

NOWCASTING PRODUCTS BASED ON MTSAT-1R RAPID SCAN OBSERVATION

In response to CGMS Action 38.33

This document reports on JMA's MTSAT-1R Rapid Scan (RS) operation activities and nowcasting products produced using related data.

Since 7 June, 2011, JMA has disseminated information on clouds around Japan to aviation users. The data used come from RS observations made at five-minute intervals, and are also adopted for the formulation of a nowcasting product to detect rapidly developing cumulus areas (RDCAs). JMA is also preparing to provide information on cumulonimbus cloud areas in addition to the cumulus cloud information from summer 2012.

RS observations were carried out at 10-minute intervals using MTSAT-1R from February to May 2011 to monitor the distribution and diffusion of volcanic ash.

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1 SUMMARY OF RAPID SCAN OBSERVATION

The Japan Meteorological Agency (JMA) started MTSAT-1R Rapid Scan (RS) observation on 7 June, 2011. A summary of RS operations is shown in Table 1. Regular operation is performed during the daytime from 09 JST to 19 JST with observations at five-minute intervals during the summer period from June to September. If volcanic ash monitoring is required, special operation is performed on a 24-hour basis at 10-minute intervals. The observation specifications of both types of operation are shown in Figure 1.

The aim of these operations is to provide information on severe phenomena observed to aviation users in a timely manner. From observations in regular operation, cloud images are produced (e.g., visible images, visible/infrared color composite images, cloud top height images and images of developing and developed cumulus clouds). The development of cumulus cloud information is under way, and its provision is scheduled to start in summer 2012. From special operations, 10.8 – 12.0 micron imagery is provided.

Table 1 Types of rapid scan operation

Operation type	Regular	Special
Observation interval	5 minutes	10 minutes
Time	Daytime only (00:00 to 09:00 UTC)	24 hours
Period	Summer only (June to September)	As required for volcanic ash monitoring
Objective	Detection of rapidly developing cumulus areas	Volcanic ash monitoring
Operation record	From 7 June, 2011 (Ongoing)	From 4 February, 2011 to 23 May, 2011 (Experimental operation conducted during the eruption of Kirishimayama)

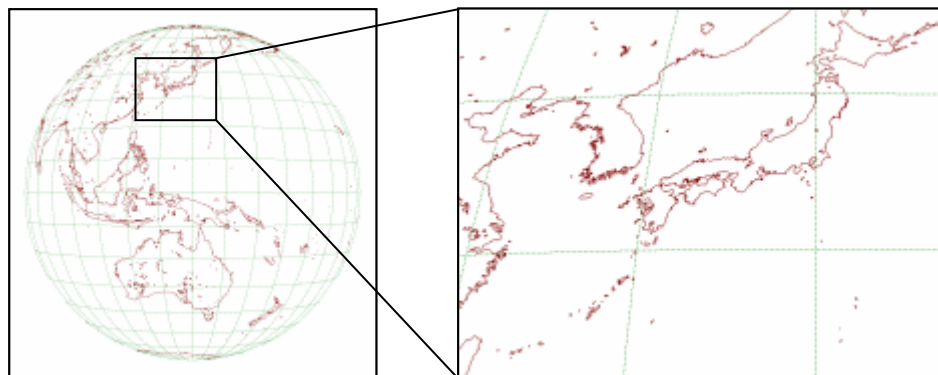
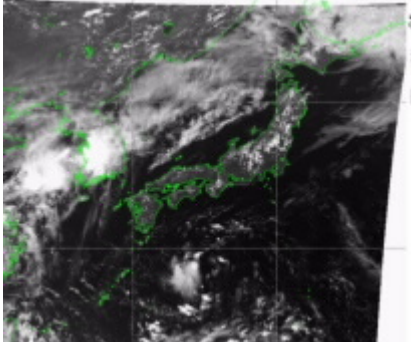
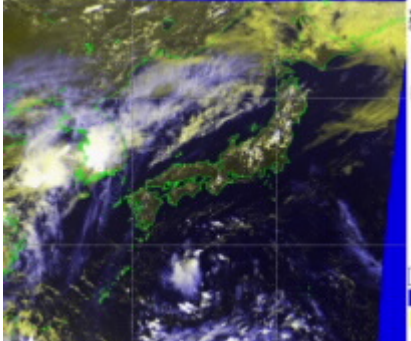
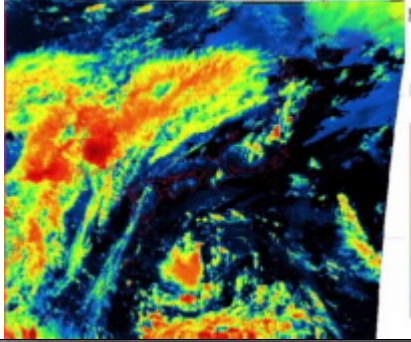
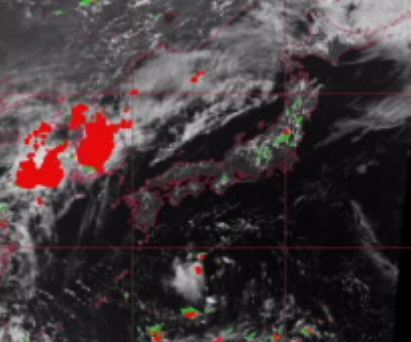


Figure 1 Rapid scan observation area

2 CUMULUS CLOUD INFORMATION IMAGERY FOR AVIATION USERS

There are four types of cumulus cloud information imagery as summarized in Table 2. Images for developing and developed cumulus clouds are also in the pipeline, with the start of provision scheduled for summer 2012.

Table 2 Cloud information from RS observation

Information type	Sample image	Summary
Visible images (infrared at nighttime)		Black and white visible images, with infrared images at nighttime.
Visible and infrared color composite images		Composite images with yellow coloring for visible images and blue for 10.8- μm infrared images.
Cloud top height images		Visible images (infrared at nighttime) with colors representing cloud top heights. Cloud height is computed from 10.8- μm brightness temperature data with reference to forecast fields of numerical weather prediction. Red and magenta areas indicate cloud tops over 40,000 ft.
Developing and developed cumulus cloud information (under development)		Developed cumulus areas are shown in red, and rapidly developing cumulus areas are shown in green over a visible image. The algorithm used to detect rapidly developing cumulus areas is described in Chapter 3.

3 RAPIDLY DEVELOPING CUMULUS AREAS

The Rapidly Developing Cumulus Area (RDCA) product is intended to provide aviation users in advance with information on developing cumulus areas that have the potential to generate thunderstorms. JMA is currently developing a related algorithm toward the scheduled start of operation in summer 2012. This section deals with the tentative version of the algorithm.

For detection, the 13 interest fields (parameters) listed in Table 3 are used. Some of these are taken from the Convective Initiation (CI) product developed by EUMETSAT. The parameter thresholds are determined in reference to lightning strike data obtained from ground-based observations made in 2010.

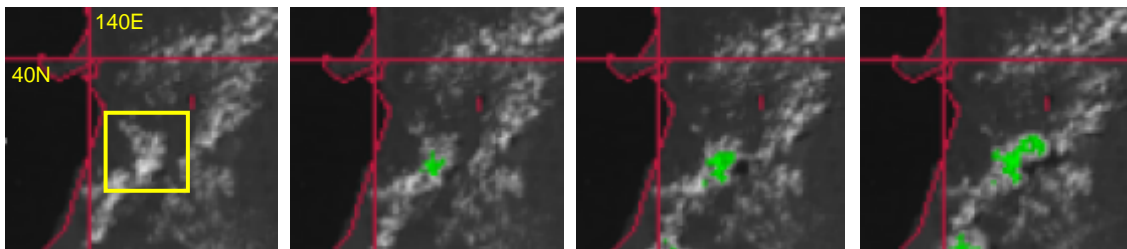
Table 3. Parameters used in RDCA

Parameter	Purpose	Notes
Visible reflectance	Detection of optically thick cloud	The reflectance value is divided by the cosine of the solar zenith angle.
Visible reflectance standard deviation	Evaluation of roughness in and around developing cumulus areas	The standard deviation is computed for a certain area. The reflectance value is divided by the cosine of the solar zenith angle.
Visible reflectance difference between maximum and average	Evaluation of roughness in and around developing cumulus areas and vertical developing trends	
10.8- μm brightness temperature (Tb) standard deviation	Evaluation of roughness in and around developing cumulus areas	
10.8- μm Tb difference between minimum and average	Evaluation of roughness in and around developing cumulus areas and vertical developing trends	
Tb difference between 10.8- μm and 12.0- μm	Removal of upper thin ice clouds	This parameter is also used to detect cumulonimbus areas.
Tb difference between 6.8- μm and 10.8- μm	Evaluation of potential to develop toward the vertical	This parameter is also used to detect cumulonimbus areas.
Slope index	Evaluation of cloud microphysical structure toward the vertical relating to upwelling flow	This parameter is defined using the 10.8- μm Tb and the effective radius computed from 3.8- μm .
Time differential of averaged reflectance	Evaluation of vertical developing trends	A cloud tracking process basically identical to that used in AMV computation is applied for motion cancellation. Mean values are computed for a certain area.
Time differential of reflectance maximum value		
Time differential of averaged 10.8- μm Tb		
Time differential of 10.8- μm Tb minimum value		
Reduction of 10.8- μm Tb in small region		

An example of RDCA is shown in Figure 2. Further development is under way as follows:

- Review of the usefulness of the parameters shown in Table 3 and identification of other parameters
- Refinement of parameter thresholds based on 2011 observations
- Computation based on data from the late afternoon, when the sensitivity of solar reflectance degrades
- Better expression of cumulus area information

RDCA results



Radar

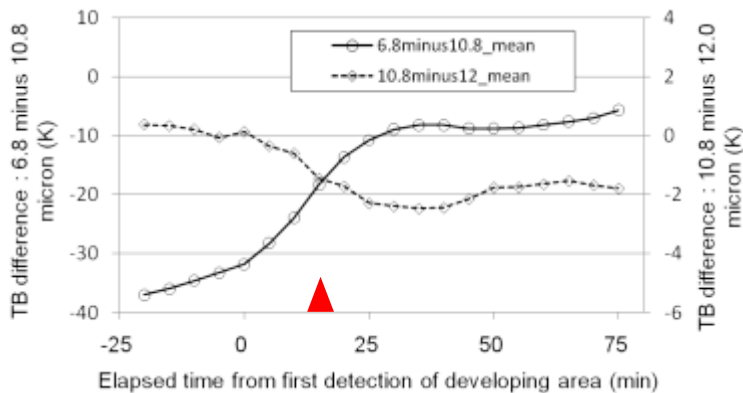
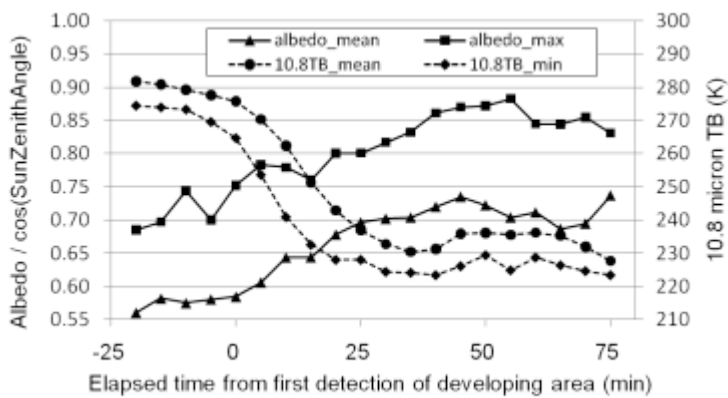
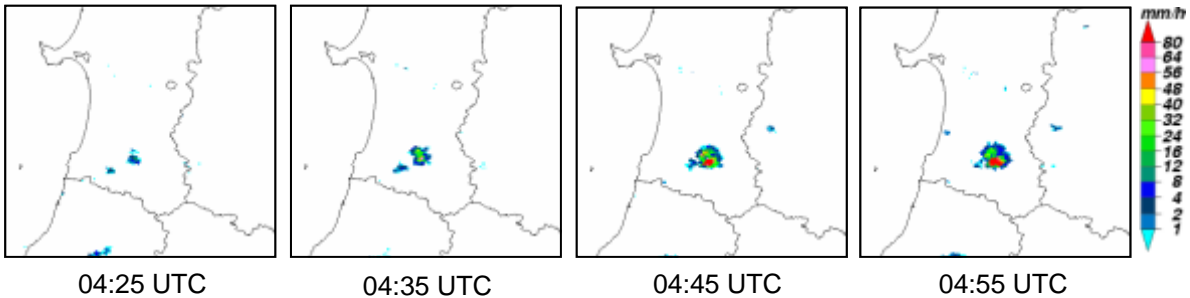


Figure 2: Example of an RDCA computed using the current algorithm with rain radar observation. The charts on the left represent the temporal sequences of reflectance (albedo) and the Tb mean and maximum values in the yellow square area. The observation date was 11 July, 2011. The red triangle indicates the time at which the first strike was detected in the square (13:35 JST).

4 VOLCANIC ASH MONITORING

JMA provided 10-minute-interval RS images to aviation users from 4 February to mid-May, 2011. These images were useful for monitoring the diffusion and spread of volcanic ash emitted by the eruption of Kirishimayama (Shinmoedake). Figure 3 shows 10.8- μm – 12.0- μm differential images, which are useful for detecting volcanic ash.

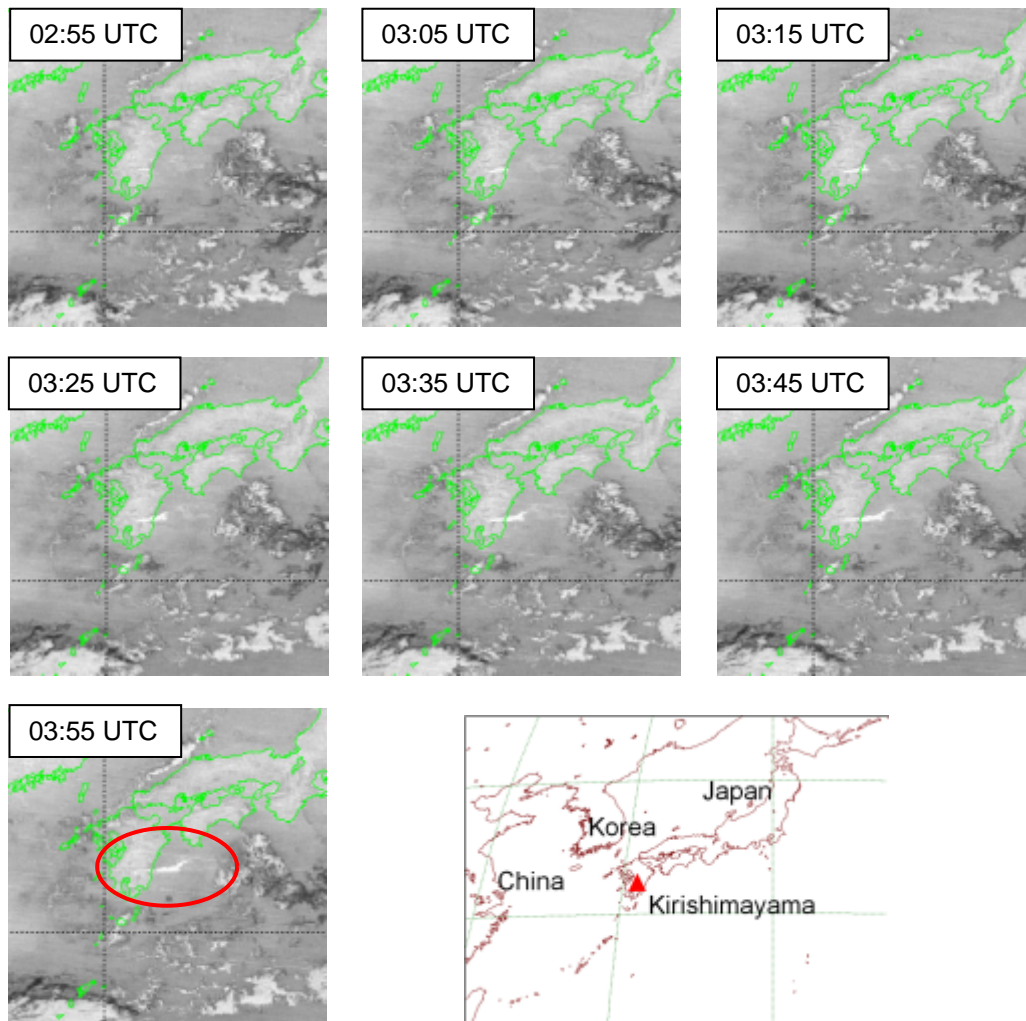


Figure 3 Volcanic ash diffusion captured in 10.8- μm – 12.0- μm differential images obtained from RS observations on 3 February, 2011