Japan Meteorological Agency
17 July 2017
JMA’s Geostationary Satellite Program

**GMS (Geostationary Meteorological Satellite)**
- **GMS** (Himawari) launched in 1977
- **GMS-2** (Himawari-2) 1981
- **GMS-3** (Himawari-3) 1984
- **GMS-4** (Himawari-4) 1989
- **GMS-5** (Himawari-5) 1995

**MTSAT (Multi-functional Transport SATellite)**
- **MTSAT-1R** (Himawari-6) launched in 2005
- **MTSAT-2** (Himawari-7) 2006

**Satellite** | **Observation period**
--- | ---
GMS | 1978 – 1981
GMS-2 | 1981 – 1984
GMS-3 | 1984 – 1989
GMS-4 | 1989 – 1995
GMS-5 | 1995 – 2003
GOES-9 | 2003 – 2005
MTSAT-1R | 2005 – 2010
MTSAT-2 | 2010 – 2015
Himawari-8 | 2015 – 2022
Himawari-9 | 2022 – 2029
Himawari-8 has been operational since July 2015.

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<tbody>
<tr>
<td>Himawari-8</td>
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<tr>
<td>Himawari-9</td>
<td>Manufacturing</td>
<td>Launch</td>
<td>Standby</td>
<td>Operational</td>
<td>Standby</td>
<td></td>
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</table>

Himawari-9 has been an on-orbit spare since March 2017. It is expected to take over the service in 2022.
First Image Captured by Himawari-9

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

0240UTC 24 January 2017
Himawari-8/9 Satellite

Major specifications of Himawari-8

<table>
<thead>
<tr>
<th>Geostationary position</th>
<th>Around 140.7° E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude control</td>
<td>3-axis attitude-controlled geostationary satellite</td>
</tr>
<tr>
<td>Imaging sensor</td>
<td>Advanced Himawari Imager (AHI)</td>
</tr>
</tbody>
</table>

Communications

1) Raw observation data transmission
   - Ka-band, 18.1 - 18.4 GHz (downlink)

2) DCS
   - 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)

Prime Contractor

- **Mitsubishi Electric Corporation**

Launch vehicle

- H-IIA rocket (planned)

(Photo: Mitsubishi Heavy Industries Group)  (Photo: Mitsubishi Electric Corporation)
Overview of Himawari System

- **Himawari-8**
  - (Ku band) Telemetry, tracking, command
  - AHI data, DCP data (Ka band)

- **Himawari-9**
  - (Ku band) Telemetry, tracking, command
  - AHI data, DCP data (Ka band)

- **Antenna site**
  - Kanto/Saitama

- **Data center**
  - Kanto/Tokyo

- **Primary station**
  - AHI data, DCP data (Landline)

- **Secondary station**
  - Antenna site / Data center
    - Hokkaido/Ebetsu

- **Remote control**
  - Osaka Regional Headquarters
    - Osaka

**a) Site diversity**

**b) Operation by HOPE**

**c) Operation by JMA**

- **Meteorological Satellite Center**
  - Tokyo
## Advanced Himawari Imager (AHI)

<table>
<thead>
<tr>
<th>Band</th>
<th>Himawari-8/AHI</th>
<th>GOES-16/ABI</th>
<th>MTSAT-2/Imager</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Band</td>
<td>Center Wavelength</td>
<td>Spatial Resolution</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0.47μm</td>
<td>1km</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>0.51μm</td>
<td>1km</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>0.64μm</td>
<td>0.5km</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>0.86μm</td>
<td>1km</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>1.38μm</td>
<td>2km</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>2.3μm</td>
<td>2km</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>3.9μm</td>
<td>2km</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>6.2μm</td>
<td>2km</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
<td>6.9μm</td>
<td>2km</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>7.3μm</td>
<td>2km</td>
</tr>
<tr>
<td>11</td>
<td>11</td>
<td>8.6μm</td>
<td>2km</td>
</tr>
<tr>
<td>12</td>
<td>12</td>
<td>9.6μm</td>
<td>2km</td>
</tr>
<tr>
<td>13</td>
<td>13</td>
<td>10.4μm</td>
<td>2km</td>
</tr>
<tr>
<td>14</td>
<td>14</td>
<td>11.2μm</td>
<td>2km</td>
</tr>
<tr>
<td>15</td>
<td>15</td>
<td>12.4μm</td>
<td>2km</td>
</tr>
<tr>
<td>16</td>
<td>16</td>
<td>13.3μm</td>
<td>2km</td>
</tr>
</tbody>
</table>

Spectral response of AHI-8(black) and AHI-9(red) for visible, near-Infrared and infrared
Observations in 10 minutes time frame

Full Disk Observation every 10 min.

Region 1
2000 x 1000km (NE Japan)
Every 2.5 min.

Region 2
2000 x 1000km (SW Japan)
Every 2.5 min.

Region 3
1000 x 1000 km (Target Area)
Every 2.5 min.

Region 4
1000 x 500 km (Landmark Area)
Every 30 sec.

Region 5
1000 x 500 km (Landmark Area)
Every 30 sec.
1. HimawariCast service

2. HimawariCloud service

Communication Satellite (CS)

Himawari-8/9

CS Operator

C-band antenna
DVB-S2 receiver
PC & software

Users

JMA

cloud

NMHSs
**HimawariCast service**

(2) The communication satellite broadcasts data received from the uplink station to the receiving station.

**HimawariCast communication satellite**
JCSAT-2B
(SKY Perfect JSAT Corporation)

**Receiving station**

(3) The receiving station’s antenna and LNB receive the data from the communication satellite and send the information to the DVB-S2 receiver.

**Antenna, LNB**
C-band

**DVB-S2 receiver**

(4) The receiver converts the data into IP packets and sends them to a computer.

**Computer**

(5) The KenCast Fazt Professional Client unencapsulates the data for storage in any directory on the computer.

- A KenCast Fazt server encapsulates data, which is sent to the communication satellite by the uplink station.

**Data type** | **Format** | **Notes**
--- | --- | ---
Himawari imagery (full disk) | HRIT/LRIT data format (Compatible with the data format used in the MTSAT HRIT/LRIT services) | - Interval: 10 minutes - HRIT: 14 bands (VIS: 1 km, IR: 4 km) - LRIT: 4 bands (VIS, IR1, IR3, IR4: 5 km)
• NWP products • In-situ observations • ASCAT ocean surface wind | SATAID format | - SATAID: Satellite Animation and Interactive Diagnosis

### Observation type

<table>
<thead>
<tr>
<th>Full disk (10-minute intervals)</th>
<th>Format</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Himawari Standard Data (HSD)</td>
<td>- HSD: 16 bands (full resolution)</td>
<td></td>
</tr>
<tr>
<td>• PNG</td>
<td>- PNG: True-color composite (1 km)</td>
<td></td>
</tr>
<tr>
<td>• HRIT data format</td>
<td>- same as the ones via HimawariCast</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Target area (2.5-minute intervals)</th>
<th>Format</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>• HSD</td>
<td>- HSD: 16 bands (full resolution)</td>
<td></td>
</tr>
<tr>
<td>• NetCDF</td>
<td>- NetCDF: 16 bands (latitude/longitude grid)</td>
<td></td>
</tr>
<tr>
<td>• PNG</td>
<td>- PNG: True-color composite (1 km)</td>
<td></td>
</tr>
</tbody>
</table>
• Himawari data are redistributed to foreign and domestic R&D users by the following Japanese scientific institutes.

  - NICT* (via Science Cloud)  http://sc-web.nict.go.jp/himawari/
  - University of Tokyo (via DIAS***)  http://www.diasjp.net/en/
  - Chiba University CEReS****  http://www.cr.chiba-u.jp/english/

* National Institute of Information and Communications Technology
** Japan Aerospace Exploration Agency
*** Data Integration and Analysis System
**** Center for Environmental Remote Sensing
< Himawari User’s Guide >

Contents:
- Overview of satellite observation
- Overview of data dissemination
- Imager (AHI) specifications
- Sample data
  - Himawari Standard Data (HSD)
  - HRIT/LRIT files
  - NetCDF
  - PNG
- Sample source code to read HSD and convert into other formats

Summary

• Himawari-8 and 9 are the new-generation geostationary meteorological satellite. Himawari-8 has been operational since July 2015. Himawari-9 has been standby on orbit since March 2017 and is expected to take over the service in 2022.

• Himawari-8 and 9 carry a new imager which is a multi-channel passive imaging radiometer similar to the Advanced Baseline Imager (ABI) on the GOES-16.

• JMA distributes the Himawari data in two ways. One is the HimawariCast service via a communication satellite. The other is the HimawariCloud service over the Internet.
Thank you for your attention

Shadow of the moon crossing on the Earth surface during a solar eclipse