STATUS OF OPERATIONAL AMVS FROM FY-2C AND D

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Abstract

This paper describes operational status of NSMC AMVs and lists application examples of NSMC AMVs in daily weather forecast, compares NSMC AMVs and radiosonde winds, diagnoses possible reason for big difference between the two, and indicates future work for improving NMC AMVs.

1. Operation Status

Since the 8th International Winds Workshop (IWW8) held in April 2006, CMA continues AMV operations and services. At present, FY2-C (105ºE) and FY-2D (86.5ºE) are both in operation. Infrared (IR) and water vapor (WV) channel AMV derivations are performed for both FY2-C and D. For FY2-C, AMVs are provided at 00 06 12 18 GMT, while for FY-2D at 03 09 15 21 GMT. The wind derivation scopes are in the regions of 50º Lat/Lon around sub satellite points. The candidate tracers are arranged at integral Lat/Lon locations with grid distance 1 degree. 10201 (101×101) candidate tracers are traced for one image triplet per channel. Since the outer circles are used for homogenous exam, 9801 (99×99) tracers are effective. AMVs passed quality control are transmitted through GTS in BURF code. Wind derivation algorithm and QI definition are described at the IWW8 (2006). Table 1 shows FY2C data availability in the year of 2007. For one image triplet, IR and WV channels provide 3725 and 5307 wind data with QIs greater than 0.8 respectively. On the whole, areas are covered with IR and WV AMVs with QIs greater than 0.8 are 38% and 54% respectively. Operations for Dec. 2007 were normal but statistics were not made.

Year/Month	IR AMVs		WV AMVs	
	Disks Derived	AMVs Transmitted with QI >0.8	Disks Derived	AMVs Transmitted with QI >0.8
2007.01	122	459424	122	571544
2007.02	90	337384	90	463256
2007.03	87	315302	88	471599
2007.04	104	383544	104	558380
2007.05	113	422205	116	626394
2007.06	109	456023	109	628241
2007.07	123	495892	123	703915
2007.08	111	434727	112	617783
2007.09	89	335273	86	480937
2007.10	103	372474	106	537045
2007.11	97	320184	97	460604
2007.12	Statistics were not made.			
2008.01	115	386188	114	510290
2008.02	98	334682	52	249138
2008.03	93	362323	93	514033

Table 1: **AMV data transmitted through GTS in BURF code in 2007 for FY2C**

2. Application of NSMC AMVs in daily weather forecast

NSMC AMVs are overlapped with imageries and distributed to weather forecast offices. The duplication display of images and AMVs can also be downloaded at the web site of 《ftp://nsmc-ftp.cma.gov.cn/》. They take important role at daily weather forecast. Significant weather events and processes are well traced by the duplication displays. A few examples are shown here.

2.1 Long lasting cold event from 10 Jan. to 5 Feb 2008

From 10 Jan. to 5 Feb 2008, southern China experienced a long lasting cold event. Figure 1a, b and c are duplicate display of WV images and AMVs, NCEP 300hPa analysis and 300hPa Radiosonde wind at 0000 GMT 28 Jan 2008 respectively. Figure 1 clearly shows low latitude convections from India Ocean to Western Pacific islands, moist advection ahead of a large scale western trough from the low latitude convections towards Southern China, divergent flow in higher troposphere in Southern China, dry intrusion from Tibetan plateau, inner boundary in Kazakhstan and a very long trough from Kazakhstan to the borderline between Northeast China and Russia. On the whole, NSMC, NCEP and radiosonde winds show same pattern. Apparent different differences are in Bay of Bengal, southern South China Sea and Western Pacific near Philippines where NSMC AMVs clearly show large scale south flow. Associate with snow event in Southern China, we believe NSMC AMVs correctly describe moist flow from India and Western Pacific Oceans.

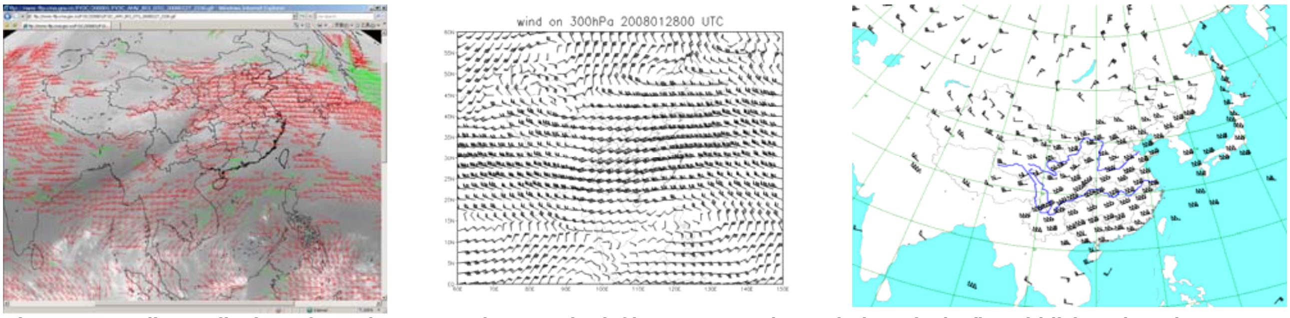

Figure 1: **Duplicate display of WV images and AMVs (a, left), NCEP 300 hPa wind analysis (b, middle) and 300hPa radiosonde wind (c, right) at 0000 GMT 28 Jan 2008**

2.2 Severe rainfall event from 2 to 10 July 2007

From 2 to 10 July 2007, Huahe river area of China experienced a severe rainfall event. Figure 2 is duplicate display of WV images and AMVs at 2330 GMT 05 July 2007. Figure 2 clearly shows a base surge in Japan sea, a zonal high level ridge extending from Tibetan Plateau to the Western Pacific south of Japan, a jet stream to the north of the ridge, divergent flow in higher troposphere between the ridge and the jet stream above the rainfall band and dry intrusion near the borderline between China and Mongolia. On the whole, NSMC, NCEP and radiosonde winds show same pattern. Divergent circulations flow out from the rainfall band extending from Eastern China to the South of Japan reflect are more clearly described by NSMC AMVs.

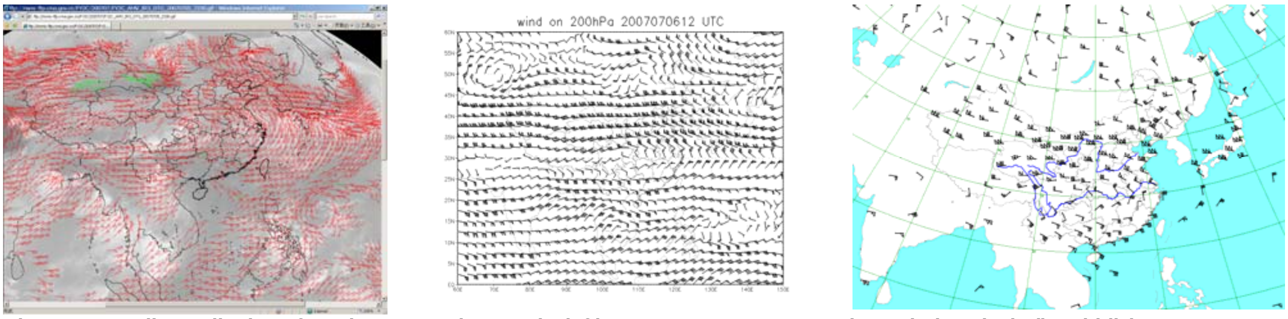

Figure 2 **Duplicate display of WV images and AMVs (a, left) at 0600 GMT, NCEP 200 hPa wind analysis (b, middle) at 0000 GMT and 200hPa radiosonde wind (c, right) at 0000 GMT 06 July 2007**

2.3 Rapid development event of a cyclone on 4 March 2007

On 4 March an extra tropical cyclone suddenly develop at Bohai Sea. Figure 3 is duplicate display of WV images and AMVs at 0530 GMT 04 March 2007. Figure 3 clearly shows the dry intrusion. At the time of figure 3, the dry intrusion is in the third stage (Patrick Santurette and Christo G.Georgiev, 2005). The ascending moist flow fans out in upper troposphere and climbs above the cold conveyor belt near the edge of warm conveyor belt. On the whole, NSMC, NCEP and radiosonde winds show same pattern. NSMC AMVs describe more clearly the moist flow from India Ocean and Southeast Asia Peninsula.

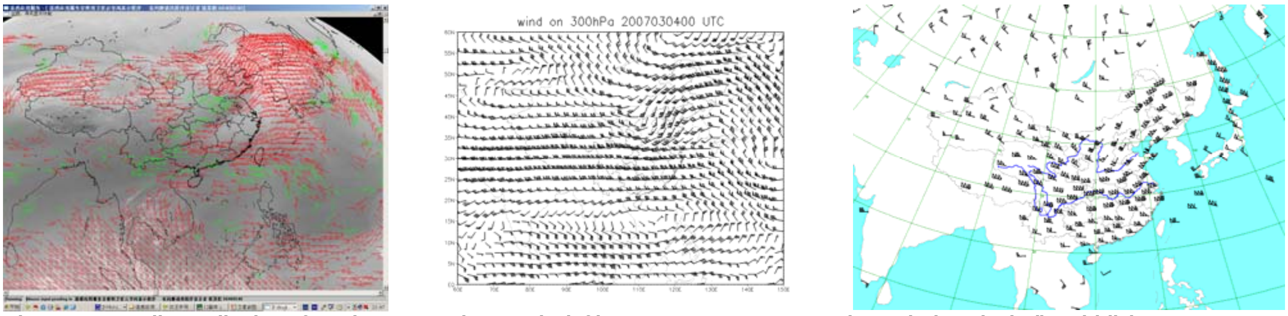

Figure 3: **Duplicate display of WV images and AMVs (a, left) at 0530 GMT, NCEP 300 hPa wind analysis (b, middle) at 0000 GMT and 300hPa radiosonde wind (c, right) at 0000 GMT 04 March 2007**

The related NWP analysis and radiosonde data verify the rationality of NSMC AMVs.

3. Comparison between NSMC AMVs and radiosonde data

Comparison between NSMC FY2C AMVs and radiosonde data were made. Results are shown in Tables 2-5. FY2D AMVs were derived with exactly same program. FY2D data is not on synoptic time and is not compared with radisonde. On the whole, wind directions are quite consistent with each other, NSMC AMV speeds are slower than radiosonde wind.

	Comparison Pairs	Bias		Absolute Difference		RMS Difference	
		Speed(m/s)	Angle(º)	Speed(m/s)	Angle(º)	Speed(m/s)	Angle(º)
2007.01	15706	-7	-4	10	19	13	36
2007.02	14690	-7	-2	9	16	12	27
2007.03	20208	-4	-1	7	14	11	25
2007.04	25850	-3	-1	6	15	9	31
2007.05	25974	-1	0	6	19	8	43
2007.06	24586	0	0	5	20	7	46
2007.07	29862	-1	-2	5	24	7	56
2007.08	25856	-3	0	5	23	8	55
2007.09	23623	-2	-3	6	19	8	43
2007.10	18884	-5	-2	7	18	11	38
2007.11	7804	-7	-2	9	20	12	43
2007.12	Statistics were not made.						
2008.01	15628	-9	-4	11	16	14	30
2008.02	8327	-9	-3	11	18	14	31
2008.03	20429	-7	-5	9	18	12	35

Table 2: **High Level (Above 400hPa) FY2C WV Wind Comparison with Radiosonde Winds**

	Comparison Pairs	Bias		Absolute Difference		RMS Difference	
		Speed(m/s)	Angle(º)	Speed(m/s)	Angle(º)	Speed(m/s)	Angle(º)
2007.01	1275	-4	-4	9	4	12	17
2007.02	1019	-6	-2	9	1	11	5
2007.03	1565	-5	-1	8	3	11	14
2007.04	1200	-3	-1	7	6	10	23
2007.05	1011	-1	0	6	4	9	15
2007.06	595	-1	0	6	0	8	3
2007.07	607	0	-2	5	1	7	3
2007.08	551	-1	0	5	1	8	5
2007.09	865	-2	-3	5	0	7	4
2007.10	993	-4	-2	7	2	9	9
2007.11	589	-5	-2	8	3	11	11
2007.12	Statistics were not made.						
2008.01	806	-4	-4	9	4	12	15
2008.02	594	-8	-3	10	3	13	11
2008.03	884	-5	-5	8	4	10	15

Table 3: **Middle Level (400-700 hPa) FY2C WV Wind Comparison with Radiosonde Winds**

	Comparison Pairs	Bias		Absolute Difference		RMS Difference	
		Speed(m/s)	Angle(º)	Speed(m/s)	Angle(º)	Speed(m/s)	Angle(º)
2007.01	9005	-10	-6	12	20	15	35
2007.02	9119	-10	-3	11	17	14	27
2007.03	13077	-8	-3	10	17	13	29
2007.04	18260	-6	-4	9	18	12	33
2007.05	18196	-4	-6	8	25	11	47
2007.06	18484	-5	-5	7	26	10	52
2007.07	20326	-4	-3	7	29	10	60
2007.08	16134	-4	-1	7	29	10	58
2007.09	16142	-4	-4	7	24	10	45
2007.10	11222	-7	-3	9	20	12	37
2007.11	4277	-8	1	9	23	13	46
2007.12	Statistics were not made.						
2008.01	10219	-10	-5	11	17	15	29
2008.02	8052	-11	-5	11	22	15	38
2008.03	13341	-9	-7	10	19	13	33

Table 4: **High Level (Above 400hPa) FY2C IR Wind Comparison with Radiosonde Winds**

	Comparison Pairs	Bias		Absolute Difference		RMS Difference	
		Speed(m/s)	Angle(º)	Speed(m/s)	Angle(º)	Speed(m/s)	Angle(º)
2007.01	784	-10	0	11	2	14	5
2007.02	426	-7	-1	8	2	11	6
2007.03	890	-6	0	7	2	10	7
2007.04	702	-4	-1	6	4	9	14
2007.05	514	-2	0	4	1	6	3
2007.06	374	0	0	4	0	6	0
2007.07	413	-1	0	4	0	6	0
2007.08	286	0	0	4	0	5	0
2007.09	479	-1	0	4	0	6	1
2007.10	650	-3	0	6	3	8	10
2007.11	216	-7	0	7	0	10	0
2007.12	Statistics were not made.						
2008.01	493	-9	0	10	1	13	4
2008.02	881	-11	0	11	1	14	8
2008.03	468	-6	0	7	2	10	7

Table 5: **Middle Level (400-700 hPa) FY2C IR Wind Comparison with Radiosonde Winds**

	Comparison Pairs	Bias		Absolute Difference		RMS Difference	
		Speed(m/s)	Angle(º)	Speed(m/s)	Angle(º)	Speed(m/s)	Angle(º)
2007.01	188	0	0	3	0	4	0
2007.02	110	0	0	2	0	3	0
2007.03	101	0	0	1	0	2	0
2007.04	56	0	-5	1	6	2	16
2007.05	47	0	0	1	0	2	0
2007.06	56	-2	0	3	0	3	0
2007.07	78	-1	0	2	0	2	0
2007.08	90	0	0	2	0	2	0
2007.09	99	0	0	2	0	2	0
2007.10	94	0	0	2	0	2	0
2007.11	51	0	0	1	0	1	0
2007.12	Statistics were not made.						
2008.01	58	0	0	3	0	3	0
2008.02	56	-1	0	3	0	4	0
2008.03	78	0	0	2	0	2	0

Table 6: **Low Level (Below 700 hPa) FY2C IR Wind Comparison with Radiosonde Winds**

4. Elements which may influence AMV quality

4.1 Image navigation quality

Image navigation influences AMV derivation greatly. Since April 2006, FY2 image navigation quality is improved, especially after orbital and attitude adjustment operations. But orbital and attitude adjustment operations still influence AMV quality. Rooms for further improvements at FY2 image navigation are limited.

4.2 Image calibration quality

The IR channels of FY-2C are calibrated by using the cross-calibration algorithm. The calibration error is mainly caused by noises from variable environmental background radiation. For the high cloud area with low cloud top temperature, the error in measured bright temperature is larger. Fig. 4 shows statistics of the bright temperature difference between AVHRR and FY-2C for cloud top areas with brightness temperature 200-220K. The bright temperature difference may reach several degrees. Further efforts will be made to improve FY2 calibration at low temperature end.

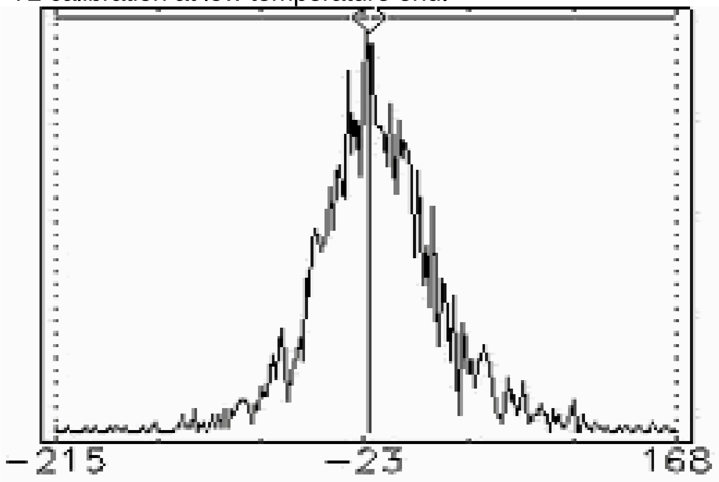

Fig. 4: **The bright temperature difference histogram between AVHRR and FY-2C for cloud top areas with brightness temperature 200-220K**

Ordinate：Frequency，Abscissa：Bright temperature difference Unit: 10K

4.3 NWP analysis quality

At present, NSMC AMV derivations use CMA NWP data without satellite data been simulated. Fig.5 compares CMA and ECMWF NWP wind fields before (left) and after (right) 3D-Var is tested at CMA. Fig. 5 shows great improvements after 3D-Var is made. The CMA 3D-Var simulation will be operational in the middle of 2008. It is expected that after CMA 3D-Var simulation is in put into operation, NSMC AMV quality will be improved.

4.4 Algorithm improvement

In 2008, it is planned to check NSMC AMV algorithm for improvements in height assignment.

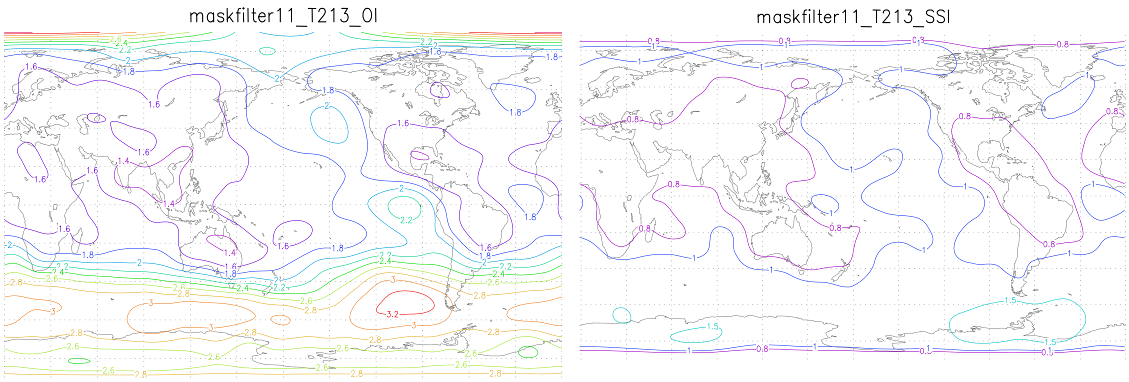

Fig.5: **Comparison between CMA and ECMWF NWP wind speed analysis fields before (left) and after (right) 3D-Var is performed at CMA**

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