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Japan Meteorological Agency

STATUS OF HIMAWARI-8/9 AND THEIR FOLLOW-ON SATELLITES PROGRAM

Overview of Himawari-8 and -9

https://www.jstage.jst.go.jp/article/jmsj/94/2/94_2016-009/_article

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Articles

An Introduction to Himawari-8/9— Japan's New-Generation Geostationary Meteorological Satellites

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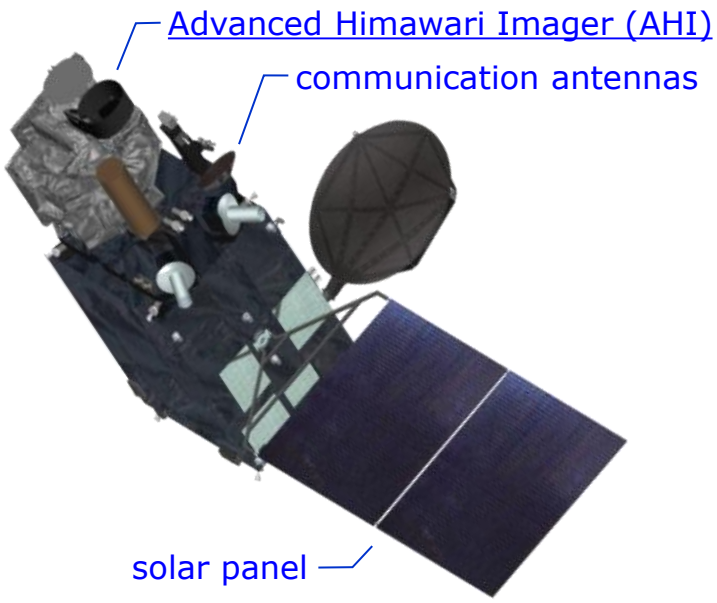
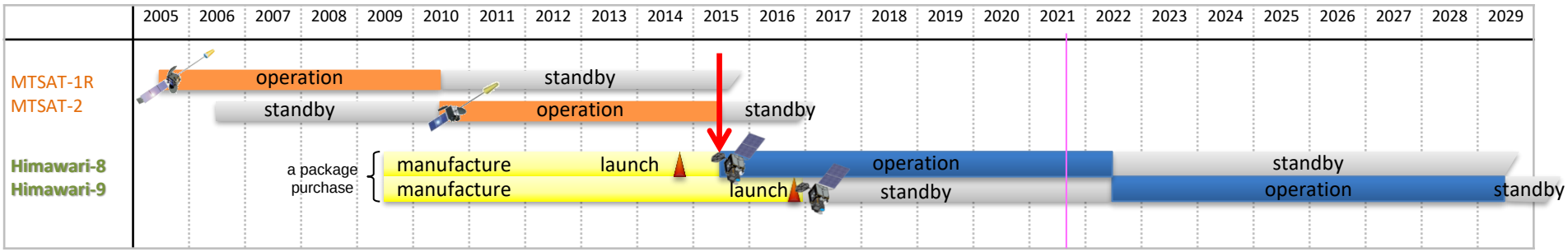
Himawari-8/9



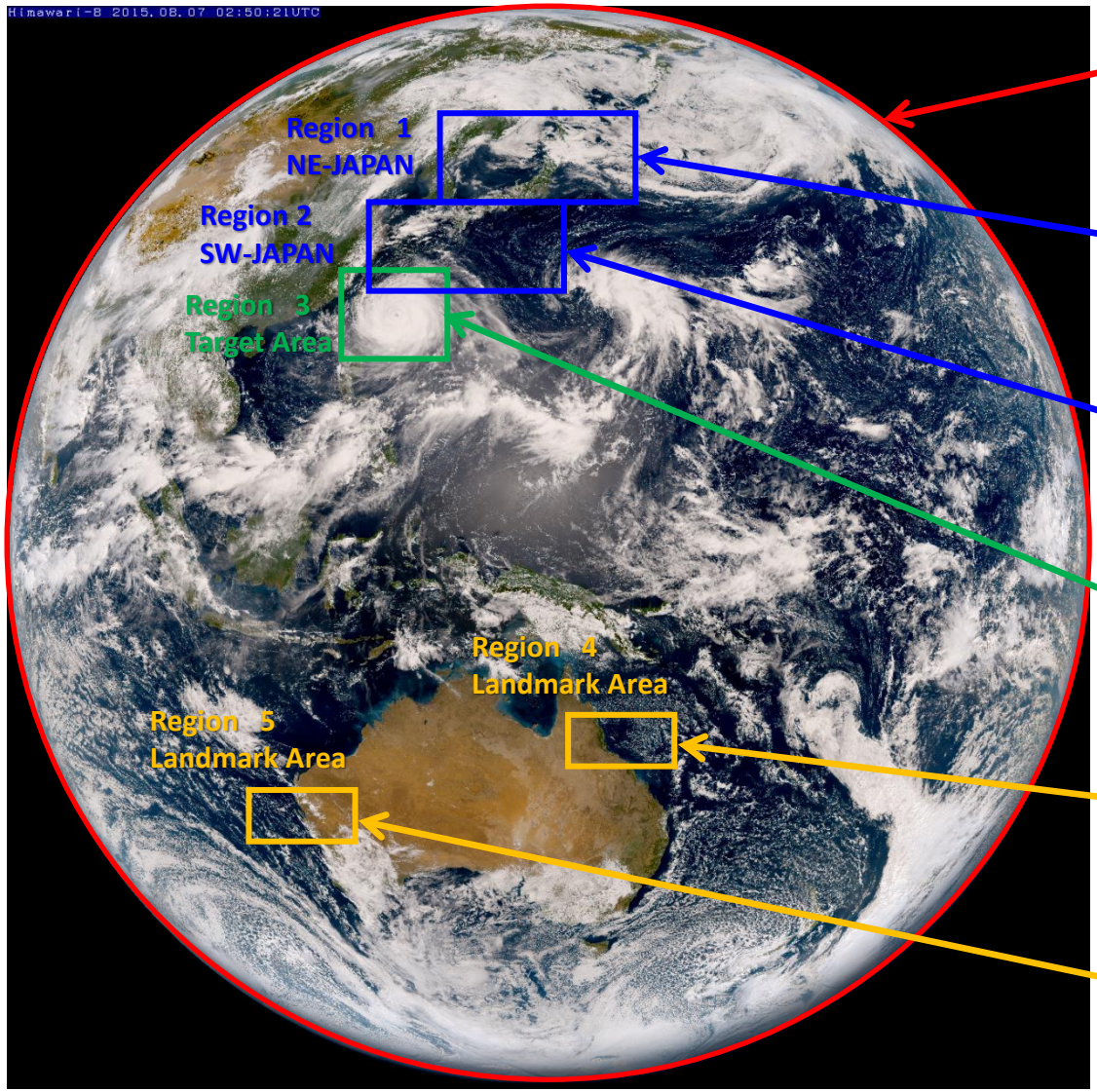
Himawari-8 began operation on 7 July 2015, replacing the previous MTSAT-2 operational satellite

Geostationary position	Around 140.7° E
Attitude control	3-axis attitude-controlled geostationary satellite
Communication	1) Raw observation data transmission Ka-band, 18.1 - 18.4 GHz (downlink)
	2) DCS (Data collection System) International channel 402.0 - 402.1 MHz (uplink) Domestic channel 402.1 - 402.4 MHz (uplink) Transmission to ground segments Ka-band, 18.1 - 18.4 GHz (downlink)
	3) Telemetry and command Ku-band, 12.2 - 12.75 GHz (downlink) 13.75 - 14.5 GHz (uplink)



JMA is now planning the switch over from Himawari-8 to -9 around Q3-4 in JFY2022.
Their parallel observation and data distribution are also under consideration.

AHI Observation Modes



Full disk

Interval : **10 minutes** (6 times per hour)

Region 1 JAPAN (North-East)

Interval : **2.5 minutes** (4 times in 10 min)

Dimension : EW x NS: 2000 x 1000 km

Region 2 JAPAN (South-West)

Interval : **2.5 minutes** (4 times in 10 min)

Dimension : EW x NS: 2000 x 1000 km

Region 3 Target Area

Interval : **2.5 minutes** (4 times in 10 min)

Dimension : EW x NS: 1000 x 1000 km

Region 4 Landmark Area

Interval : **0.5 minutes** (20 times in 10 min)

Dimension : EW x NS: 1000 x 500 km

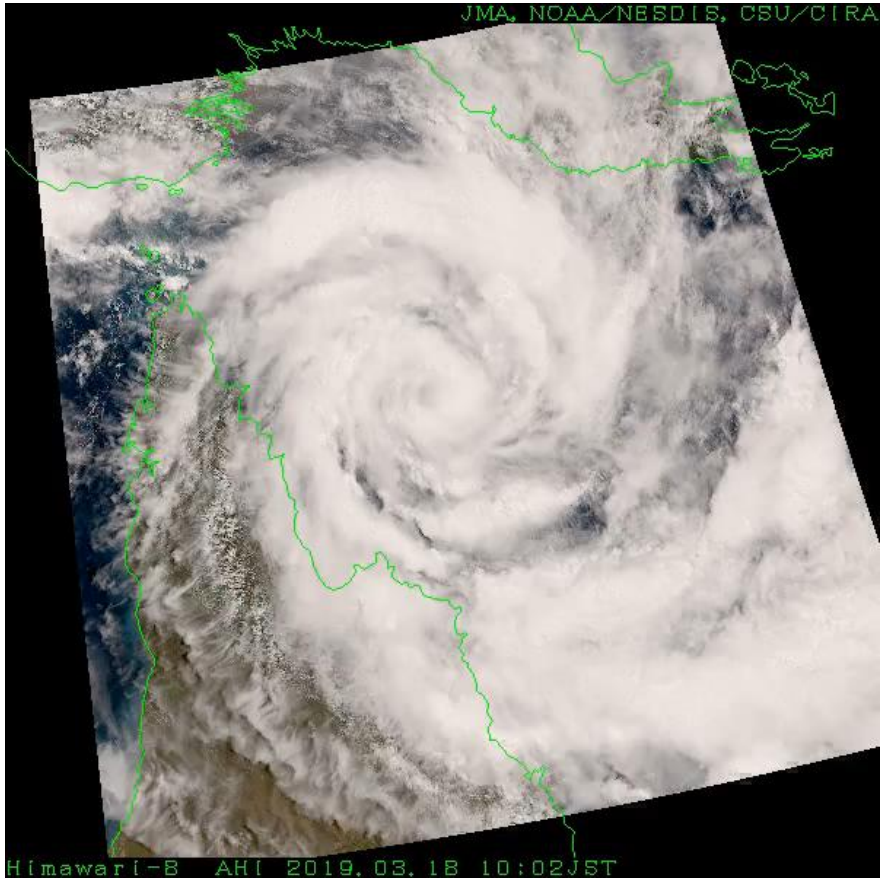
Region 5 Landmark Area

Interval : **0.5 minutes** (20 times in 10 min)

Dimension : EW x NS: 1000 x 500 km

HimawariRequest

- HimawariRequest was started from January 2018 in cooperation with Bureau of Meteorology (BoM), Australia.
- International service for NMHSs in Himawari-8/-9 coverage area to request Target Area observation (***1,000 x 1,000 km area every 2.5 minutes***).
- JMA expects this service to support ***disaster risk reduction activities in the Asia Oceania*** region.
- Status as of 5 October 2021
  - Registration: **22** NMHSs
  - **122** requests for TC, volcanic eruption, wild fires, etc.



HimawariRequest from BoM on 13-19 Mar. 2019

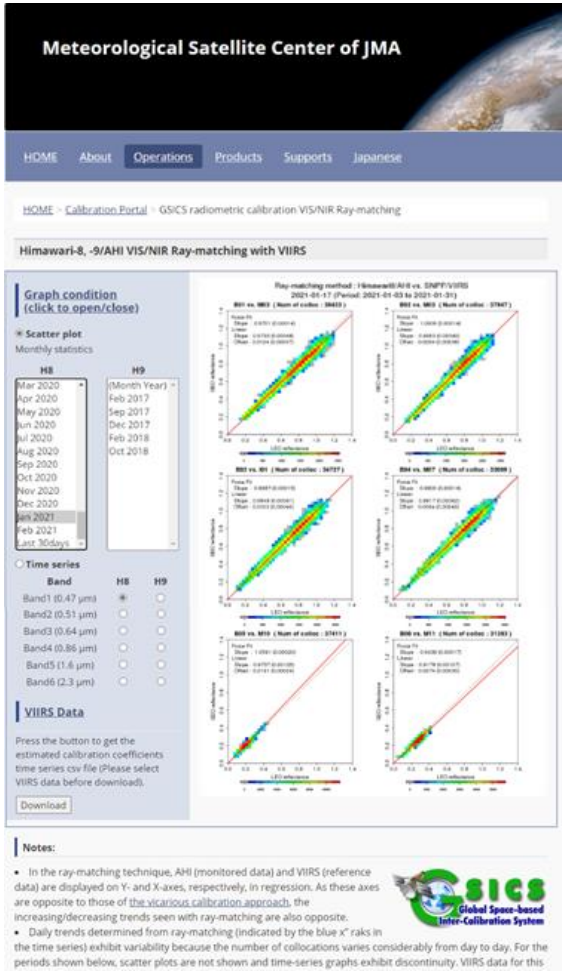
Himawari-8 observation data quality

INR (Image Navigation and Registration)

- Image navigation errors are within 600 m at the sub-satellite point.

Calibration

- Radiometric calibration biases are less than 5% in reflectivity for VNIR bands (bands 1 to 6) and less than 0.3 K in brightness temperature for IR bands (bands 7 to 16).
- Parameters for sensor sensitivity correction for bands 1 to 6 have been updated on annual basis. The last update was implemented on 15 July 2021.
- Himawari-8 visible and near infrared band calibration performance validated by a ray-matching approach utilizing VIIRS became available in June 2021, in addition to an existing approach using radiative transfer simulation.



https://www.data.jma.go.jp/mscweb/data/monitoring/navigation.html
https://www.data.jma.go.jp/mscweb/en/oper/calibration/calibration_portal.html

Provision of Himawari Data for Researcher

Himawari-8 data are being redistributed to R&D users by the following Japanese scientific cooperative institutes.

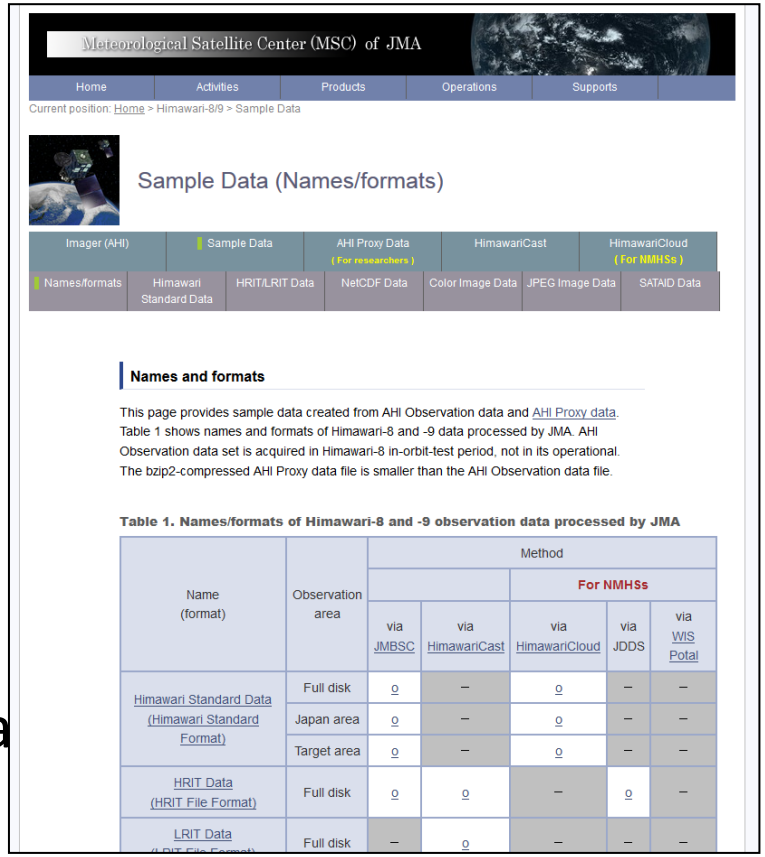
- **NICT (National Institute of Information and Communications Technology)**
  - https://himawari8.nict.go.jp/en/himawari8-image.htm
- **CEReS (Center for Environmental Remote Sensing, Chiba University)**
  - http://www.cr.chiba-u.jp/databases/GEO/H8_9/FD/index_en_V20190123.html
- **DIAS (Data Integration and Analysis System, University of Tokyo)**
  - https://diasjp.net/en/service/himawari8-data-download/
- **JAXA (Japan Aerospace Exploration / Earth Observation Research Center)**
  - http://www.eorc.jaxa.jp/ptree/index.html

Himawari-8/9 Users Support Information

https://www.data.jma.go.jp/mscweb/en/support/support.html

Contents:

- Overview of satellite observation
- Overview of data dissemination
- Imager (AHI) specifications
- Operational status
- Sample data
- Sample source code to read Himawari-8 data and convert into other formats
  - From HSD or HRIT to NetCDF Data
  - From HSD or HRIT to SATAID Data
  - From HSD to HRIT Data etc.


Meteorological Satellite Center (MSC) of JMA

Home | Activities | Products | Operations | Supports

Current position: Home > Himawari-8/9 > Sample Data

Sample Data (Names/formats)

Imager (AHI) | Sample Data | AHI Proxy Data (For researchers) | HimawariCast | HimawariCloud (For NMHSs)

Names/formats | Himawari Standard Data | HRIT/LRIT Data | NetCDF Data | Color Image Data | JPEG Image Data | SATAID Data

Names and formats

This page provides sample data created from AHI Observation data and AHI Proxy data.
Table 1 shows names and formats of Himawari-8 and -9 data processed by JMA. AHI Observation data set is acquired in Himawari-8 in-orbit-test period, not in its operational.
The bzip2-compressed AHI Proxy data file is smaller than the AHI Observation data file.

Table 1. Names/formats of Himawari-8 and -9 observation data processed by JMA

Name (format)	Observation area	Method				
				For NMHSs		
		via JMBSC	via HimawariCast	via HimawariCloud	via JDDS	via WIS Potal
Himawari Standard Data (Himawari Standard Format)	Full disk	o	–	o	–	–
	Japan area	o	–	o	–	–
	Target area	o	–	o	–	–
HRIT Data (HRIT File Format)	Full disk	o	o	–	o	–
LRIT Data	Full disk	–	o	–	–	–

Feel free to contact:

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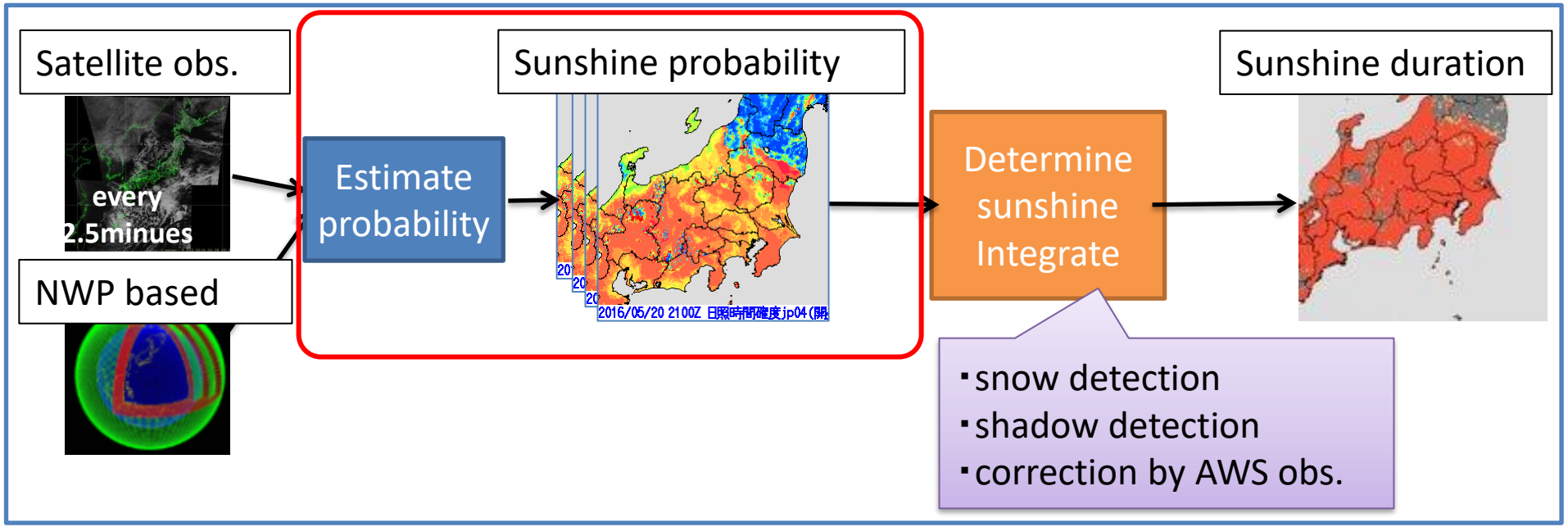
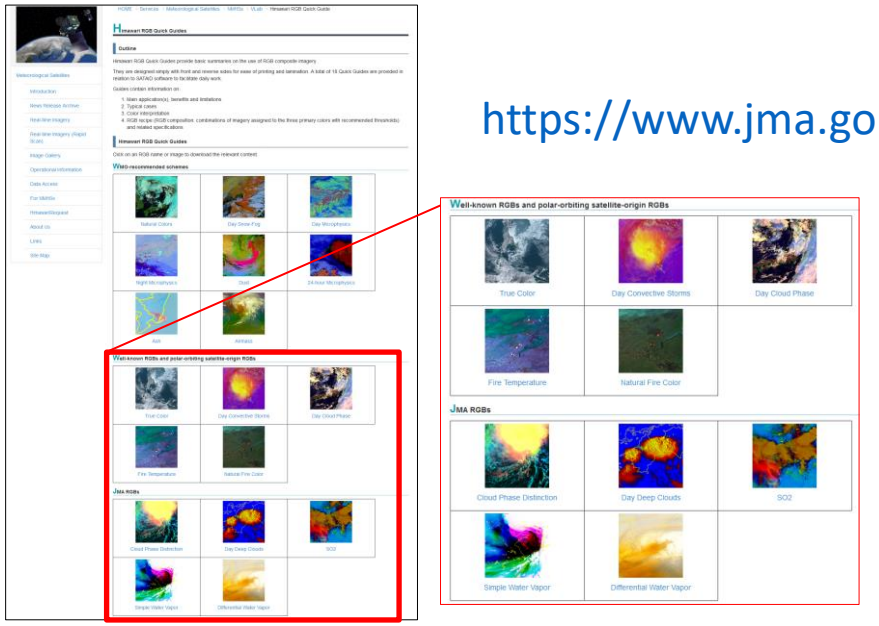
Sunshine duration product from Himawari

- Sunshine duration product from every 2.5 minutes Himawari observation data over Japan is newly and operationally open to the public.
- Sunshine durations are defined as period of direct solar radiation intensity is at least 120W/m^2.
- The algorithm of the product consists of 3 steps including **estimation of sunshine probability** in every 2.5 minutes Himawari-8 observation scene, **determination of whether there is sunshine or not** at each scenes and **integration of number of sunshine scenes** to be sunshine duration.
- It is expected to use this product in various fields, especially for Japanese agriculture.



Himawari RGB quick guides



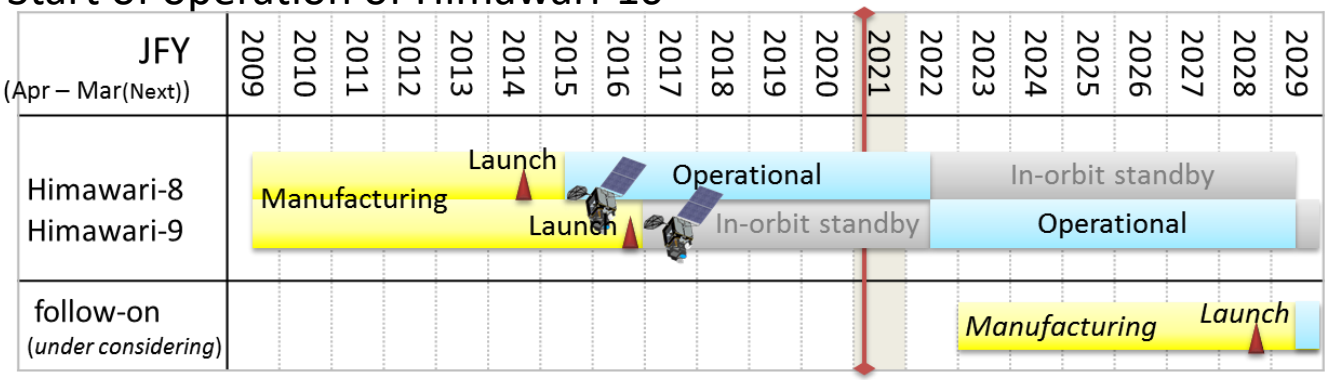
https://www.jma.go.jp/jma/jma-eng/satellite/VLab/RGB_QG.html

- **The Himawari RGB Quick Guides in Japanese and English were newly released in late September 2020 at JMA/MSC website.**
- There were requests from users to make simple, quick-look materials (including color interpretations and AHI band characteristics).
- Other meteorological satellite training centers such as EUMeTrain and SPoRT (NOAA/NASA) have been already providing similar “RGB Quick Guides”.

Himawari follow-on program

- JFY2018: JMA has started to consider the next GEO satellite (Himawari-10) program.
  - "By *JFY2023* Japan will start manufacturing the Geostationary Meteorological Satellites that will be the successors to Himawari-8/9, aiming to *put them into operation in around JFY2029*"

    Japan's "Basic Plan on Space Policy" (June 2020)
  - JMA will pursue seamless GEO satellite system by considering CGMS (Coordination Group for Meteorological Satellites) baseline and Vision for WIGOS in 2040.
- JFY2019: Worldwide Technology Trends Survey on Future Satellites/Instruments
- JFY2020: OSSE of hyperspectral IR sounder on JMA NWP systems was implemented.
- JFY2021: User requirements will be summarized.
- JFY2022: RFI and RFP
- JFY2023: Start of manufacturing of H-10
- JFY2028: Launch of Himawari-10
- JFY2029: Start of operation of Himawari-10



Vision for WIGOS in 2040 for GEO

	Application	Satellite/Instrument
VIS/IR Imager w/ rapid repeat cycles	Cloud amount/type/top height/temperature, wind, sea/land surface temperature, precipitation, aerosols, snow cover, vegetation cover, albedo, atmospheric stability, fires, volcanic ash, sand/dust storm, convective initiation	• **NOAA: GOES-16,17/ABI** • **JMA: Himawari-8,9/AHI** • **KMA: GK-2A/AMI** • **CMA: FY-4A,4B/AGRI** • **EUMETSAT: MTG-I1/FCI (2022)**
Hyperspectral IR Sounder	Atmospheric temperature/humidity, wind, rapidly evolving mesoscale features, sea/land surface temperature, cloud amount/top height/temperature, atmospheric composition	• **NOAA: N/A** • **JMA: N/A** • **KMA: N/A** • **CMA: FY-4A,4B/GIIRS** • **EUMETSAT: MTG-S1/IRS (2024)**
Lightning Mapper	Lightning, location of intense convection, life cycle of convective systems	• **NOAA: GOES-16,17/GLM** • **JMA: N/A** • **KMA: N/A** • **CMA: FY-4A/LMI** • **EUMETSAT: MTG-I1/LI (2022)**
UV/VNIR Sounder	Ozone, trace gases, aerosol, humidity, cloud top height	• **NASA: TEMPO (2022)** • **JMA: N/A** • **KMA: GK-2B/GEMS** • **CMA: N/A** • **EUMETSAT: MTG-S1/UVN (2024)**

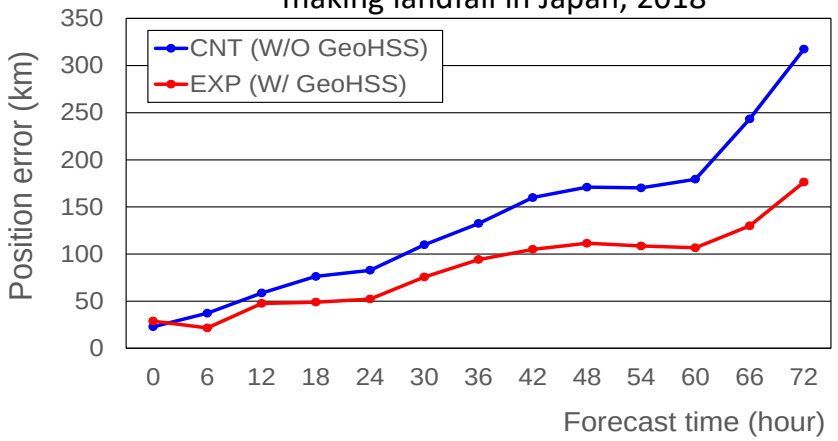
Concept of Himawari-10

- **Mission Instrument(s)**
  - AHI-class or FCI-class VIS/IR imager (with optional improved capabilities)
  - New instruments (under consideration)
    - ✓ Hyperspectral IR sounder
    - ✓ Lightning mapper
- **Orbital location**
  - Around 140 degrees East
- **Design lifetime**
  - 15 years (10-year in-orbit operation and 5-year in-orbit storage)
- **Communication subsystems**
  - Ka-band (18 GHz) for mission raw data downlink
  - Ku-band (12-14 GHz) for telemetry, tracking & command
  - Data Collection System (collection of in-situ meteorological data)

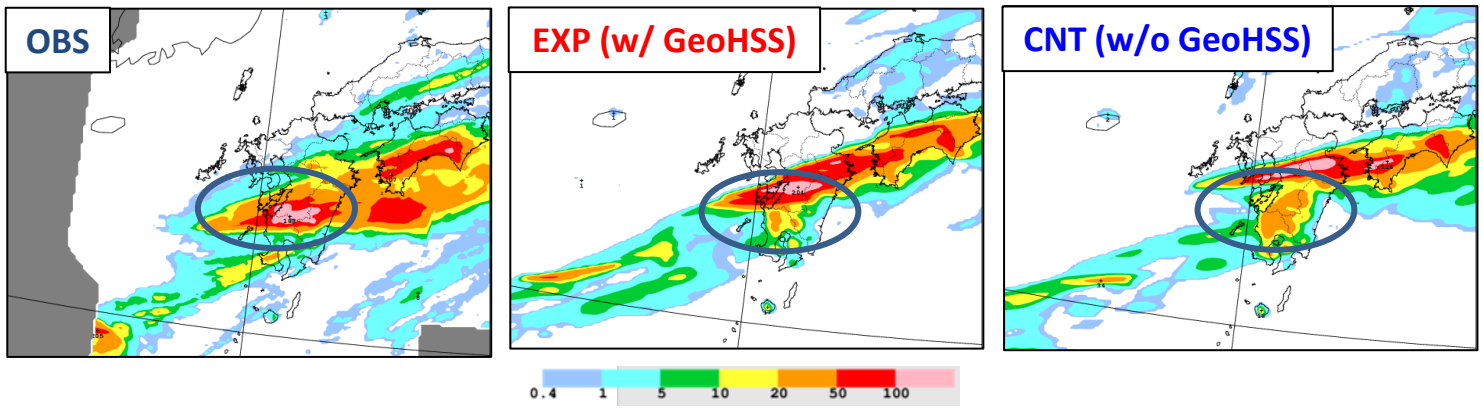
OSSE of hyperspectral IR sounder

- Several experiments were implemented with Okamoto *et al.* (2020)
  - Operational DA configuration (incl. use of AIRS/CrIS/IASI in global model)
  - Hypothetical IRS on GEO at 140.7 E, hourly full-disk obs w/ 30 km spatial resolution from ERA5
- Global DA (upper figure)
  - ~140 km improvement in typhoon position for 3-d forecast (time of landing)
- Regional DA (bottom figures)
  - Better location of the heaviest rain area which caused devastating floods

Averaged track forecast errors (4 typhoons) making landfall in Japan, 2018



3-hour accumulated rainfall (mm), 12-h forecast valid at 0900 UTC on 2020-07-04



Collecting user requirements for H-10

- JMA internal group (users/developers of satellite data/products)
  - Weather, aviation, ocean, atmospheric environment, volcano and climate
- Himawari data utilization promotion group (JMA internal/external scientists)
  - Activities under advisory panel on JMA's geostationary meteorological satellites
- Mission Investigation Team (MInT)
  - Volunteer group of Japanese remote sensing scientists including JAXA, research organizations and universities to propose recommendations for Himawari follow-on satellite and future Japanese geostationary Earth observation satellites
- Australia
  - Bureau of Meteorology and scientists in Australia (EOA survey)
- Domestic/International meetings
  - Spring/Autumn conferences of Meteorological Society of Japan
  - Annual meeting of Japan Geoscience Union
  - Asia-Oceania Meteorological Satellite Users' Conference

JMA internal Requirements for Imager

- Keeping current spectral bands (incl. 3 WV bands) as possible
- Adding 1.38 μm band for weather/aviation apps
  - Cloud mask: detection of thin cirrus and cloud identification over snow/ice-covered surfaces
  - Sunshine duration and weather estimation: reducing false alarms over snow-covered surface
- Shifting central wavelength of green band (from 0.51 to 0.55 μm)
  - Advantages in ocean color and land apps + true color imagery
- Upgrading spatial resolution (from 2 km to 1 km)
  - 1.6 μm: Sunshine duration, convective initiation, cloud microphysics (e.g. icing and supercooled cloud), SW radiation, snow/ice, RGB imagery (e.g. sea ice), volcanic activities monitoring, etc.
  - 3.9 μm: nighttime low-level AMV, low-level cloud/fog, RGB, volcanic activities monitoring, etc.
  - 2.26 μm: cloud microphysics (e.g. effective radius)
- Expanding rapid scanning (regional observation) capability
  - Monitoring weather around Japan, tropical cyclones, volcanos (incl. ash), researches in convection lifecycle,
- Improving latency: specific value TBD
- L1B reprocessing: re-analysis, L2 products (e.g. SST, aerosol)
- DNB capability (if possible): weather/marine monitoring, L2 products (cloud, fog, SST, etc.)

Himawari follow-on program

- The upgrade of Imager including adding bands, increasing observation frequency, increasing observation area of rapid scan and so on will be considered.

- The benefit of Hyperspectral IR sounder has been confirmed from OSSEs. Operational purpose of Lightning mapper is still under consideration.

- ***Positive suggestions, comments and requests for new satellite and candidate sensors from attendees of AOMSUC-11 are highly welcomed.***

Feel free to contact:
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metsat@met.kishou.go.jp

Thank you!!

The first image of Himawari-9
02:40 UTC, 24 Jan. 2017

True Color Reproduction imagery

This imagery was developed on the basis of collaboration between the JMA Meteorological Satellite Center and the NOAA/NESDIS GOES-R Algorithm Working Group imagery team.