variables are zonal wind, meridional wind, temperature, specific humidity, and surface pressure. As an integration scheme, we use spherical harmonics basis function in the horizontal direction, while in the vertical direction we use vertical leapfrog, semi-Lagrangian, and semi-implicit time integration schemes. Horizontal resolution was set to TL319 (grid interval: ~60 km) until November 20, 2007, and has been set to TL959 (grid interval: 20 km) since then. A vertical resolution was 40 hybrid layers, covering up to 0.4 hPa geopotential height until November 20, 2007, which has been then set to 60 hybrid layers covering up to 0.1 hPa geopotential height since November 21, 2007. To determine initial values we employ a four-dimensional data assimilation technique, setting the resolution of an inner loop model to T106L40 before November 20, 2007 and T159L60 after. For more details about the forecast models, please refer to JMA's documents. Published meteorological data are summarized in the following tables.

Before November 20, 2007

Basic equations	Primitive equations
Initial time	00UTC, 12UTC
Forecast time	84 hours (every 6 hours) for 00 UTC 96 hours (every 6 hours) for 12 UTC
Covered regions	Global
Model resolution	TL319L40 (60 km)
Data format	GRIB (readable by wgrib)
Vertical layer number	16 layers (1000, 925, 850, 700, 500, 400, 300, 250, 200, 150, 100, 70, 50, 30, 20, 10 hPa)
Surface physical quantities	Corrected atmospheric pressure at the sea level [Pa], Surface zonal wind [m/s], Surface meridional wind [m/s], Surface temperature [K], Relative humidity [%], Precipitation [kg/m ²], Surface pressure [Pa]
Pressure surface physical quantities	Geopotential height [m], Zonal wind [m/s], Meridional wind [m/s], Temperature [K], Relative humidity [%], Vertical pressure velocity [Pa/s]

Note: Relative humidity and vertical pressure velocity are provided up to 300 hPa geopotential height.

Since November 21, 2007

Basic equations	Primitive equations
Initial time	00UTC, 06UTC, 12UTC, 18UTC
Forecast time	312 hours (every 6 hours) for 00UTC, 06UTC, 18UTC 800 hours (every 6 hours) for 12UTC
Covered regions	Global
Model resolution	TL959L60 (20 km)
Data format	GRIB2 (readable by wgrib2)
Vertical layer number	16 layers (1000, 925, 850, 700, 500, 400, 300, 250, 200, 150, 100, 70, 50, 30, 20, 10 hPa)
Surface physical quantities	Corrected atmospheric pressure at the sea level [Pa], Surface pressure [Pa], Zonal wind 10 m above the ground [m/s], Meridional wind 10 m above the ground [m/s], Temperature 2 m above the ground [K], Relative humidity 2 m above the ground [%], Low-level clouds [%], Middle-level clouds [%], High-level clouds [%], Precipitation [kg/m ²]
Pressure surface physical quantities	Geopotential height [m], Zonal wind [m/s], Meridional wind [m/s], Temperature [K], Relative humidity [%], Vertical pressure velocity [Pa/s]

Notes:

- Precipitation is a predicted value.
- Relative humidity and vertical pressure velocity are provided up to 300 hPa geopotential height.

2.2 Regional Spectral Model (RSM)

As with GSM, RSM also employs the primitive equations in which the hydrostatic equilibrium is assumed. A Cartesian coordinate system is adopted in the horizontal direction, while in the vertical direction a hybrid coordinate system is used as GSM. The GSM outputs are used for boundary conditions in RSM. The

horizontal grid covers East Asia, including Japan, with a horizontal grid interval of 20 km. The number of vertical grids is 40, covering up to 10 hPa geopotential height. As described in section 2.1, the GSM resolution was changed to TL959 (20 km) from TL319 (60 km) on November 21, 2007, and then RSM was terminated. RSM employs the Japanese domestic grid binary (DGRB) format, which is a special format. Instructions for reading this data will be described in a separate document.

Basic equations	Primitive equations
Initial time	00UTC, 12UTC
Forecast time	18 hours (every 1 hour for surface physical quantities) (every 3 hours for pressure surface physical quantities)
Covered regions	From latitude 20° north and longitude 120° east to latitude 50° north and longitude 150° east
Data format	Japanese domestic grid binary (DGRB) format
Horizontal resolution	—
Vertical layer number	16 layers (1000, 925, 850, 700, 500, 400, 300, 250, 200, 150, 100, 70, 50, 30, 20, 10 hPa)
Surface physical quantities	Corrected atmospheric pressure at the sea level [Pa], Surface pressure [Pa], Zonal wind 10 m above the ground [m/s], Meridional wind 10 m above the ground [m/s], Temperature 2 m above the ground [K], Relative humidity 2 m above the ground [%], Low-level clouds [%], Middle-level clouds [%], High-level clouds [%], Precipitation [kg/m ²]
Pressure surface physical quantities	Geopotential height [m], Zonal wind [m/s], Meridional wind [m/s], Temperature [K], Relative humidity [%], Vertical P velocity [Pa/s]

Notes:

- Precipitation is a predicted value.
- Relative humidity and vertical pressure velocity are provided up to 300 hPa geopotential height.

2.3 The Meso-Spectral Model (MSM)

MSM employs full-compressible elastic equations based on the non-hydrostatic equilibrium model. In the vertical direction, a terrain-based coordinate system, not a pressure-based one, is used. As explained in the following, horizontal resolution, forecast frequency, and forecast time have been revised. The horizontal resolution has been 5 km since March 1, 2006, upgraded from 10 km (between May 1, 2005 and February 28, 2006). The forecast frequency is eight times per day (00UTC, 03UTC, 06UTC, 09UTC, 12UTC, 15UTC, and 18UTC) since March 1, 2006; it was four times a day (00UTC, 06UTC, 12UTC, and 18UTC) between May 1, 2005 and February 28, 2006. The forecast time is 33 hours for the 03UTC, 09UTC, 15UTC, and 21UTC initial time since July 10, 2007, which was extended from a previously used 18 hours (between May 1, 2005 and February 28, 2006).

Basic equations	Full-compressible elastic equations based on the non-hydrostatic equilibrium model
Initial time	00 UTC, 06 UTC, 12 UTC, 18 UTC
Forecast time	18 hours (every 1 hour for surface physical quantities) (every 3 hours for pressure surface physical quantities) 03UTC, 09UTC, 15UTC, 21UTC since July 10, 2007 Changed to 33 hours from 18 hours for the prediction at each initial time
Covered region	Between (latitude 22.4° N, longitude 120° E) and (latitude 47.6° N, longitude 150° E)
Data format	Japanese domestic grid binary (DGRB) format (until February 28, 2006) GRIB2 (since March 1, 2006)
Horizontal resolution	10 km (until February 28, 2006) 5 km (since March 1, 2006)
Vertical layer number	14 layers (1000, 975, 950, 925, 900, 850, 700, 500, 400, 300, 250, 200, 150, 100 hPa)
Surface physical quantities	Corrected atmospheric pressure at the sea level [Pa], Zonal wind [m/s], Meridional wind 10 m above the ground [m/s], Temperature 2 m above the ground [K], Relative humidity 2 m above the ground [%], Cloud amount [], Precipitation [mm/h]
Pressure surface physical quantities	Geopotential height [m], Zonal wind [m/s], Meridional wind [m/s], Temperature [K], Relative humidity [%], Vertical pressure velocity [Pa/s]

Note: Relative humidity and vertical pressure velocity are provided up to 300 hPa geopotential height.

2.4 Weekly Ensemble Numerical Weather Prediction Model

A weekly ensemble numerical weather prediction provides a forecast once a day using low-resolution GSM data with 12UTC data as initial time. The resolution of this model was TL159L40 until November 20, 2007, upgraded to TL319L60, afterwards. The number of ensemble members is 51. We have employed the breeding of growing modes (BGM) method as the initial perturbation until November 20, 2007 and singular vector (SV) method since then.

Before November 20, 2007

Basic equations	Primitive equations
Initial time	12 UTC
Forecast time	1 week (168 hours)
Covered regions	Global
Data format	GRIB (until February 28, 2006) GRIB2 (since March 1, 2006)
horizontal resolution	TL159L40 (~120 km grid, 1.125°) TL319L60 (~60 km grid, 0.5625°)
Vertical layer number	16 layers (1000, 925, 850, 700, 500, 400, 300, 250, 200, 150, 100, 70, 50, 30, 20, 10 hPa)
Surface physical	Corrected atmospheric pressure at the sea level [Pa], Surface zonal wind [m/s],

quantities	Surface meridional wind [m/s] Surface temperature [K], Relative humidity [%], Precipitation [kg/m ²], Surface pressure [Pa]
Pressure surface physical quantities	Geopotential height [m], Zonal wind [m/s], Meridional wind [m/s], Temperature [K], Relative humidity [%], Vertical P velocity [Pa/s]

Note: Relative humidity and vertical pressure velocity are provided up to 300 hPa geopotential height.

3. How to use the data

3.1 User registration

To use the data described in this manual, users need to access the following web site and register. Note that the use of the data is allowed for academic purposes only, and any commercial use is prohibited.

<http://gpvjma.ccs.hpcc.jp/~gpvjma/>

- Access <http://gpvjma.ccs.hpcc.jp/~gpvjma/> and click the “REGISTER” button.
- Input required information (* mark indicates mandatory information) and click on the “Next Step” button.
(Please use your work e-mail address provided by your affiliated organization, not a free or personal email address.)
- Confirm that all the displayed information including the email address is correct. Carefully read the note on data usage and check the box, and then click on the “Submit” button.

3.2 Wgrib and wgrib2

The data provided by the CCS uses three data formats: the Japanese domestic grid binary (DGRB) as well as GRIB1 and GRIB2. A tool to convert GRIB1 and GRIB2 formatted data into various other data formats is provided on the following web sites of the National Oceanic and Atmospheric Administrations (NOAA).

GRIB1: <http://www.cpc.ncep.noaa.gov/products/wesley/wgrib.html>

GRIB2: <http://www.cpc.ncep.noaa.gov/products/wesley/wgrib2/>