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RA II WIGOS Project Newsletter

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

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Geo-Kompsat-2A AMI Radiometric Performance based on GSICS

The Korea Meteorological Administration (KMA) announced that its next-generation geostationary meteorological satellite, Geo-Kompsat-2A (hereafter GK2A), began operation at 00:00 UTC on 25 July 2019.

KMA has been testing and checking GK2A AMI radiometric performance after its launch. GK2A AMI has two onboard calibration targets: a blackbody for emissive bands, referred to as the Internal Calibration Target (ICT); and a solar diffuser for the reflective bands called the Solar Calibration Target (SCT). Unlike onboard calibration targets that degrade over time or Earth surface targets that are used for vicarious calibration, the Moon is a very stable reflector and views of the Moon by satellite sensors have been used for long term characterization.

Vicarious Calibration of visible channels

The visible channel of the GK2A includes four channels of 0.4, 0.5, 0.6, and 0.8 μm, and two near infrared channels 1.3 and 1.6 μm having characteristics of the visible channel. KMA has been monitoring AMI visible channels (6 channels) using GEO-LEO inter calibration method (called ray-matching method). Ray-matching method is temporal and spatial matching between two satellites (GK2A AMI and

Terra MODIS) data within ± 5 minutes, latitude 30 ° N to 30 ° S, and longitude 98.2 ° E to 158.2 ° E in a grid of 0.1 ° × 0.1 ° and after matching, comparison AMI grid and MODIS grid directly. AMI and MODIS have different spectral response functions (SRFs), therefore MODIS SRF's is adjusted to AMI using SBAF (Spectral Band Adjustment Factor).

From June to September 2019, the results of the visible channel performance analysis using the ray-matching method are as follows.

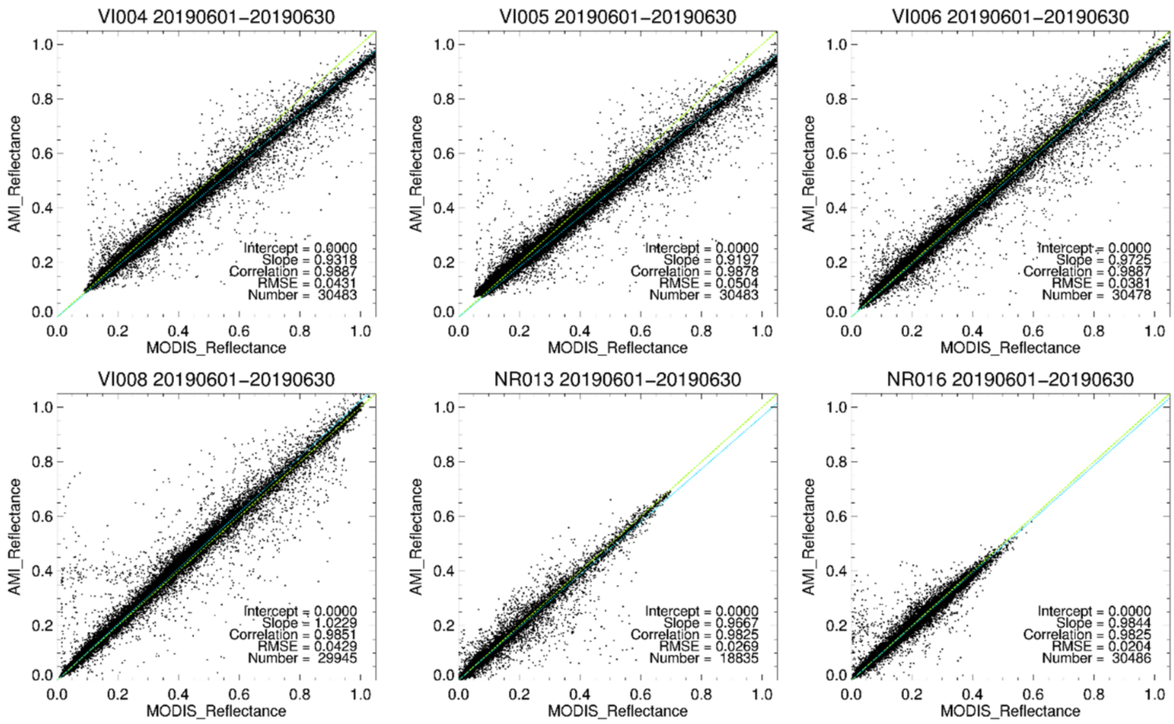

Figure 1 Ray-matching results in June 2019 (VI004, VI005, VI006, VI008, NR013, NR016).

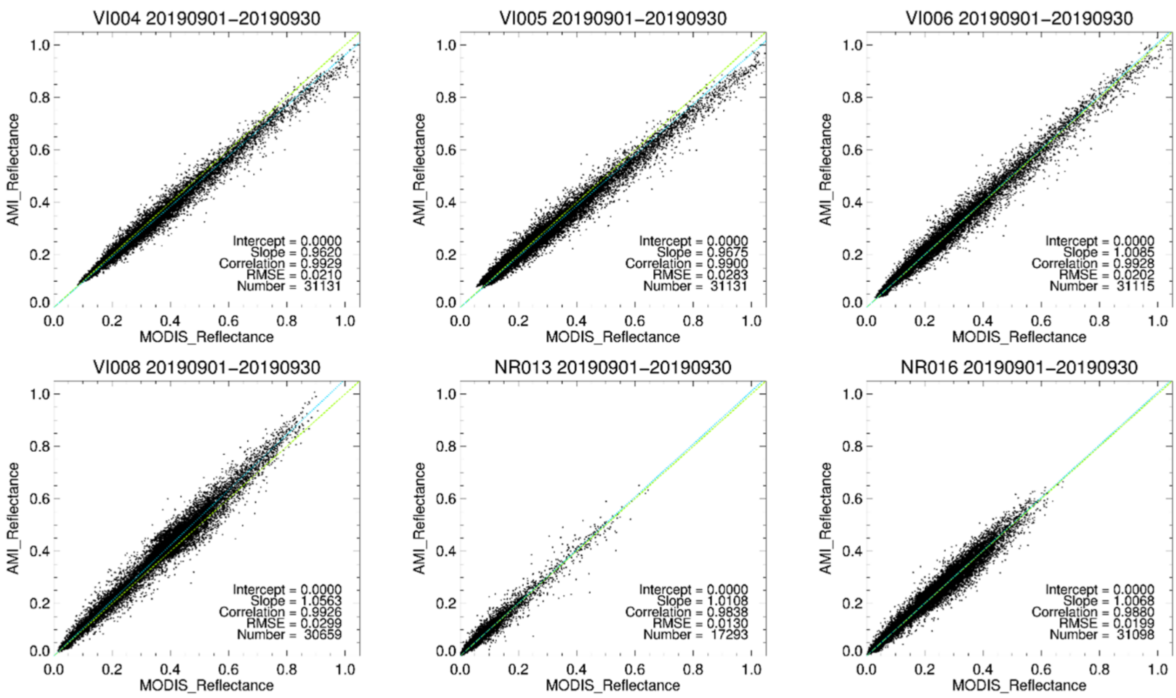

Figure 2 Ray-matching results in September 2019 (VI004, VI005, VI006, VI008, NR013, NR016).

Compared AMI and MODIS, there is a difference of less than 5% except VI004 and VI005 channels. And almost channels have RMSE (Root Mean Square Error) under 0.3. However, time series of ray-matching in Fig. 3 show that the trend of the ratio between AMI and MODIS is very stable.

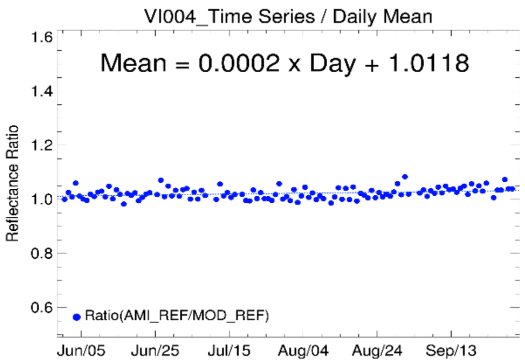

Figure 3 Time series of ray-matching result. June to September 2019. (VI004 channel)

AMI VI004 channel have about 8% difference compared with MODIS. But, the ratio (AMI Reflectance/MODIS Reflectance) is very stable with a slope of 0.0002

Therefore, GK2A AMI visible channels maintain accuracy without significantly reducing their radiometric performance after launch. And KMA/NMSC are developing ray-matching method using Suomi-NPP VIIRS and vicarious targets method using the DCC (Deep Convective Cloud), Water Cloud, Desert, Ocean.

Lunar Calibration

AMI collects several Moon images without impacting the core image collections of Full Disk and Extended Local Area. During the standard 10-minute observation timeline including 5 local target observations (LA), the time slot allocated to collection of 1 LA image can be repurposed to observe the moon (Figure 3). Many images with similar phases of the Moon can be used to reduce uncertainties in the evaluation of each individual image. The ability to scan the entire Moon in a single swath also drastically reduces one significant error source in using the Moon for characterization—knowledge of where on the Moon each detector sample was collected. The World Meteorological Organization (WMO), through the Global Space-based Inter-Calibration System (GSICS), coordinates international collaboration to develop a standard methodology for vicarious calibration of satellites instrument using lunar irradiance.

Figure 3 An AMI image of the Moon and portion of the Earth observed by GK2A on 17 May 013039 in VI006 channel (0.64μm).

AMI observed the Moon 189 times from May to September 2019 and KMA used 142 times moon data except where the moon was observed in close proximity to Earth.

Figure 4 shows the irradiance ratio between instrument observations and GIRO (GSICS Implementation of the ROLO model) of AMI visible and near infrared channel. The irradiance ratio is normalized by the first ratio (t=0, 2019-05-14)

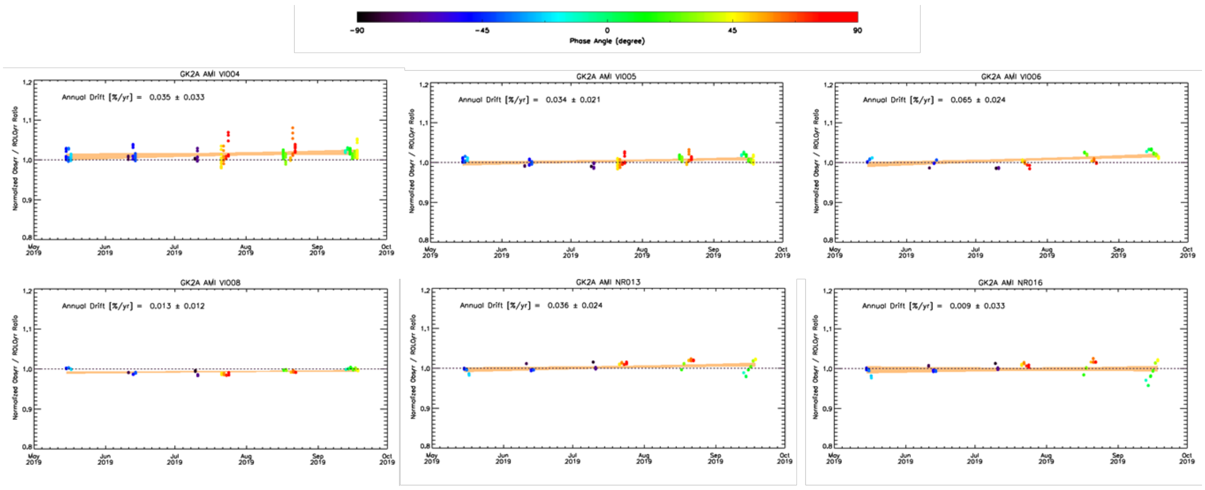

Figure 4 AMI lunar calibration results for VNIR channels from May to September 2019

GEO-LEO inter-calibration of infrared channels

During the commissioning period, AMI Infrared channels (3.8μm, 6.3μm, 6.9μm, 7.3μm, 8.7μm, 9.6μm, 10.5μm, 11.2μm, 12.3μm, and 13.3μm) data have been monitored using five well-calibrated hyper-spectral sounders on LEO (Low Earth Orbit) satellites, IASI (Infrared Atmospheric Sounding Interferometer)/MetOp-A, B and CrIS (Cross-track Infrared Sounder) /SNPP (Suomi NPP), NOAA20 and AIRS (Atmospheric Infrared Sounder)/Aqua, as references for inter-calibration.

AMI Data from 1 June to 30 September 2019 (from 23 July for IR133) were analyzed as GSICS. An array of 7 x 7 AMI pixels with 2km resolution centered on the pixel closest to center of each AIRS/CrIS/IASI pixel with 13.5km/14km/12km diameter are defined as target area. AMI radiances in target area are averaged to compare with the LEOs radiance, and their time difference is less than 300s. And satellite zenith angles of the selected pixels are checked to consider the atmospheric optical length of two satellites. Also, the homogeneity of the collocation scenes is checked to avoid the possible contamination due to fractional clouds. The environment is defined as 21 x 21 AMI pixels centered on its target area. The AMI radiance data in the target area represent the data evaluated by the environment uniformity check.

Figure 5 and table1 show a scatter plot of Tb from GK2A/AMI and LEOs and statistical results of inter-calibration for IR channels.

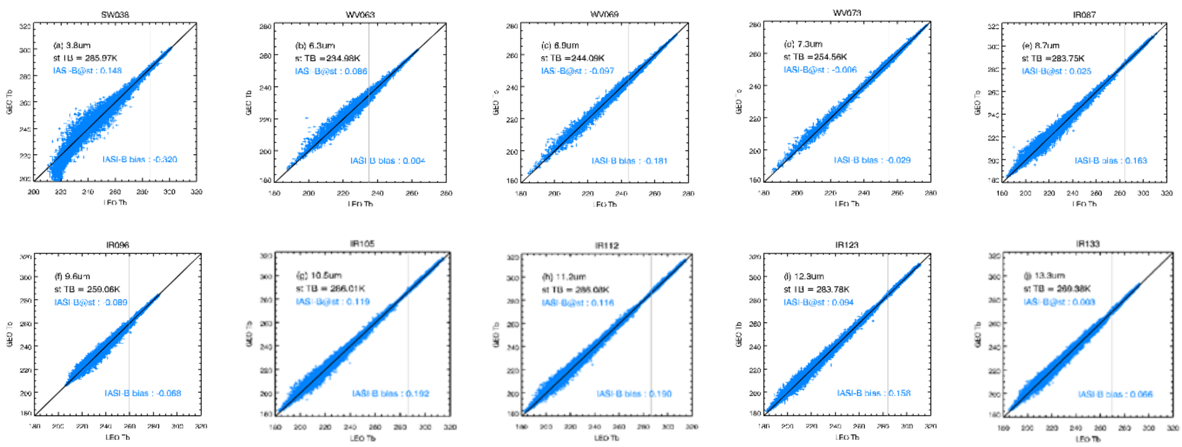

Figure 5 Scatter plot of Tb from GK2A/AMI and IASI-B(blue) for IR channels

Table 1. Tb mean bias and bias at standard scene Tb with respect to IASI-B

AMI-IASIB	SW038	WV063	WV069	WV073	IR087	IR096	IR105	IR112	IR123	IR133
standard scene Tb(K)	285.97	234.98	244.09	254.56	283.75	259.06	286.01	286.08	283.78	269.38
bias@st	0.15	0.08	-0.09	-0.00	0.02	-0.08	0.11	0.11	0.09	-0.02
mean bias	-0.32	0.00	-0.18	-0.02	0.16	-0.06	0.19	0.19	0.15	0.03

The Tb biases at standard scene Tb as GSICS results are less than 0.15K in all channels and the mean biases are less than 0.2K in channels except SW038. So AMI radiometric calibration performance shows well accuracy.

GEO-GEO inter-comparison of infrared channels

KMA directly compared Geo-Kompsat-2A/AMI infrared channels with Himawari-8/AHI infrared channels. The pixels with less than 1% difference in satellite zenith angle and less than 1-minute difference in observation time were selected to generate temporal and spatial collocation data.

Among the collocation data, the homogeneous pixels with variation coefficients (standard deviation/average) of 9x9 pixels within 1% and latitudes within ±10° was selected. And then the average of brightness temperatures (Tb) in 3x3 pixels is used to compare the two imagers. The analysis period is in August 2019, and 10-minute intervals of full disk data were used.

The TB bias (AMI–AHI) showed within about 0.5K except for the SW038 in Table 2.

Table 2. The statistics of inter-comparison between AMI and AHI Infrared channels

	SW038	WV063	WV069	WV073	IR087
Bias	0.558	0.393	0.070	-0.125	0.128
RMSE	0.810	0.353	0.428	0.613	2.495
Slope	0.951	1.001	0.993	0.981	0.990
Intercept	14.781	0.041	1.896	4.782	2.885
	IR096	IR105	IR112	IR123	IR133
Bias	0.062	0.186	0.128	0.242	-0.243
RMSE	0.985	1.223	1.295	1.354	1.221
Slope	0.993	0.998	0.995	0.999	0.984
Intercept	1.765	0.685	1.498	0.504	3.904

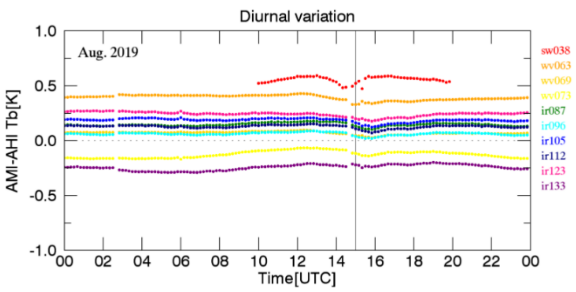

Figure 8 Diurnal variation of brightness temperature difference between AMI and AHI infrared channels in August 2019

The diurnal variation of Tb bias is stable, showing the range of variation within about 0.1K (Figure 8). In case of COMS/MI, the range of variation is about SWIR (3.8μm) 0.7K, WV (6.7μm) 0.5K, IR1 (10.8μm) 0.8K, and IR2 (11.2μm) 0.3K from 2016 to 2017. Thus, Geo-Kompsat-2A/AMI infrared channels show a similar radiometric performance to Himawari-8/AHI.

(Eunkyu Kim, Tae-Hyeong Oh, Minju Gu, Hyeji Yang, NMSC/KMA)

Transition plans for Himawari data dissemination and distribution services

JMA plans updates to services related to data from its Himawari-8/9 satellites, including the HimawariCloud, HimawariCast, Himawari JDDS and Himawari Real-time Image provided via the Meteorological Satellite Center (MSC) website. This article summarizes the changes and the associated transition of key operations from Himawari-8 to -9.

Transition from Himawari-8 to Himawari-9

JMA plans to switch observation from its Himawari-8 satellite (operational since 7 July 2015) to Himawari-9 around summer 2022 in conjunction with the end of the eight-year design lifetime of the unit's Advanced Himawari Imager.

Specific information on a planned period of parallel operation for Himawari-8 and Himawari-9 in 2022 will be provided once the details have been finalized.

Himawari-9 health check operations and data provision

Himawari-8 and -9 both carry Advanced Himawari Imagers (AHIs) with identical observation specifications. However, slight differences in sensor characteristics, such as SRF (spectral response function) and data processing performance (e.g., capacity for radiometric calibration), lead to differences in image quality between the two satellites.

Since the commencement of Himawari-9's period of back-up operation, JMA has performed five health check (HC) operations to verify the unit's observation functionality and image quality (Table 1). To support smooth transition from Himawari-8 to Himawari-9, JMA plans to open Himawari-9 HC data to NMHSs users.

Table 1 Himawari-9 health check operations

Term
29 May – 12 Jun. 2017
29 Aug. – 13 Sep. 2017
28 Nov. – 12 Dec. 2017
31 Jan. – 16 Feb. 2018
2 Oct. – 19 Oct. 2018

HimawariCloud updates

JMA launched the HimawariCloud service in April 2015 with the distribution of Himawari-8 in-orbit-test imagery for National Meteorological and Hydrological Services (NMHSs) in the Himawari-8/9 coverage area. The data can be accessed using an HTTP 1.1 client such as a Web browser or Wget.

In its ongoing provision of the HimawariCloud service, JMA plans to employ a new contractor as of 29 February 2020, and a pilot operation of the new services will commence in January 2020. Further information will be provided by the end of 2019.

HimawariCast updates

JMA launched its HimawariCast service using communication satellite in January 2015, providing Himawari imagery in full-disk HRIT/LRIT files compatible with previous MTSAT HRIT/LRIT data. Files are provided every 10 minutes using 14 of Himawari-8/9's 16 bands for HRIT files. The Agency also disseminates meteorological data and products in Satellite Animation and Interactive Diagnosis (SATAID) format, including numerical weather prediction products and observational data.

Although the ground segment of the HimawariCast service will be updated in January 2020, the JCSAT-2B communication satellite will maintain its current role of broadcasting data for HimawariCast. On the occasion of the update, the HimawariCast dissemination will be cancelled for a couple of timelines in December 2019. Users do not need to make any related changes.

HimawariCast future plan

JMA is considering to terminate its provision of LRIT data, replace the all deep space counts of HRIT data with invalid value and commence provision of new satellite-derived geophysical products such as ASWinds (AMV-based Sea-surface Wind data) as described at: https://www.data.jma.go.jp/mscweb/en/product/product/aswind/index.html

Himawari JDDS updates

Himawari-8/9 imagery and related geophysical products are available on the JMA Data Dissemination System (Himawari JDDS). As JMA plans to terminate FTP-based provision on 30 September 2020, an HTTPS service was commenced on Himawari JDDS on 24 July 2019. Users accessing Himawari JDDS via FTP should update their communication protocols to enable HTTPS access.

Tables 2 and 3 show products disseminated via Himawari JDDS using FTP and HTTPS.

Table 2 Satellite data disseminated through JDDS via FTP

	File format	Periodicity
High-resolution Cloud Analysis Information (HCAI)	GRIB2	Every 60 minutes
HRIT satellite imagery	HRIT	Every 30 minutes
JPEG satellite imagery	JPEG	Every 30/60 minutes

Table 3 Satellite data disseminated through JDDS via HTTPS

	File format	Periodicity
High-resolution Cloud Analysis Information (HCAI)	GRIB2	Every 60 minutes
		Every 10 minutes (*)
HRIT satellite imagery	HRIT	Every 30 minutes
JPEG satellite imagery	JPEG	Every 30/60 minutes Without user ID/password
ASWind from Target Area Observation	SATAID wind format	Every 10 minutes
ASWind from Full-disk Observation		Every 30 minutes

(*) JMA plans to begin HCAI dissemination every 10 minutes in December 2019.

Registration for Himawari JDDS

To register for Himawari JDDS access newly, use the form available at:

https://www.jma.go.jp/jma/jma-eng/satellite/jdds.html#terms

Registered users can access satellite products online using an HTTP 1.1 client such as a Web browser or Wget. Users currently accessing the service via FTP should update their communication protocols to enable HTTPS provision as mentioned above.

Himawari Real-Time Image web resource

Himawari Real-Time Image is a web-based service providing RGB composite imagery and the Heavy Rainfall Potential Areas product via the MSC web page at: https://www.data.jma.go.jp/mscweb/data/himawari/index.html.

In 2020, JMA will begin to provide zoomable tiled satellite imagery as already available on the RSMC Tokyo for Nowcasting web page at: https://www.jma.go.jp/jma/jma-eng/jma-center/nowcasting/

(ANDOU Akiyoshi, JMA)

RSMC Tokyo for Nowcasting

The Regional Specialized Meteorological Center (RSMC) Tokyo for Nowcasting located at JMA was designated by WMO at the 69th session of its Executive Council in Geneva in May 2017. The Center began operations with the launch of a web resource (https://www.jma.go.jp/jma/jma-eng/jma-center/nowcasting/) on 20 December 2018 to supply NMHSs in the Asia and Pacific regions with graphical nowcasting products to improve capacity for disaster risk reduction (Figure 9). The resource initially provides two Himawari satellite products known as Heavy Rainfall Potential (HRP) and High-resolution Cloud Analysis Information (HCAI) covering the area of 60°N – 60°S and 80°E – 160°W (Figure 10).

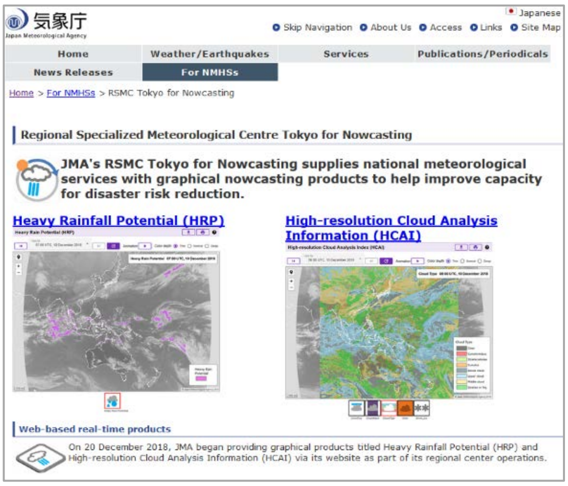

Figure 9. RSMC Tokyo for Nowcasting web resource

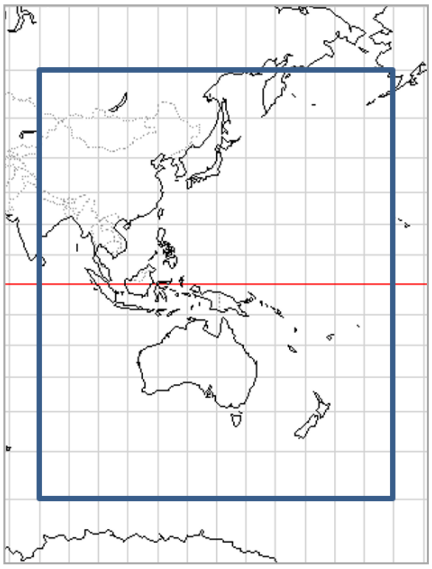

Figure 10. Area of coverage

High-resolution Cloud Analysis Information

HCAI provides data on cloud top height, cloud mask, cloud type, dust mask and snow/ice mask (Figure 11). The product is also derived from Himawari satellite imagery and updated on an hourly basis

Heavy Rainfall Potential area

HRP provides information on the potential for rainfall with an intensity of 20 mm/h or more associated with deep convective clouds (Figure 12). The product is derived from Himawari satellite imagery and updated every 10 minutes.

Further information on these products is available on the RSMC Tokyo for Nowcasting web page. The data are particularly useful in the monitoring and analysis of tropical cyclones and heavy rain.

(MATSUDA Kohei, JMA)

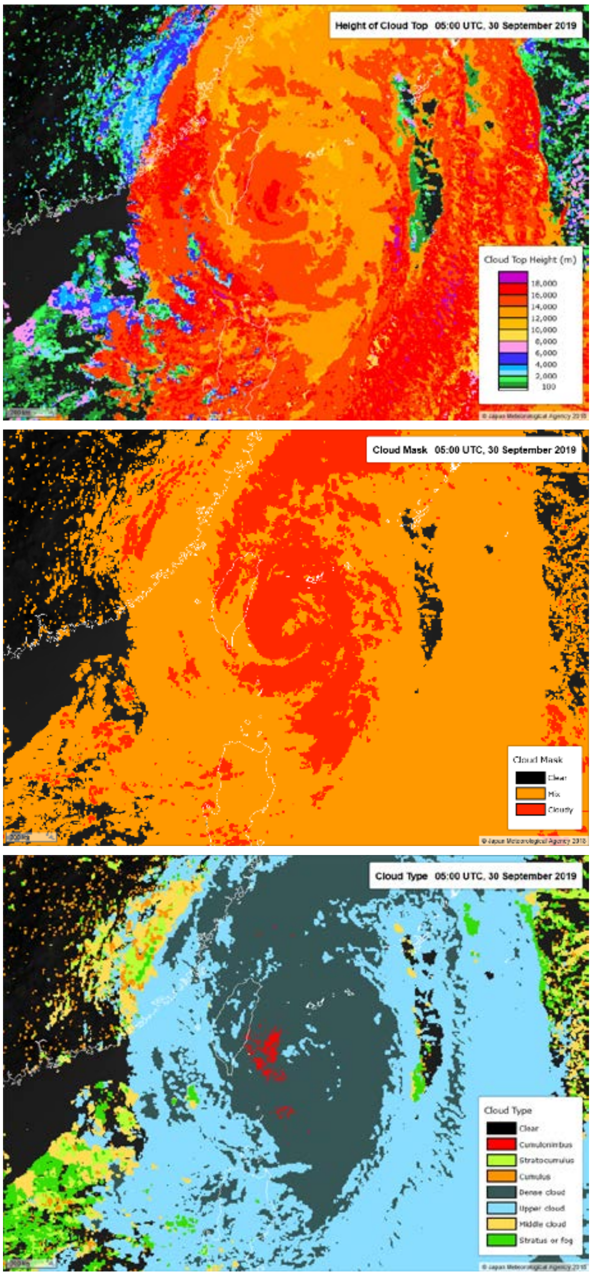

Figure 11. HCAI imagery (left: cloud top height; center: cloud mask; right: cloud type) for TY 1918 (Mitag) at 05:00 UTC on 30 September 2019

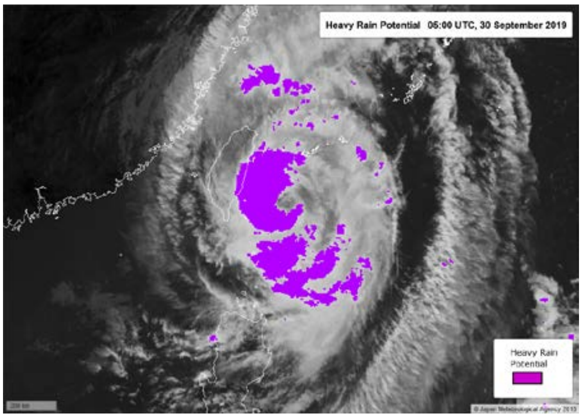

Figure 12. An HRP image of TY 1918 (Mitag) at 05:00 UTC on 30 September 2019

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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 WIGOS Project Coordinating Group. We look forward to receiving your contributions to the newsletter.
(Dohyeong KIM, KMA, and Kotaro BESSHO, JMA)

RA II WIGOS Project Home Page

http://www.jma.go.jp/jma/jma-eng/satellite/ra2wigosproject/ra2wigosproject-intro_en_jma.html

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