Status of operational AMVS from FY-2 satellites since the 10th wind workshop

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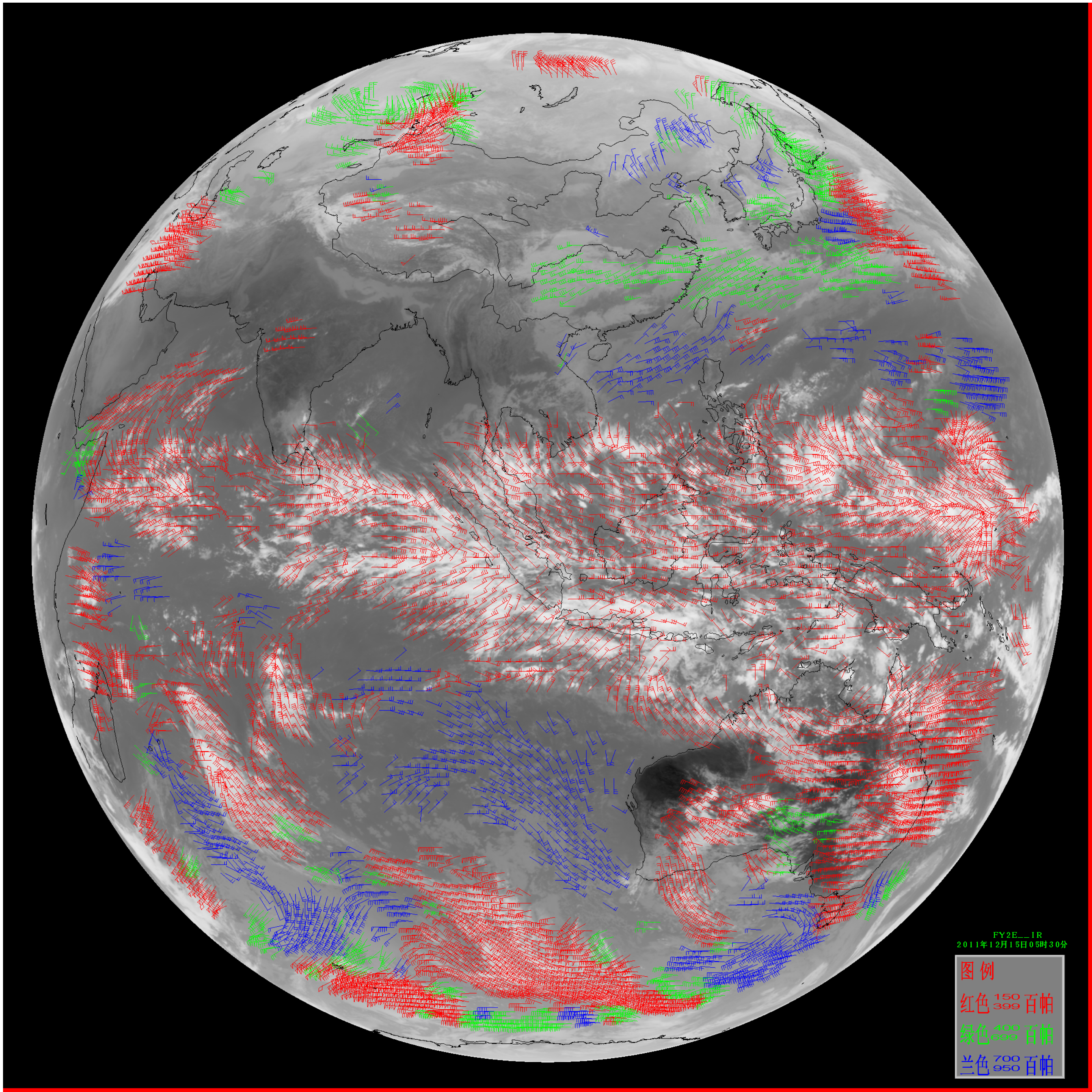
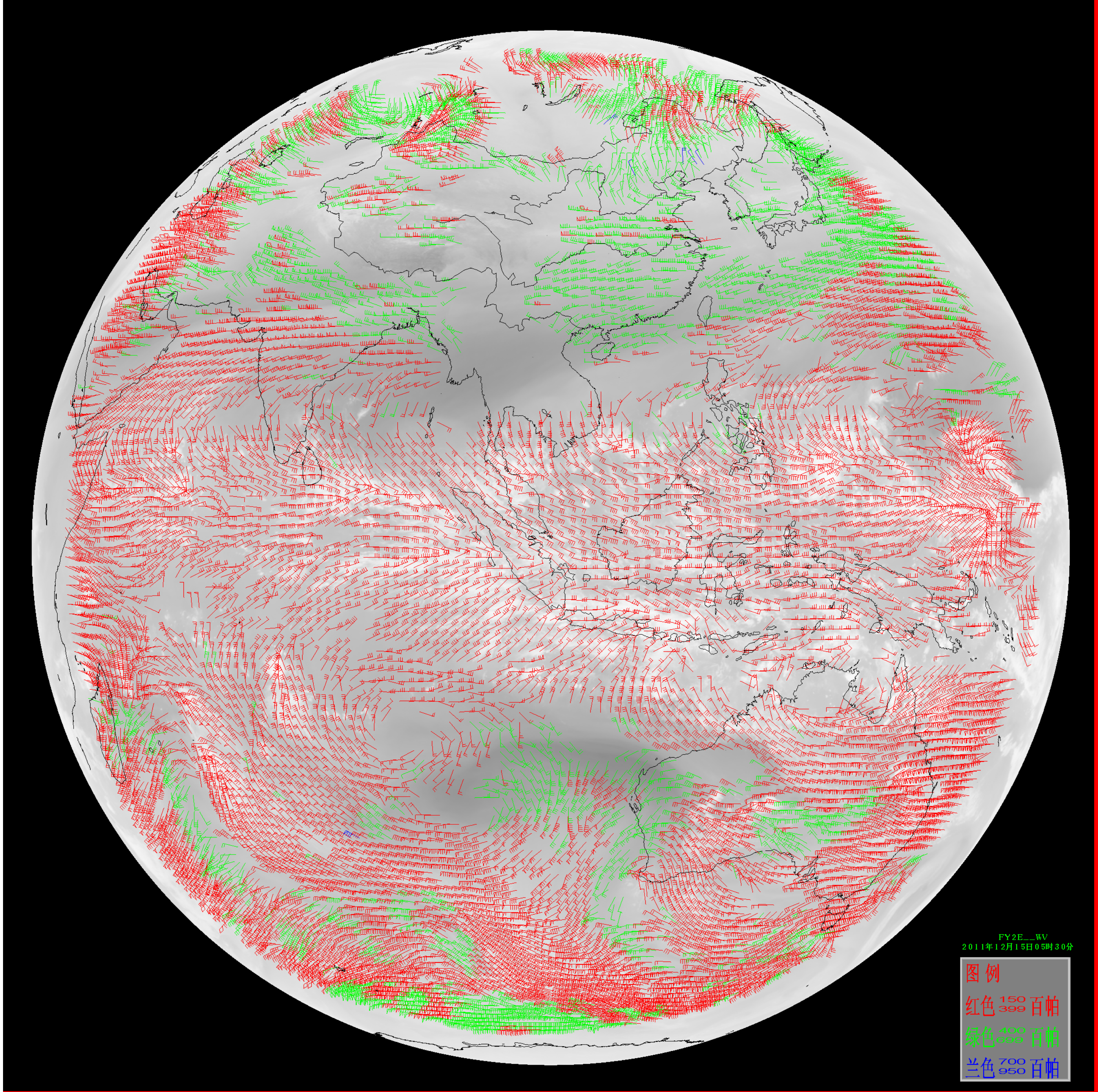
Operation status

- Since the 10th wind workshop, FY2-E (105°E) and FY-2D (86.5°E) are both in operation. Infrared (IR) and water vapor (WV) channel AMV derivations are performed for both FY2-E and D.
- For FY2-E, AMVs are provided at 00 06 12 18 GMT, while for FY-2D at 03 09 15 21 GMT.
- AMVs passed quality control are transmitted through GTS in BURF code.

IR winds at 06 GMT, Dec. 15, 2011



WV winds at 06 GMT, Dec. 15, 2011



RMS differences between FY2 IR and Radio sonde winds

	High level winds (Above 399hPa)			Middle level winds (Between 400-699hP)			Low level winds (Below 700hPa)		
	2009	2010	2011	2009	2010	2011	2009	2010	2011
Jan.	14.94	13.63	7.26	13.58	12.26	11.94	10.32	7.55	5.27
Feb.	15.46	12.64	**6.98**	12.67	12.27	**10.50**	8.13	7.00	**5.10**
March	13.19	12.88	**7.15**	12.60	12.10	**9.30**	9.72	9.30	**6.03**
April	13.79	12.40	**7.33**	11.79	10.83	**8.98**	8.24	8.27	**4.78**
May	10.74	10.74	**7.25**	11.37	10.71	**7.46**	6.61	6.09	**4.42**
June	10.81	10.32	**7.75**	9.88	8.48	**8.50**	6.12	7.0	**5.03**
July	10.10	8.93	**7.53**	9.29	9.21	**7.50**	5.55	6.16	**4.95**
Aug.	8.80	8.78	**8.99**	10.96	10.09	**8.27**	5.79	5.86	**5.55**
Sept.	9.17	8.74	**8.44**	9.90	8.51	**6.78**	7.54	6.24	**3.72**
Oct.	10.94	10.74	**8.31**	9.99	9.55	**8.14**	5.66	10.48	**3.60**
Nov.	11.60	11.05	**8.59**	12.73	11.73	**9.60**	12.70	6.71	**4.58**
Dec.	13.30	11.37	**7.95**	15.26	14.79	**10.56**	6.86	8.44	**6.01**

Since Feb. 2011, algorithm for IR channel has been improved. After improvement, the comparison results are shown in thick words. Apparent improvements are noticed.

RMS differences between FY2 WV and Radio sonde winds

	High level winds (Above 399hPa)			Middle level winds (Between 400-699hP)		
	2009	2010	2011	2009	2010	2011
Jan.	12.86	11.27	10.62	15.65	16.02	14.54
Feb.	12.66	10.92	10.40	15.70	14.54	13.38
March	11.84	9.92	9.68	14.90	14.81	12.97
April	9.30	9.65	9.11	9.56	13.36	12.20
May	8.17	8.77	8.76	8.61	11.25	10.05
June	8.13	8.36	9.71	9.37	9.28	10.10
July	7.90	8.09	9.66	10.06	11.02	11.36
Aug.	8.04	8.19	9.98	10.09	11.86	12.08
Sept.	8.94	8.52	**6.93**	9.57	10.19	**7.83**
Oct.	8.63	8.50	**6.29**	9.52	9.42	**7.86**
Nov.	9.51	10.43	**6.04**	12.37	13.16	**7.32**
Dec.	10.08	11.27	**6.41**	16.02	16.05	**8.21**

Since Sept. 2011, algorithm for WV channel has been improved. After improvement, the comparison results are shown in thick words. Apparent improvements are noticed.

Major algorithm improvements for IR channel winds

① the IR/WV relationship fitness between theoretical opaque clouds and observational semi-transparent clouds are improved;

② clear sky radiance is involved in making IR/WV relationship statistics of semi-transparent clouds;

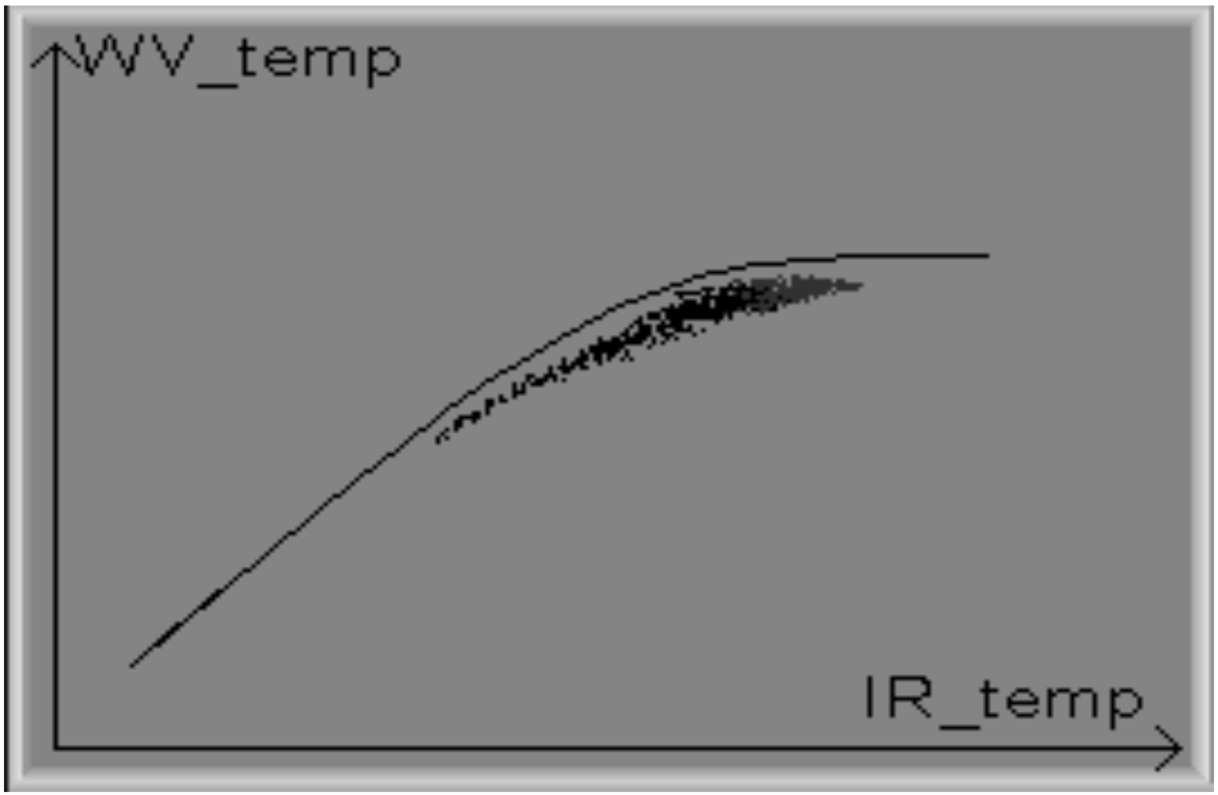
③ contribution to coefficient for individual pixels (ccij) are considered at height assignment.

In revising the algorithm, documents (Borde R. and Oyamma R., 2008) and (Takahito I, and Oyama R, 2008) were referenced.

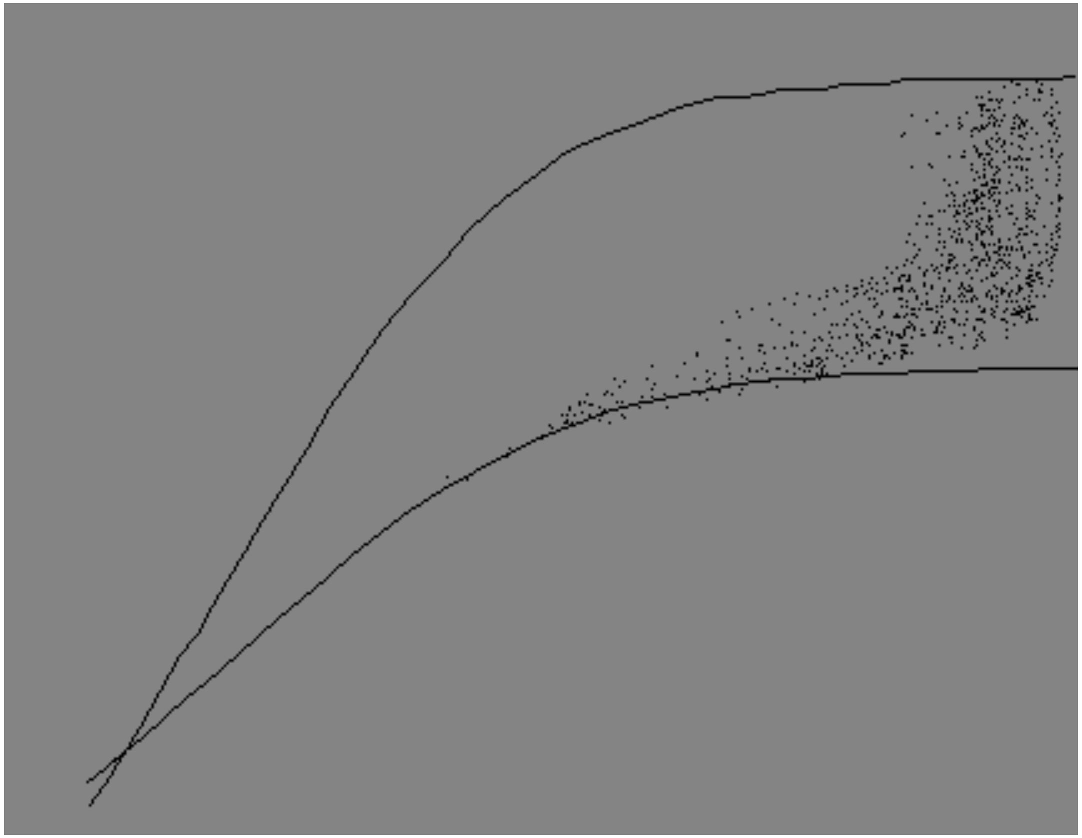
The IR/WV relationship fitness between theoretical opaque clouds and observational semi-transparent clouds

- In making height adjustments, two IR/WV relationships are used: a curve and a straight line. The curve is calculated from NWP data for opaque clouds; the straight line is extracted from satellite observation for semi-transparent clouds. They should be fit with each other.
- Fig. 2 is the fitness scheme diagrams between the two IR/WV relationships. In case the scene holds different types of clouds including opaque clouds, the upper outline of the satellite observation should approach the curve as shown in Fig. 2a. In reality, this regulation was not met for many scenes, as shown in Fig. 2b. In Fig. 2b, the major observational data are even above the curve calculated from NWP data. Before making height adjustment, it is need to make adjustment to the curve calculated from NWP data.

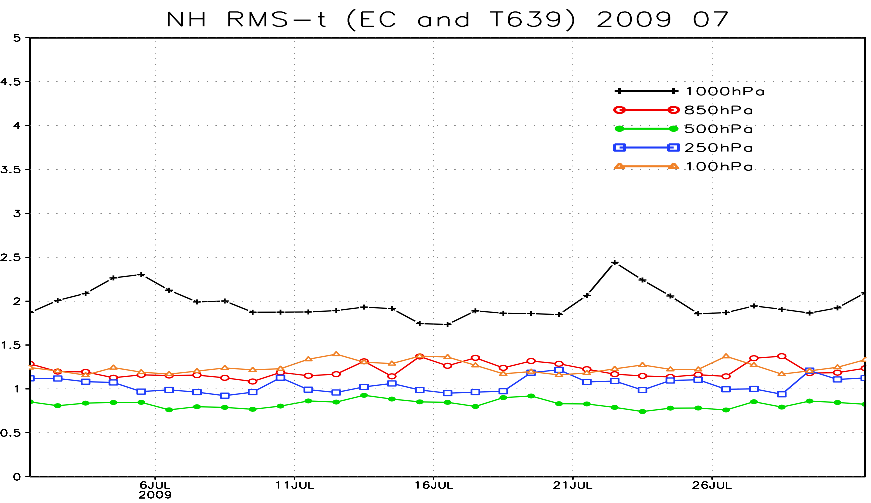
A scene holding different types of clouds including opaque clouds. In this case, the upper outline of the observational IR/WV relationship is duplicated with the IR/WV relationship calculated from NWP data

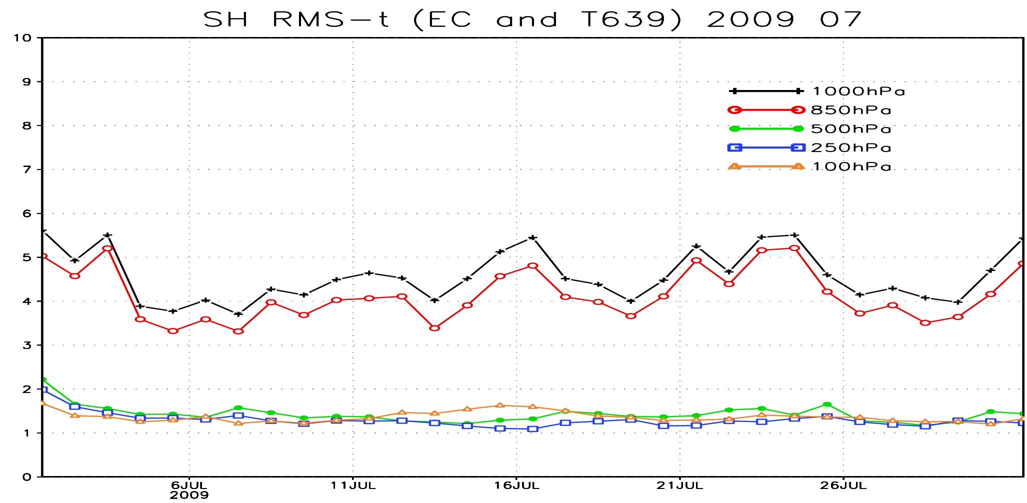


A scene. In this case, the upper outline of the observational IR/WV relationship is not duplicated with the IR/WV relationship calculated from NWP data.



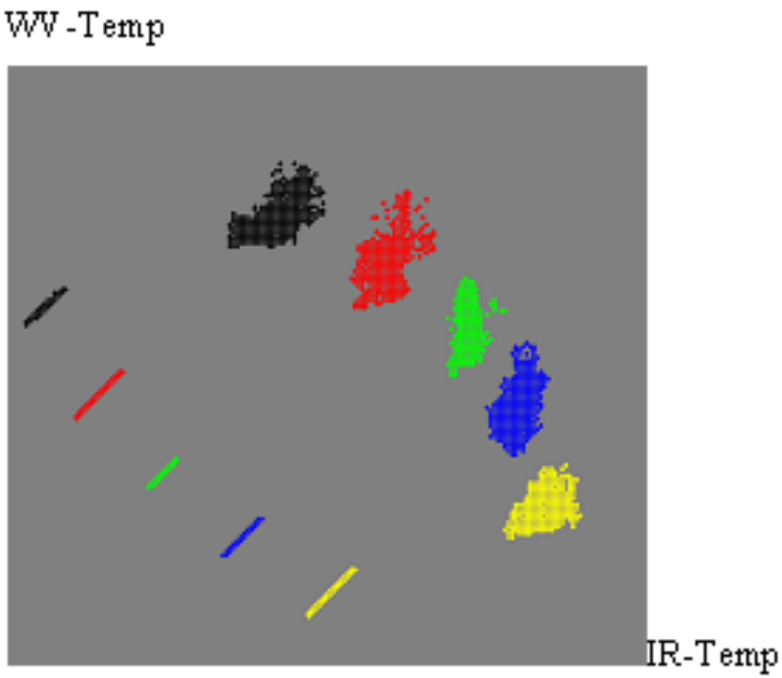
RMS difference of temperature analysis between Chinese T639 model and ECMWF in July 2009





- The Chinese T639 model analysis results are 2°and 4-5°departure from the ECMWF analysis in northern and southern hemispheres respectively. This model analysis error may influence radiation calculation.

The statistics for the differences between calculated and observational IR/WV relationship values at the two terminal points: surface and top of the atmosphere



In Figure 4, the differences at surface and at the top of the atmosphere are plotted on upper right and down left sides respectively； the differences at different latitudinal zones from north to south are shown from upper left to downright sides. From Fig.4, it is noticed that for all latitudinal zones, the differences between calculated and observational IR/WV relationship values are bigger at the surface than at the top of the atmosphere. Thus, in the improved algorithm, the IR/WV relationship curve for opaque cloud is moved in the following way: At the surface, the terminal point of the curve fit the upper outline of observational value; at the top of the atmosphere, the terminal point of the curve does not move; between the two terminals, the curve moves proportionally.

Clear sky radiance involved in making IR/WV relationship statistics of semi-transparent clouds

- Clear sky radiance is guessed from large area and historical maxima. Large area is an area with size 64×96 pixel. It is extended from the 32×32 pixel size tracer. Historical data in the past 15 days is considered. Clear sky radiance estimated is involved in making IR/WV relationship straight line for semi-transparent clouds, see next section.

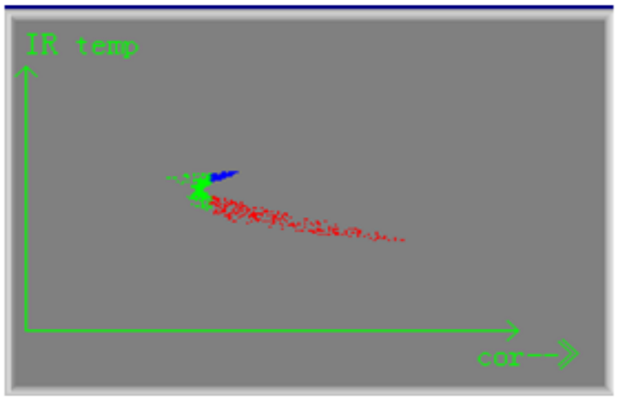
Contribution to coefficient for individual pixels (ccij) considered at height assignment

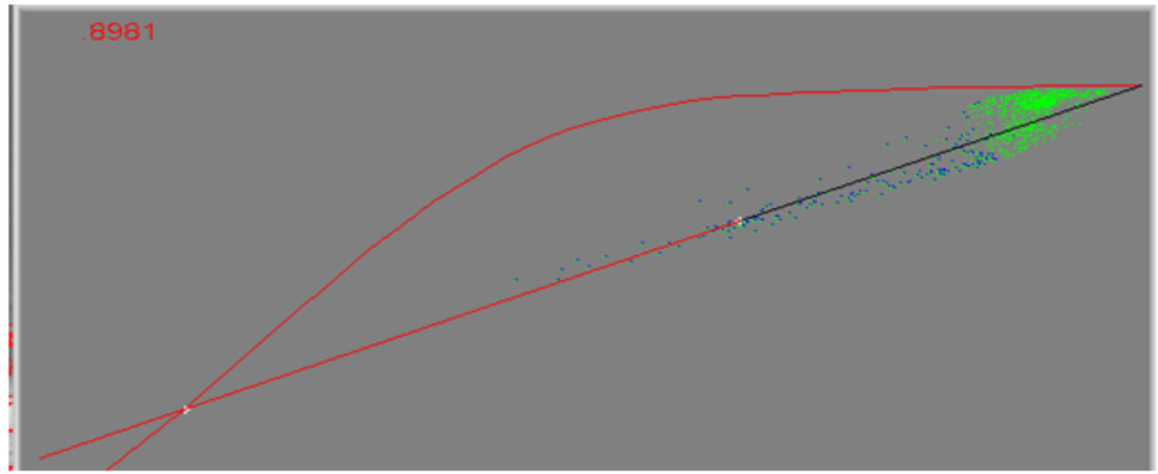
- Contribution to coefficient for individual pixels (ccij) proposed by Borde R. and Oyamma R. (2008) are examined.
- By checking variety of data, it is noticed that in using ccij method in height adjustment, it is need to notice ccij distribution patterns. In some patterns, colder pixels represent motion of the tracer; while in other pattern, warmer pixels represents motion of the tracer.

There are 4 types of patterns.

- Figures 5-8 (a) are scheme diagrams to illustrate the patterns. In Figs. 5-8 (a)， abscissa is the contribution to coefficient for individual pixels (ccij), ordinate is the IR brightness temperature. Pixels in the tracer are divided into 3 groups. Group 1 contains 1/3 pixels with least contributions and middle range IR brightness temperatures in the tracer. This group is shown in green. The other two groups with larger contributions contains 2/3 pixels in the tracer totally. Group 2 shown in blue is warmer in IR brightness temperature and group 3 shown in red colder. Figures 5-8 (b) are used to make the height adjustment. In Figs. 5-8 (b), clear sky radiances are linked with the radiances from the group with significant contribution to the motion of the tracer. The lines are then extended and crossed with the IR/WV relationships of theoretical opaque clouds to form the height adjustment point.

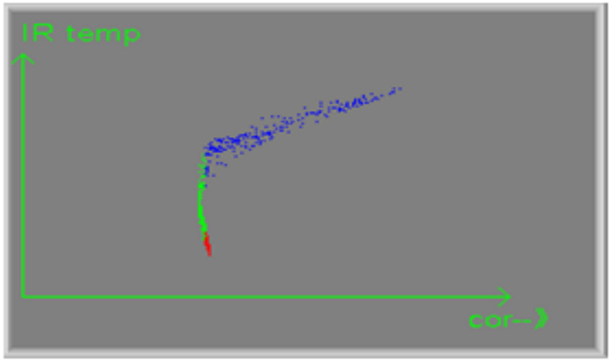
Type 1: Colder pixels make significant contribution to the motion of the tracer

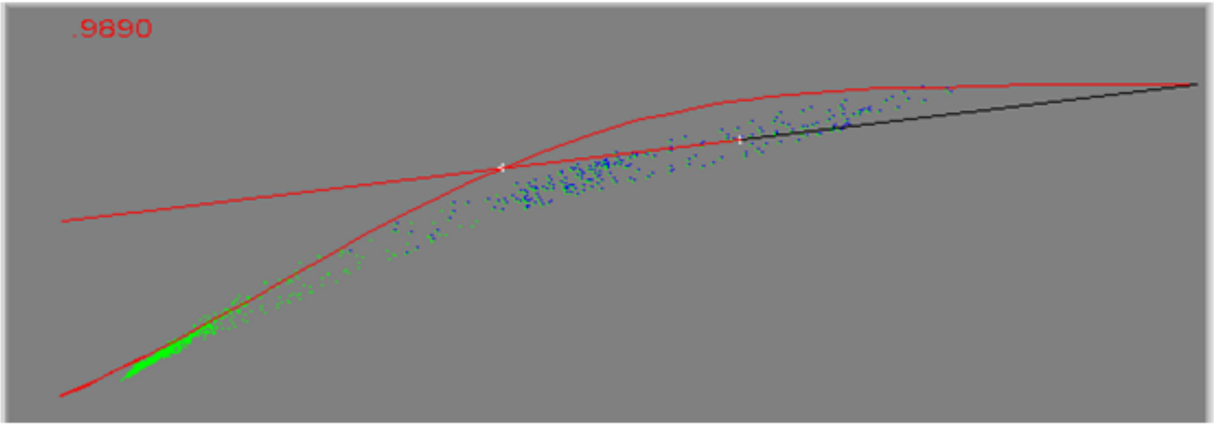




- Figure 5 is the scheme diagrams of pattern 1. In fig. 5 (a) colder pixels in red are much longer in length and greater by number than warmer pixels. This is the tracer containing multi level of clouds. Under the high level clouds, there are different lower clouds with different motion. High level clouds represent the motion of the tracer. For this pattern, height assignment should be based on the colder group of pixels.

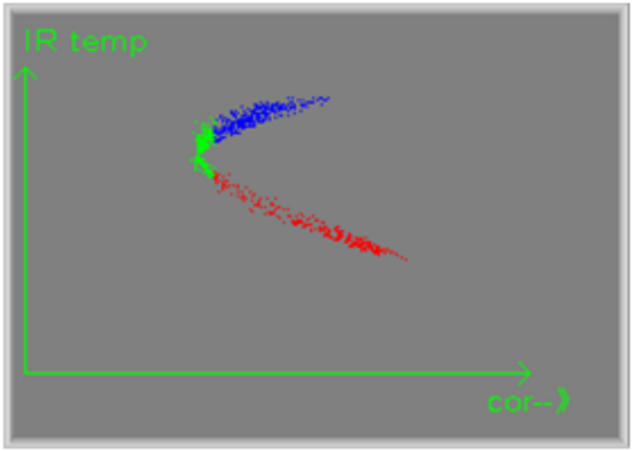
Type 2: Warmer pixels make significant contribution to the motion of the tracer

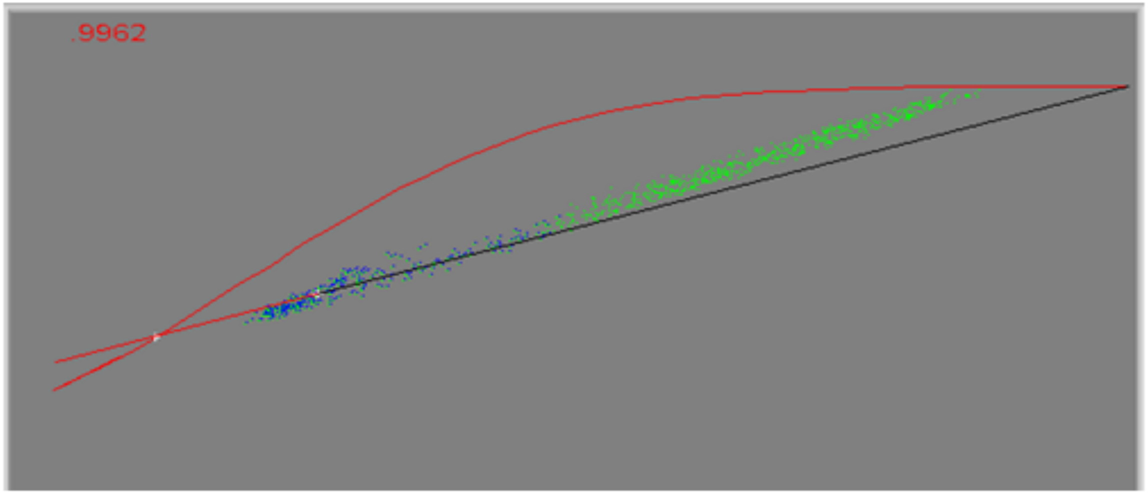




- Figure 6 is the scheme diagrams of pattern 2. In fig. 6 (a) warmer pixels in blue are much longer in length and greater by number than colder pixels. This is the tracer containing stratus clouds embedded with convections. The convection clouds embedded in the frontal cloud belt do not represent motion of the stratus cloud which is warmer. For this pattern, height assignment should be based on the warmer group of pixels.

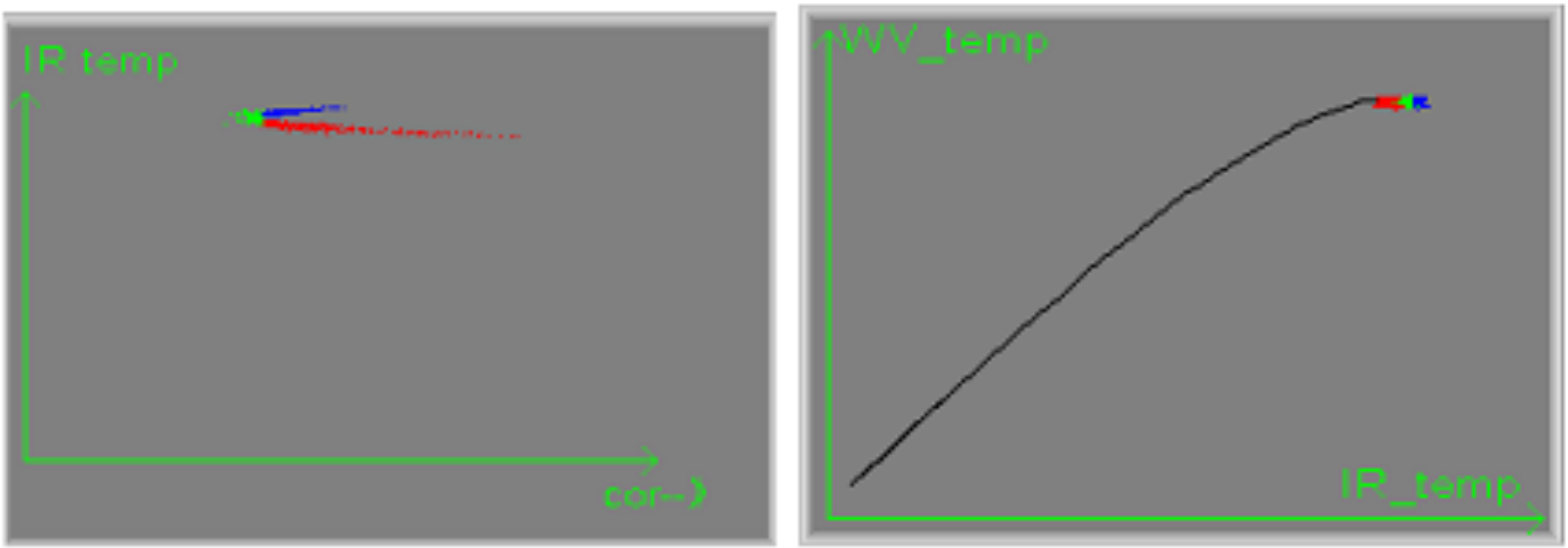
Type 3: Both warmer and colder pixels make significant contribution to the motion of the tracer and the clouds in the tracer are very high





- Figure 7 is the scheme diagrams of pattern 3. In fig. 7 (a), the warmer pixels in blue and the colder pixels in red are comparable in length and by number. The dynamical range of IR brightness temperature is big. This is the tracer containing high level clouds and surface. For this pattern, height assignment should be based on the colder group of pixels and height adjustment should be performed.

Type 4: Both warmer and colder pixels make significant contribution to the motion of the tracer and the clouds in the tracer are very low



- Figure 8 is the scheme diagrams of pattern 4. In fig. 8 (a), the warmer pixels in blue and the colder pixels in red are comparable in length and by number. The dynamical range of IR brightness temperature is small. This is the tracer containing low level clouds and surface. For this pattern, height assignment should be based on the colder group of pixels and height adjustment should not be performed.

Major algorithm improvements for WV channel winds

- Since Sept., 2011, WV algorithm is improved. Contribution to coefficient for individual pixels (ccij) proposed by Borde R. and Oyamma R. (2008) are also examined for WV winds.
- Similar analysis as IR channel is also performed. For WV channel, height assignment is based on the colder group of pixels with contribution to the motion of the tracer.
- If the major pixels with contribution to the motion are judged as high level clouds, height adjustment is not performed.
- If the major pixels with contribution to the motion are judged as clear sky area, height adjustment is performed.

Future works

① Location of the pixels which makes contribution to the motion of the tracer will be considered.

② Viewing angle bias will be adjusted.

③ Tracing size influences will be examined.

④ Calibration and navigation will be improved.

End