CGMS

CGMS-34 JMA-WP-10
Prepared by JMA
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ATMOSPHERIC MOTION VECTOR PRODUCT IN JMA

This paper reports on the status of operational Atmospheric Motion Vector (AMV) products of JMA. With the commencement of MTSAT-1R operation, JMA started deriving 6-hourly AMVs for full disk from three successive MTSAT-1R images of 15-minute intervals instead of 30-minute intervals. The quality of AMVs is comparable to that of AMVs derived from GOES-9 or GMS-5. JMA continues improvement of algorithm to reduce wind speed bias focusing on height assignment. In addition to 6-hourly AMVs, JMA newly started deriving hourly AMVs over northern hemisphere. The status of hourly AMVs is also summarized in this paper.

The statistics of MTSAT-1R AMVs are available at the following website:
http://mscweb.kishou.go.jp/library/report/inter_com_amv/

ATMOSPHERIC MOTION VECTOR PRODUCT IN JMA

1. INTRODUCTION

The Meteorological Satellite Center (MSC) of the Japan Meteorological Agency (JMA) has been generating Atmospheric Motion Vectors (AMVs) since 1978. As reported in the JMA-WP-13 at CGMS-XXXIII, MTSAT-1R images have been used to derive operational AMVs since 15 July 2005. The interval of successive observation used for deriving MTSAT-1R 6-hourly AMVs was reduced from 30 minutes (GOES-9 and GMS-5) to 15 minutes. In addition to the 6-hourly AMVs, JMA started generating hourly AMVs (at 01-05, 07-11, 13-17 and 19-23 UTC) from MTSAT-1R. Areas generating MTSAT-1R hourly AMVs are limited to over the northern hemisphere, while those for 6-hourly AMVs are over full disk. The time interval of images used in generating the hourly AMVs is basically 30 minutes with the exception of 60 minutes at 01, 07, 13 and 19 UTC. Table 1 shows the parameters for deriving MTSAT-1R AMVs.

Table 1 MTSAT-1R atmospheric motion product generated by JMA

Wind Product	Time (UTC)	Image sector	Level of Height	Image interval (minutes)	Distribution
Infrared (11 μm)	00, 06, 12, 18	Full Disk	Upper, middle, lower	15	BUFR and SATOB via GTS
	02-05, 08-11, 13-16, 20-23	N. Hemisphere	Upper, middle, lower	30	Internal use only
	01, 07, 13, 19	N. Hemisphere	Upper, middle, lower	60	Internal use only
Water Vapor (6.7 μm)	00, 06, 12, 18	Full Disk	Upper, middle	15	BUFR and SATOB via GTS
	02-05, 08-11, 13-16, 20-23	N. Hemisphere	Upper, middle	30	Internal use only
	01, 07, 13, 19	N. Hemisphere	Upper, middle	60	Internal use only
Visible (daytime)	00, 06	Full Disk	Lower	15	BUFR and SATOB via GTS
	02-05, 08, 09, 22, 23	N. Hemisphere	Lower	30	Internal use only
	01, 07	N. Hemisphere	Lower	60	Internal use only

2. STATUS OF MTSAT-1R 6-HOURLY AMV

This section describes the status of the MTSAT-1R 6-hourly AMVs derived at 00, 06, 12 and 18 UTC.

Figure 1 shows the time series of monthly statistics (Root Mean Square Vector Difference (RMSVD) and wind speed bias (BIAS)) for the upper height level (100-400 hPa) IR1 AMVs with reference to radio sonde observations over the northern hemisphere, the southern hemisphere, and the tropics. The figure indicates that the quality for winter 2005 over the northern hemisphere is comparable to that of the past winters in the period of GMS-5 and GOES-9.

JMA considers that the improvement in the accuracy of height assignment is one of the solutions to mitigate BIAS, and is trying to improve the height assignment scheme.

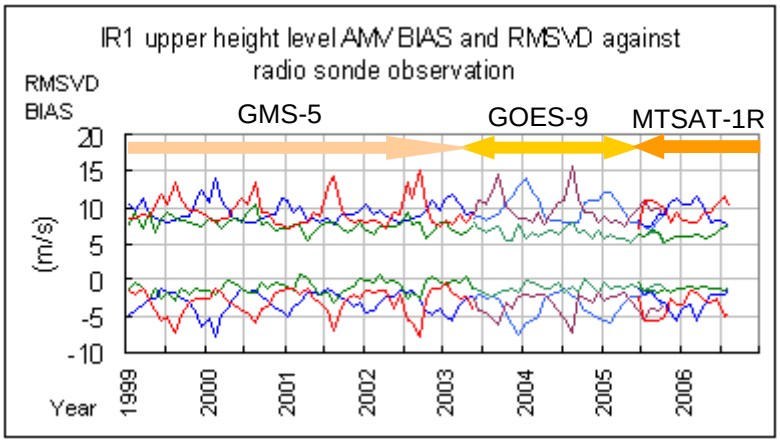

Figure 1 Long-term time series of RMSVDs (top) and BIASs (bottom) of IR AMV at upper height level over the northern hemisphere (blue), the southern hemisphere (red), and the tropics (green).

Figure 2 shows the time series of monthly statistics for upper height level AMVs derived from infrared window images (IR AMVs): RMSVD and BIAS from radio sonde observations, and the number of the derived AMVs. In the computation of the statistics, only the AMVs with quality indicator (QI) larger than 0.85 are used.

RMSVDs are in the range between 7.6 m/s and 9.7 m/s. BIASs are in the range between -3.7 m/s and -1.9 m/s.

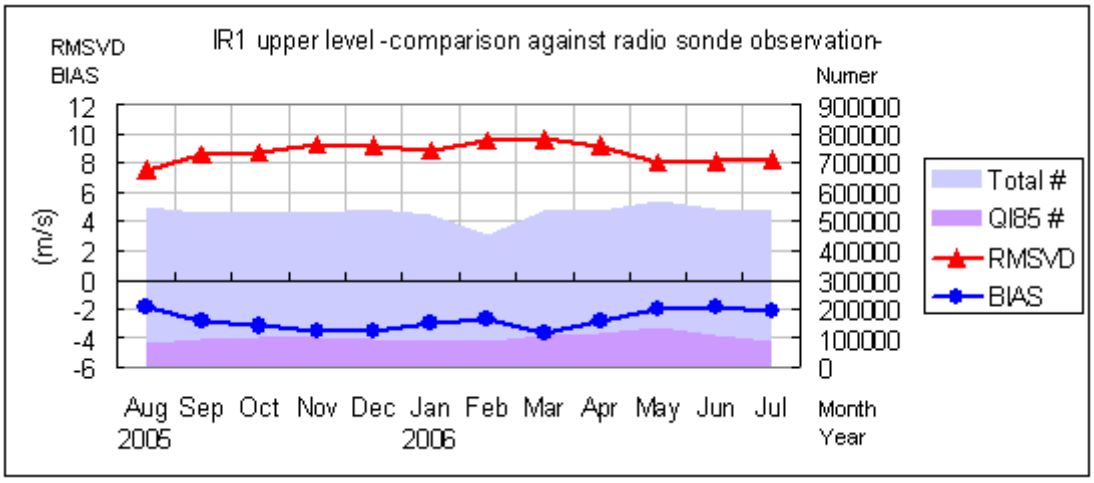

Figure 2 Number and quality of AMVs at upper height level (100-400 hPa) derived from infrared window images. The red line denotes RMSVDs, and the blue line denotes BIASs. The blue-shaded area denotes the total number of derived AMVs, and the purple-shaded area is the number of derived AMVs with QI larger than 0.85.

Figure 3 is similar to Figure 2, but for the AMV derived from water vapor images (WV AMVs). RMSVDs are in the range between 7.4 m/s and 8.8 m/s. BIASs are in the range between -0.3 m/s and 1.1 m/s.

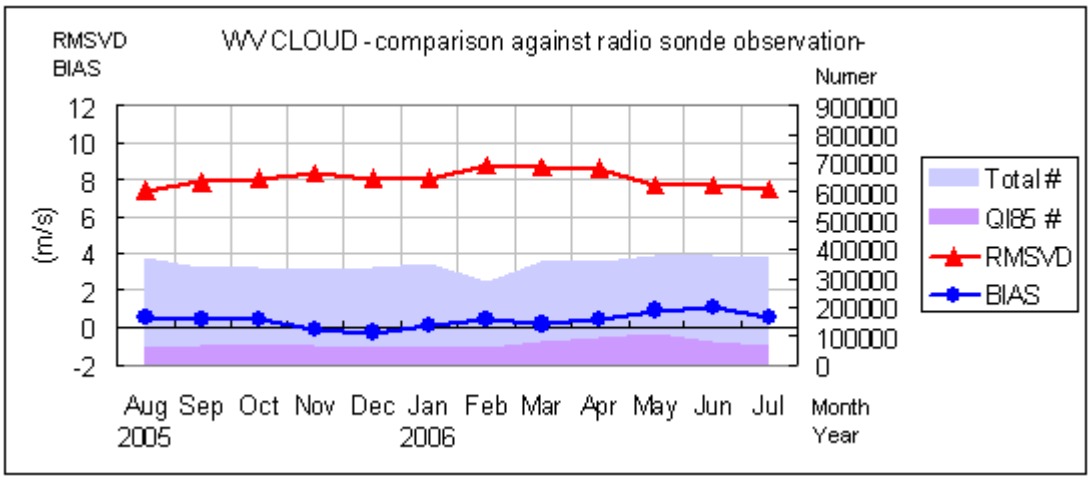

Figure 3 Number and quality of AMVs derived from water vapor channel images at upper height level (100-400 hPa) cloudy region. The red line denotes RMSVDs, and the blue line denotes BIASs. The blue-shaded area denotes the total number of derived AMVs, and the purple-shaded area is the number of AMVs with QI larger than 0.85.

Figure 4 is similar to Figure 2, but for the lower height level AMVs derived from visible images (VIS AMVs). RMSVDs are in the range between 3.6 m/s and 4.2 m/s. BIASs are in the range between -0.4 m/s and 0.6 m/s.

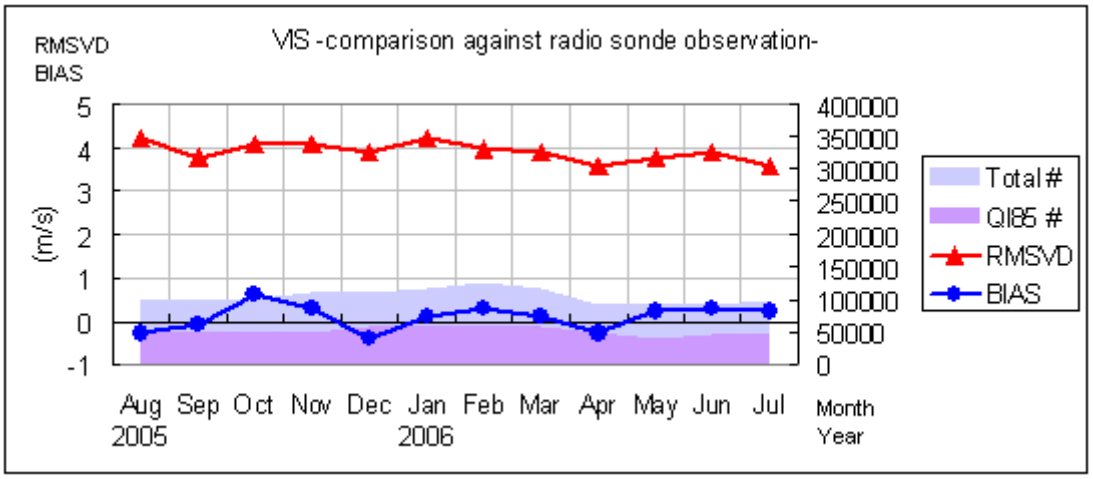

Figure 4 Number and quality of AMVs at lower height level (850-925 hPa) derived from visible images. The red line denotes RMSVDs, and the blue line denotes BIASs. The blue shaded area denotes the total number of derived AMVs, and the purple shaded area is that the number of AMVs with QI larger than 0.85.

3. STATUS OF MTSAT-1R HOURLY AMVS

For the evaluation of the quality of hourly AMVs, hourly AMVs have been compared to the observation data of JMA's wind profilers. There are 31 wind profilers installed in Japan, and their locations are shown in Figure 5.

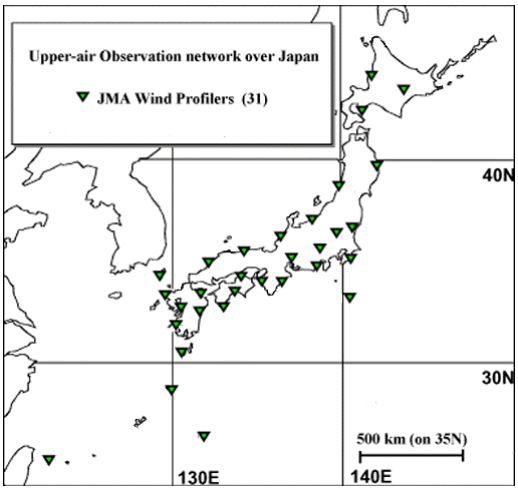

Figure 5 Location of wind profilers

Figure 6 shows the time series of monthly statistics (RMSVDs and BIASs) of the hourly IR AMVs on upper height level with reference to the data of wind profiler. The red lines denote the statistics of AMVs using 15 minutes interval images (00, 06, 12, 18 UTC), the blue lines denote those of using 30 minutes interval images (02-05, 08-11, 14-17, 20-23 UTC), and the green lines denote those of using 60 minutes interval images (01, 07, 13 and 19 UTC). In the comparisons, only AMVs with QI values larger than 0.85 are used. The average of the monthly RMSVDs are 8.0 m/s, 7.4 m/s and 7.0 m/s, for 15-, 30-, and 60-minute interval image AMVs, respectively. The averages of the monthly BIASs are -1.8 m/s, -1.7m/s, and -2.2 m/s for 15-, 30-, and 60-minute interval image AMVs, respectively.

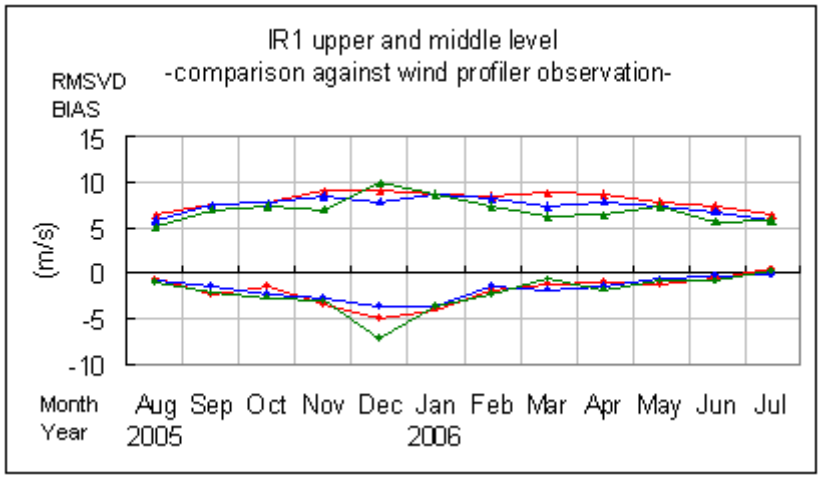

Figure 6 Time series of the monthly statistics (RMSVDs and BIASs) of IR AMVs at upper and middle height level (higher than 5000m) with reference to wind profiler observations. The upper lines denote RMSVDs, and lower lines denote BIASs. The red, blue and green lines denote the statistics of AMVs using 15-, 30-, and 60-minute interval images, respectively.

Figure 7 is similar to Figure 6, but for the hourly VIS AMVs. Averaged RMSVDs of 15-, 30-, and 60-minute AMVs are 7.2 m/s, 6.8 m/s, and 6.9 m/s, respectively. Averaged BIASs are -1.5 m/s, -1.4 m/s and -1.7 m/s, respectively.

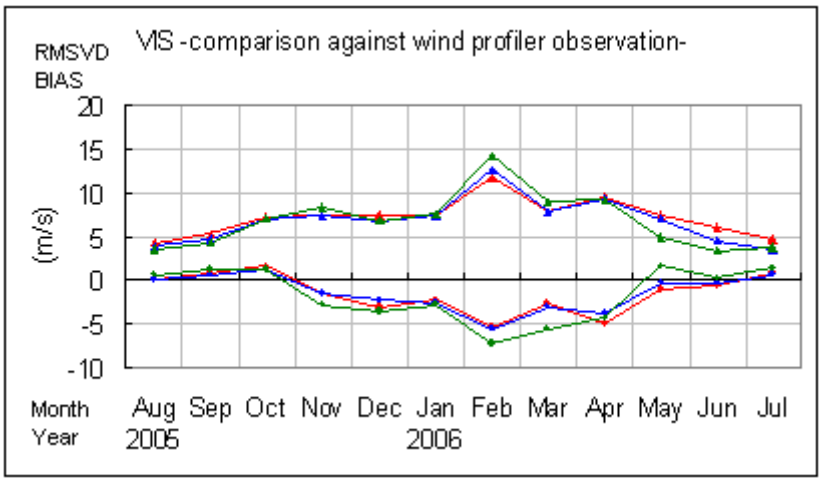

Figure 7 Time series of the monthly statistics of VIS AMVs at lower height level (less than 5000m) with reference to wind profiler observations. The upper lines denote RMSVD, and lower lines denote BIAS. The red, blue and green lines denote the statistics of AMVs using 15-, 30-, and 60-minute interval images, respectively.

4. ACTIVITIES TO IMPROVE AMV ACCURACY

As shown in Figure 1, there have been large negative BIASs against sonde, especially in winter hemisphere. Large negative BIASs against NWP wind also exist. For mitigating BIAS, JMA has been trying to improve the height assignment scheme. Table 2 shows the statistics of IR AMVs with the improved scheme against NWP winds (Test) at 06UTC on 3 August 2006. For comparison, those of routine AMVs are also shown (Routine). Much improvement in southern (winter) hemisphere is seen. JMA plans to introduce the new scheme on an operational basis, after the sufficient examination of the feasibility of the scheme and the notification to users.

Table 2 Statistics of IR AMVs with the improved scheme against NWP winds

AMV (QI>0.85) statistics	NH (50N-20N)		TR (20N-20S)		SH (20S-50S)	
against NWP wind	Routine	Test	Routine	Test	Routine	Test
RMS of vector difference (m/s)	6.79	7.10	5.17	4.95	13.29	9.05
Wind speed BIAS (m/s)	-1.49	-1.76	-0.95	-0.46	-7.33	-2.80

Red cells represent 'not improved' and blue cells represent 'improved'.