

Convective clouds detection using RGB composite imagery with COMS observation.

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Introduction

- ◆ Convective clouds detection using satellite measurements is very important because typhoons and heavy rainfalls primarily cause natural disasters over Korean peninsula.
- ◆ For meteorological purposes, recently, COMS (Communication, Ocean, and Meteorological Satellite) with 5 channels are in operation from April, 1 2011. The next-generation geostationary meteorological satellite with 16 channels will be planned to be launched in 2017.
- ◆ RGB composite imagery is very effective to support the forecasters because it contains a lot of useful information, easy to implement and interpret.
- ◆ In this study, a RGB composite method using COMS infrared channels is presented for detecting the convective clouds in day and nighttime.

Methods

- ◆ Data and cases
 - Two cases: Jang-ma (stationary rainy front) (2013.7.27.18:00UTC~2013.7.28.07:00UTC) and Typhoon Bolaven (2012.08.27.00:00UTC~2012.08.28.23:45UTC).
 - Data: Brightness temperature difference (BTD) between the IR12.0 and IR10.8, BTD between the WV6.7 and IR10.8, and BT at IR10.8.
- ◆ Characteristics of channels
 - The BTD between IR12.0 and IR10.8 is sensitive to water vapors in the atmosphere (It appears darker when the BTD increases).
 - The BTD between WV6.7 and IR10.8 is related to strong convection (Kurino, 1997) (Its value is positive when the rain rate > 20 mm/hr) (NWC SAF, 2009).
- ◆ Convective clouds and satellite observation
 - The threshold values of RGB composite for the detection of convective clouds are determined using a Look-Up Table (LUT) of Convective Rainfall Rate (CRR) algorithm.
 - KMA improved a LUT of CRR using rainfall datasets with Korea radar network system and COMS observations during 10 months (2011-2012) (Fig. 1). The KMA CRR LUT based on the NWCSAF CRR (Fig. 2) shows a better performance at 10 mm/hr or higher rain rates (Kim *et al.*, 2012).
 - * CRR is one of nowcasting products in EUMETSAT/NWCSAF.
- ◆ Threshold values
 - The threshold values for RGB composite image depends on the KMA LUT
 - For IR10.8 (Red color), brightness temperature from 210K to 300K is used to cover a variety of CRR.
 - For IR10.8–WV6.75 and IR12.0–IR10.8, threshold values using KMA CRR LUT(2D) are summarized in Table I.

Table 1. Recommended Range of Convection

Color	Channel (μm)	Threshold (K)
Red	IR12.0 – IR10.8	-4 ~ 2
Green	IR10.8 – WV6.75	-15 to 20
Blue	IR10.8	210 ~ 300

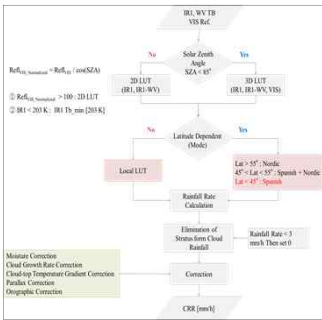


Fig. 1. CRR Algorithm

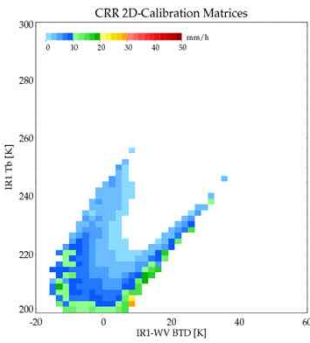


Fig. 2. CRR 2D-Calibration Matrices

Results

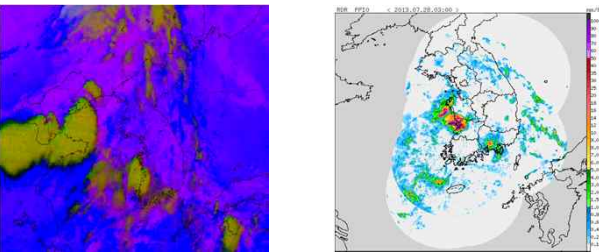


Fig. 3. 2013.7.27.18:00UTC RGB composite imagery of convection (Left) and Radar PPI0 (Right).

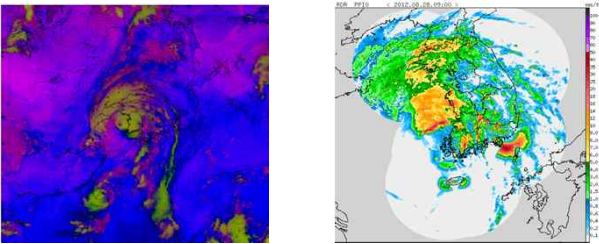


Fig. 4. 2012.08.28.00:00UTC RGB composite imagery of convection (Left) and Radar PPI0 (Right).

- ◆ Color interpretation
 - Greenish color in RGB image describes a strong convection (because of IR10.8–WV6.75) with heavy rainfall. High green means over 20 millimeter per hour of rain.
 - Yellowish color (combination of red and green) stands for weak convection
 - Pinkish color indicates low-level clouds because red (IR12.0–IR10.8) and blue (IR10.8) colors are associated with low-level clouds.
 - Black color indicates that the brightness temperature at IR10.8 is less than 210K.
- ◆ Jang-ma (stationary rainy front) (2013.7.27.18:00UTC~2013.7.28.07:00UTC)
 - Convective clouds are detected over the Shandong peninsula and Yellow sea at 1800UTC July 27, 2013 (Fig. 3. Left panel). This RGB image shows heavy rain fall over Byeonsan peninsula in Korea in comparison with rainfall (upto 20 mm/hr) detected by the ground radars (Fig. 3. Right panel).
- ◆ Typhoon Bolaven (2012.08.27.00:00UTC~2012.08.28.23:45UTC)
 - RGB image shows the CRR characteristics of typhoon Bolaven (over the Korea) and typhoon Tembin (over the southern Taiwan) at 0000UTC August 28, 2012 (Fig. 2. left panel in comparison with rainfall (upto 20 mm/hr) detected by the ground radars (Fig. 3. Right panel).

Summary

- ◆ In this study, an improved RGB composite method for detecting convective clouds is developed and applied to COMS observations.
- ◆ This RGB method has an advantage not to show the discontinuity between day and night because it is based on the infrared observations.
- ◆ In addition, the RGB image for cloud convection can be quantitatively analyzed because the threshold values of RGB compositions based on an improved LUT of CRR algorithm.
- ◆ Consequently, this study will be helpful for forecasters to analyze convective clouds using the current and future geostationary satellites.

Reference

➢ Kurino, T., 1997: A satellite infrared technique for estimating “deep/shallow” precipitation. *Advances in Space Research*, 19(3), 511-514.

➢ NWC SAF, 2009: Algorithm Theoretical Basis Document for Convective Rainfall Rate.

➢ Kim, S., E. Sohn, S.-R. Chung, and B.-C. Choi, 2012: Rainfall rate retrieval from COMS satellite for nowcasting in KMA/NMSC, In EUMETSAT Meteorological Satellite Conference, 3-7 September 2012, Sopot, Poland.