CGMS-XXIX JPN-WP-13
Prepared by Japan
Agenda Item: III/4
Discussed in WG III

Height Assignment of Cloud Motion Wind for Semi-transparent Clouds in JMA

In response to the Action 28.28, JMA reviewed the current operational height assignment techniques and reports to CGMS XXIX on the multi-spectral method used for the height assignment in JMA.

No action is required on this subject.

Height Assignment of Cloud Motion Wind for Semi-transparent Clouds in JMA

1. Background

At the CGMS XXVIII meeting, the Working Group (WG) III addressed the long-standing problem of a speed bias and encourages satellite wind producers to maintain further research concerning that problem. WG III discussed possible causes of the speed bias. Considering that height assignment of semi-transparent clouds is a potential cause of a bias, WG III noted the need to review the current operational height assignment techniques.

ACTION 28.28 CGMS Members to provide working papers to CGMS XXIX on operational multi-spectral methods used for the height assignment of cloud-tracked winds. The analysis should also include accuracy estimates for the heights of semi-transparent clouds.

In response to the Action 28.28, JMA reviewed the current operational height assignment techniques and reports to CGMS XXIX on the multi-spectral method used for the height assignment in JMA and the estimation of accuracy of the height assignment.

2. Multi-spectral method for height assignment

The Meteorological Satellite Center (MSC) introduced a multi-spectral method to the height assignment for the operational IR wind extraction. The VISSR channels used for the method are the IR-1 channel in 11 micron band and the WV channel in 6.7 micron band. The procedure of the multi-spectral method is as follows:

(1) Figure 1 shows a schematic diagram for the height assignment of semi-transparent clouds for IR high-level winds in multi-spectral method. The relation between the brightness temperatures of IR and WV channels is calculated using atmospheric temperature and water vapor amount of the Numerical Weather Prediction of the JMA Global Spectral Model (GSM), and is shown as a IR-VW curve in the Figure 1. In the processing for the height assignment, the relation is actually provided as a Look-Up Table (LUT).

(2) In the IR-WV scatter diagram, the distribution of every IR and WV pixels observed in a target area of 32 x 32 pixels is discriminated to up to 20 clusters using cluster analysis method. The clusters within 2.5 degrees from the IR-WV brightness temperature curve are not used for the processing of the height assignment.

(3) The background brightness temperatures for IR and WV in each target area are statistically calculated with the VISSR images in clear sky condition observed in the previous day.

(4) A straight line is drawn from the point of the background temperatures to the center of gravity of a cluster in the IR-WV scatter gram. Then the intersection of the straight line and the curve is found and the brightness temperature of IR at the

intersection is set to be the corrected brightness temperature for all of the pixels in the cluster. The corrections are conducted for every cluster selected in the procedure (2).

(5) If no intersection is found, a linear regression line is drawn with the brightness temperatures for IR and WV in the cluster (cluster 3). And the IR brightness temperature at the intersection of the regression line and the curve is set to be a corrected IR brightness temperature instead.

(6) The histogram of the IR brightness temperature is revised with the corrected brightness temperatures of the clusters.

(7) The cloud top heights are assigned to the satellite-derived wind vectors with the corrected IR brightness temperature histogram using the minimum temperature method.

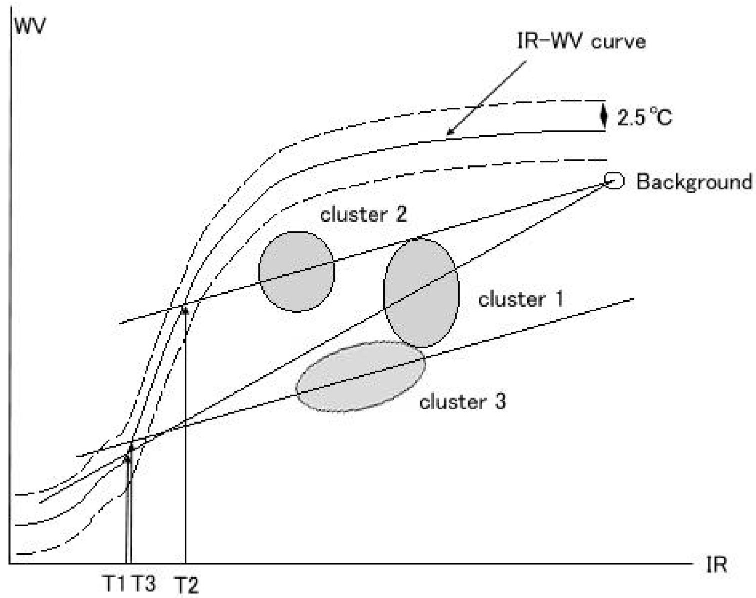

Fig. 1 Schematic diagram for height assignment of IR high-level winds in multi-spectral method

3. Accuracy estimation of the height assignment

A study for the estimation of accuracy of the height assignment was made for September 1995 and January 1996 after the commencement of the GMS-5 operation and the result of the study was reported to the third international wind workshop held in Ascona, Switzerland from 10 to 12 June 1996. The following is the summary of the result.

The accuracy for two cases, i.e. Case 1: Minimum temperature method only (not corrected) and Case 2: Multi-channel method (corrected), are shown in Table 1. It should be noted that the two cases have no relation in the statistics, namely corrected or not corrected. In other word, the same pixels were not applied to the two cases.

There were few events in which the correction was effectively applied although the number of vectors is small and the duration of the study is short only for September 1995 and

January 1996.

Table 1 Statistical results of high-level CMWs

September 1995														
50-20N					20N-20S					20S-50S				
400-300hPa					400-300hPa					400-300hPa				
CASE	N	BIAS	MEAN	RMSDV	CASE	N	BIAS	MEAN	RMSDV	CASE	N	BIAS	MEAN	RMSDV
1	356	-6.0	13.9	17.7	1	76	-1.5	6.8	13.3	1	43	-12.7	17.3	17.2
2	1	-4.6	20.8	9.4	2	-	-	-	-	2	-	-	-	-
300-200hPa					300-200hPa					300-200hPa				
CASE	N	BIAS	MEAN	RMSDV	CASE	N	BIAS	MEAN	RMSDV	CASE	N	BIAS	MEAN	RMSDV
1	469	-5.2	15.1	17.7	1	241	-3.5	7.7	10.2	1	17	-14.3	17.8	10.2
2	23	-1.7	14.7	8.5	2	54	-3.9	9.7	12.3	2	-	-	-	-
200-100hPa					200-100hPa					200-100hPa				
CASE	N	BIAS	MEAN	RMSDV	CASE	N	BIAS	MEAN	RMSDV	CASE	N	BIAS	MEAN	RMSDV
1	132	-4.8	9.0	10.5	1	202	-7.1	8.2	12.5	1	-	-	-	-
2	8	-3.7	12.2	25.4	2	40	-5.8	11.9	11.8	2	-	-	-	-

January 1996														
50-20N					20N-20S					20S-50S				
400-300hPa					400-300hPa					400-300hPa				
CASE	N	BIAS	MEAN	RMSDV	CASE	N	BIAS	MEAN	RMSDV	CASE	N	BIAS	MEAN	RMSDV
1	150	-6.0	13.9	17.7	1	129	-0.5	6.9	11.3	1	103	-3.9	10.5	16.0
2	-	-	-	-	2	-	-	-	-	2	-	-	-	-
300-200hPa					300-200hPa					300-200hPa				
CASE	N	BIAS	MEAN	RMSDV	CASE	N	BIAS	MEAN	RMSDV	CASE	N	BIAS	MEAN	RMSDV
1	35	-5.2	15.1	17.7	1	283	-3.0	7.7	10.2	1	99	-5.9	13.4	14.0
2	-	-	-	-	2	77	-2.4	9.7	12.3	2	1	-0.4	17.0	6.7
200-100hPa					200-100hPa					200-100hPa				
CASE	N	BIAS	MEAN	RMSDV	CASE	N	BIAS	MEAN	RMSDV	CASE	N	BIAS	MEAN	RMSDV
1	3	-29.0	30.1	42.6	1	238	-6.4	7.4	10.9	1	21	-7.9	9.6	14.1
2	-	-	-	-	2	53	-6.5	9.7	11.9	2	-	-	-	-

Case 1: Minimum temperature method only; Case 2: Multi-channel method

Reference

Tokuno, M: "Operational system for extracting cloud motion and water vapor motion winds from GMS-5 image data", Proceedings of the third international winds workshop, EUM P 18, pp20-30.