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RA II Pilot Project Newsletter

DEVELOPING SUPPORT FOR NATIONAL METEOROLOGICAL AND HYDROLOGICAL SERVICES IN SATELLITE DATA, PRODUCTS AND TRAINING

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JMA's New Satellite Product for Severe Weather Monitoring

The Meteorological Satellite Center of JMA (MSC/JMA) started to provide a new satellite product called Imagery with Heavy Rainfall Potential Areas on 19 March, 2012, via its website at http://mscweb.kishou.go.jp/RA-II/sat_img.htm.

This product is generated from Multi-functional Transport Satellite (MTSAT) images as a contribution to the WMO CBS Severe Weather Forecasting Demonstration Project in Southeast Asia (SWFDP-SeA). It comes in image form and provides information on areas that may experience heavy rainfall associated with deep convective clouds. A sample of the product is shown in Figure 1. Parts shaded in magenta indicate potential areas of heavy rainfall.

The basic algorithm for identifying deep convective clouds that bring heavy rainfall includes the following criteria: the brightness temperatures of 6.7 μm (T6.7), 10.8 μm (T11) and 12.0 μm (T12) are almost identical when convective cloud tops reach the tropopause; T6.7 is lower than T11 when clouds are in the development stage; and the difference between T11 and T12 increases when thin cirrus clouds are observed.

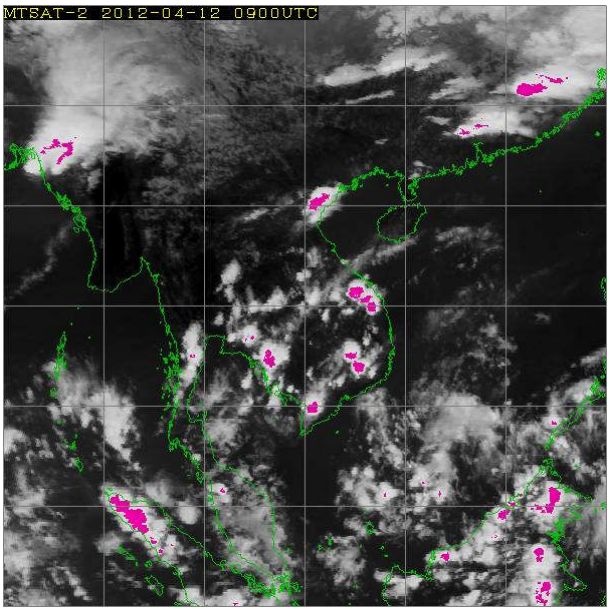


Figure 1 Sample of Imagery with Heavy Rainfall Potential Areas

Threshold values for the detection of deep convective clouds are adjusted to prioritize the improvement of detection probability. The probability of detection (POD [i]) and the success ratio (SR [ii]), which are often used in forecast verification, are calculated to evaluate the product. Potential areas of heavy rainfall it identifies are compared on a pixel-by-pixel basis to rainfall retrieval data from microwave imagers on board the polar orbiting satellites used in the Global Satellite Mapping of Precipitation (GSMaP [iii]) project. A rainfall rate of 20 mm/h is adopted as the criterion for heavy rainfall. The POD is 0.812 and the SR is 0.012 based on comparison for the period from January to October 2011.

The product indicates the probability or possibility of heavy rainfall rather than identifying areas of actual rainfall. As shown by the SR value, around 1.2% of potential areas experienced heavy rainfall. Despite these product characteristics, potential areas cover about 81% of heavy rainfall zones as shown by the POD value. The product is expected to be useful in severe weather monitoring for regions lacking a ground-based rain radar network.

(Ayako TAKEUCHI, JMA)

i) **POD = H / (H + M) shows the ratio of correctly identified rainfall. Here, "H" denotes the number of hits (i.e., instances where heavy rainfall is observed in the potential area), and "M" denotes the number of missed detections (i.e., instances where heavy rainfall is observed outside the potential area).**

ii) **SR = H / (H + F) gives the ratio of the potential area where heavy rainfall is actually observed. Here, "H" denotes the number of hits in the same way as above, and "F" denotes the number of false alarms (i.e., instances where heavy rainfall is not observed in the potential area).**

iii) **The GSMaP project is sponsored by JST-CREST and promoted by the JAXA Precipitation Measuring Mission (PMM) Science Team. GSMaP products are distributed by the Earth Observation Research Center of the Japan Aerospace Exploration Agency. (http://sharaku.eorc.jaxa.jp/GSMaP_crest/index.html)**

Rapidly Developing Cumulus Areas based on MTSAT Rapid Scan Images

The Japan Meteorological Agency (JMA) has operated MTSAT-2 for observation over the Western Pacific region since June 2010, and also manages MTSAT-1R as its backup. Using this backup satellite, JMA has now started Rapid Scan (RS) observation at five-minute intervals covering the limited area around Japan during summer to provide aviation users with observation information on rapidly developing cumulus clouds and thunderstorms. To enhance the information provided, JMA plans to add the Rapidly Developing Cumulus Areas (RDCA) product generated from MTSAT-1R RS images.

RDCA is an image-based product;

specifically, it consists of satellite cloud images with rapidly developing cumulus and cumulonimbus areas highlighted in particular colors. In the development of the product, JMA referred to EUMETSAT's Convective Initiation product. First, clear sky regions were excluded, and possible areas of developing cumulus and cumulonimbus cloud were extracted. Second, areas of rapidly developing cumulus cloud were extracted by evaluating roughness and height at the cloud surface and related temporal variations. For the evaluation of these variations, cloud movement at five-minute intervals was considered.

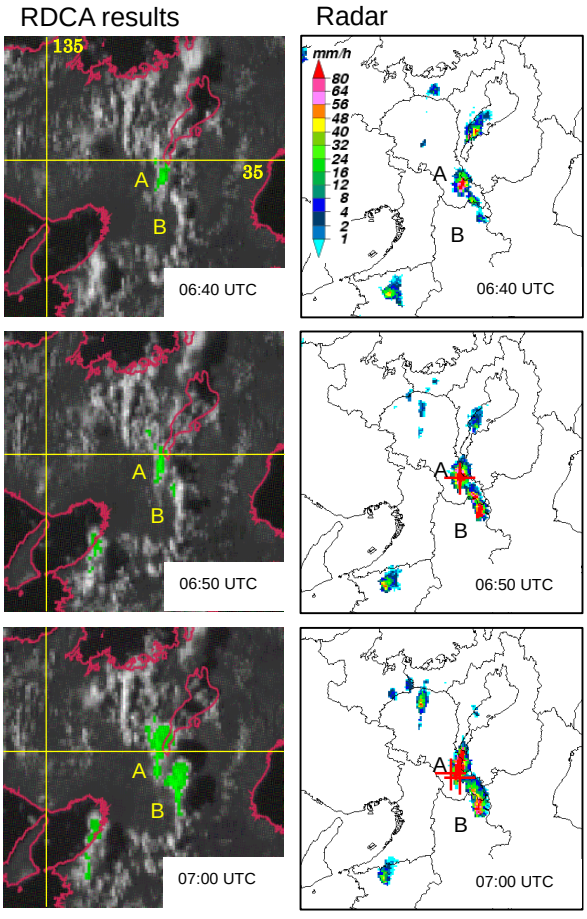


Figure 1 Examples of RDCA images and radar charts (11 July, 2011). Detected RDCAs are marked in green on the images. The red crosses on the radar charts represent thunder.

The images in the left-hand column of Figure 1 show an example of rapidly developing cumulus areas (green) in the RDCA product for 11 July, 2011. Corresponding rain radar charts are shown in the column on the right of the figure. In this example, cells A and B, detected as RDCAs, developed within a short period of time. The cumulus in cell A developed into cumulonimbus, and the first occurrence of thunder was observed 10 minutes later. Cell B was detected at almost the same time when an intense echo appeared in the radar observation.

JMA plans to launch Himawari 8 and 9, the next generation of geostationary satellites, in 2014 and 2016 respectively, and to start Himawari 8's operation in 2015. These satellites will carry new earth-imaging sensors equipped with a function to produce full-disk images at 10-minute intervals. These images are expected to enhance severe weather watch over the Western Pacific region and contribute to the issuance of early warnings, especially for regions where the rain radar network is underdeveloped.

(Kouki MOURI, JMA)

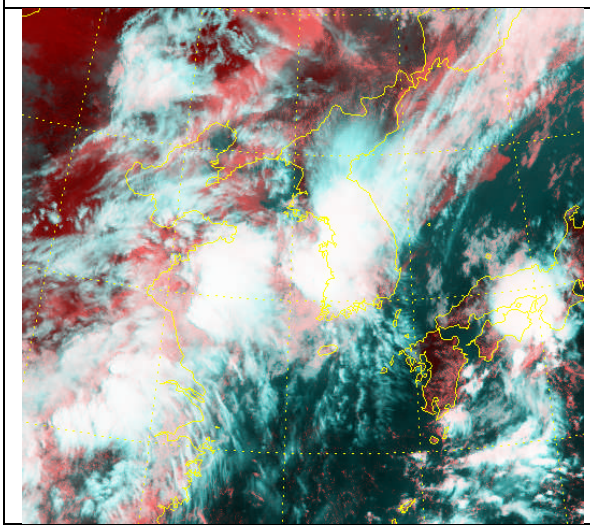
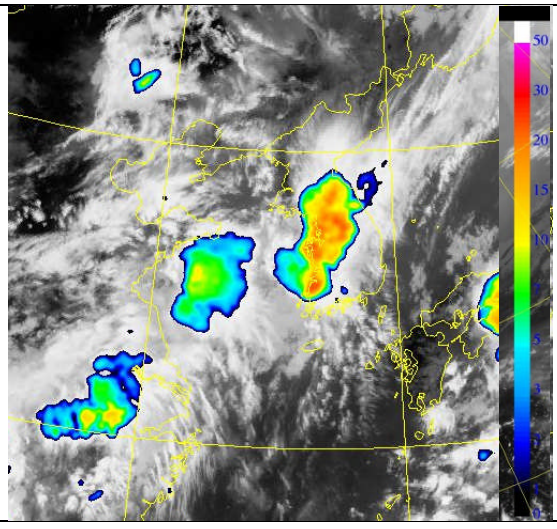
COMS severe weather nowcasting: Convective Rainfall Rate

KMA/NMSC has been providing information on convective system such as rapid development thunderstorms and convective rainfall rate for forecasters since July 2011. These products are produced by using KMA's numerical weather prediction model (GDAPS-UM) and ground radar data as well as COMS meteorological data through EUMETSAT Satellite Application Facilities on Support to Nowcasting and Very Short Range Forecasting (SAFNWC) software module which was introduced on technical cooperation of KMA-EUMETSAT.

In particular this article describes convective rainfall rate (CRR) product. Because radiation from visible and infrared channels cannot penetrate clouds, the estimation of precipitation uses empirical relationship. CRR algorithm uses the relationship that the higher and thicker are the clouds the higher is probability of occurrence and the intensity of precipitation. Information about cloud top height and cloud thickness can be obtained from the IR brightness temperature and VIS reflectance, respectively. And brightness temperature difference of IR1 and WV channels is useful parameter for extracting deep convective cloud with heavy rainfall. CRR algorithm has calibration matrices, which contain rain rates, is a relationship between satellite multi-channel imagery and rainfall data from ground radar. Calibration matrices are consists of 2-D (IR1, IR1-WV) and 3-D (IR1, IR1-WV, VIS). If solar zenith angle is lower than 85° in a pixel, 3-D matrix is used for rainfall rate estimation (EUMETSAT, 2011). KMA/NMSC has developed new calibration matrices using COMS and KMA radar data which observed in summer period of 2011.

Figure 1 shows heavy rainfall case over Korea on 0100 UTC 12 July 2011. At that time there are convective systems over Yellow Sea and in the middle of Korea on COMS composite image. COMS CRR was estimated maximum value of about 20mm/h in in-land of Korea which was high compared to AWS and radar values. And the detected rainfall area was larger than that of ground observed data.

KMA takes advantage of COMS satellite to observe developing convective system rapidly around Korea beyond ground observation coverage. Above all, it is important to produce essential information to provide forecasters on time for forecasting severe weather. To do this, KMA/NMSC makes effort to develop nowcasting techniques for severe storms using various data including COMS and NWP data.

< COMS RGB Composite image >	< COMS Convective Rainfall Rate (mm/h)>
	

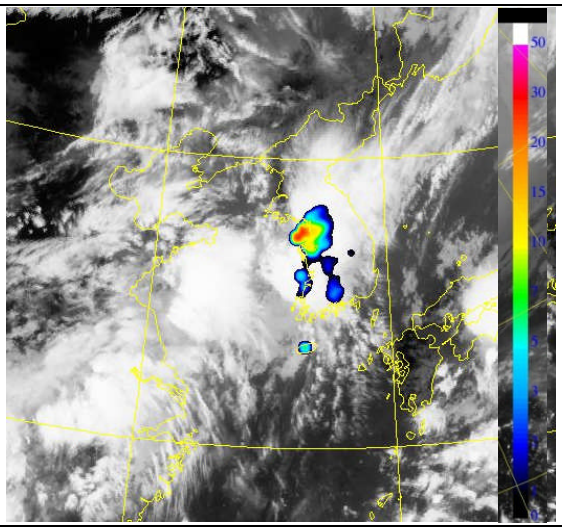
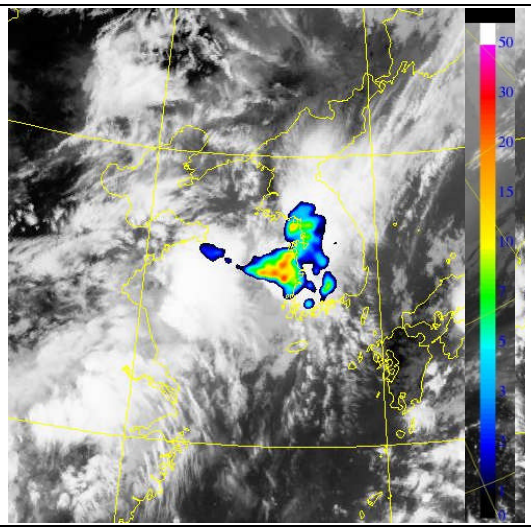
< COMS IR image + AWS rainfall >	< COMS IR image + Radar >
	

Figure 1. Heavy rain case detected by COMS (201107120100 UTC)

Reference

EUMETSAT/NWCSAF, 2011: Algorithm theoretical basis document for “Convective Rainfall Rate” (CRR-PGE-05)

(Sung-Rae, Jung, KMA)

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From the Co-editors

The co-editors invite contributions to the newsletter. Although it is assumed that the major contributors for the time being will be satellite operators, we also welcome articles (short contributions of less than a page are fine) from all RA II Members, regardless of whether they are registered with the WMO Secretariat as members of the Pilot Project Coordinating Group. We look forward to receiving your contributions to the newsletter.

(*Toshiyuki KURINO, JMA, and Dohyeong KIM, KMA*)

RA II Pilot Project Home Page

http://www.wmo.int/pages/prog/sat/ra2pilotproject-intro_en.php

RA II Pilot Project Mailing Lists

Two mailing lists for discussion on the pilot project will soon be set up using the Google Groups service, and will be implemented either through the Google Groups web interface or by e-mail.

One list is for Pilot Project Coordinating Group members who are already registered with the WMO's Regional Office for Asia and the South-West Pacific.

Group name: ra2pp_sat_cg
Group home page:
http://groups.google.com/group/ra2pp_sat_cg
Group email address:
ra2pp_sat_cg@googlegroups.com

The other list is for RA II Members in general.

Group name: ra2pp_sat
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