CGMS

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Prepared by JMA
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JMA REPORT ON THE STATUS OF CURRENT AND FUTURE SATELLITE SYSTEMS

The Japan Meteorological Agency (JMA) operates two geostationary meteorological satellites, Himawari-8 and -9, equipped with Advanced Himawari Imager (AHI). JMA conducted the operational satellite switchover from Himawari-8 (in operation since July 2015) to Himawari-9 in December 2022 for scheduled operation until FY 2029. JMA also provided parallel distribution of experimental Himawari-9 products and observation data for several months as an alternative approach before the switchover for user readiness (non-operational purposes).

JMA contracted manufacturing of the follow-on satellite Himawari-10 in March 2023, with initiation of operation scheduled for FY 2029. Himawari-10 is scheduled to carry a visible/infrared imager as well as an infrared sounder and a space environmental suite.

Action/Recommendation proposed: none

JMA report on the status of current and future satellite systems

1 INTRODUCTION

This paper reports on the status of JMA's current and future satellite systems.

2 CURRENT SATELLITE SYSTEMS

Table 2.1 JMA's current GEO satellites

Sector	Satellite	Location	Launch date DD/MM/YYYY	Data Access	Payload and status
East Asia and Western Pacific	Himawari-8	140.7°E	07/10/2014	HimawariCast HimawariCloud	16-channel AHI, DCS, SEDA; in-orbit standby
	Himawari-9	140.7°E	02/11/2016	HimawariCast HimawariCloud	16-channel AHI, DCS, SEDA; operational

2.1 Status of current GEO satellite systems

The Japan Meteorological Agency (JMA) operates two geostationary meteorological satellites, Himawari-8 and -9, equipped with Advanced Himawari Imager (AHI) units. JMA has established a satellite observation system with redundancy based on twin satellite operation, which is expected to contribute to disaster risk reduction in Asia and the western Pacific until 2029. Himawari-8 had chiefly been used for observation during the early part of this period, with Himawari-9 in a back-up role. Their operation was switched in December 2022 to place Himawari-9 in the main observation role with Himawari-8 as back-up. The switch had been conducted almost seamlessly, with no data format or data dissemination system changes other than filenames for Himawari Standard Data (HSD) and NetCDF file. JMA also provided parallel distribution of experimental Himawari-9 products and observation data for several months as an alternative approach before the switchover for user readiness (non-operational purposes).

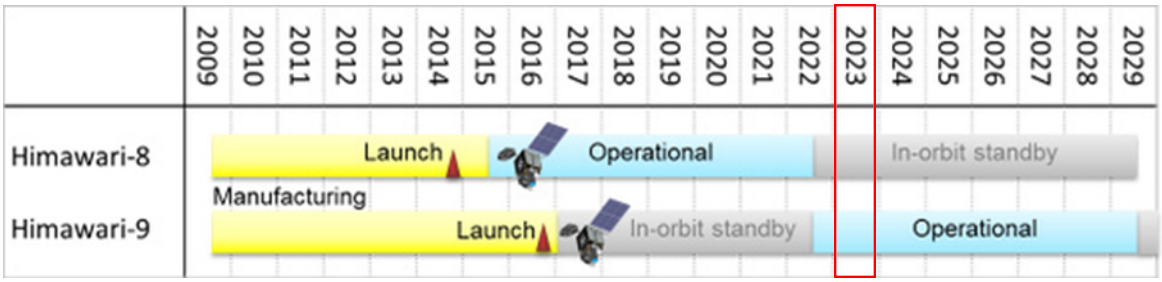

Figure 1: Himawari-8 and -9 timeline

2.1.1 Status of spacecraft

2.1.1.1 Himawari-8

The status of Himawari-8 is normal, with no significant anomalies since CGMS-50. The following webpage provides information on irregular events, processing events and data outages of the satellite:

Himawari-8 Event Log, MSC/JMA
https://www.data.jma.go.jp/mscweb/en/oper/event_H8.html

In the event of a critical Himawari-9 malfunction, Himawari-8 will begin back-up observation.

2.1.1.2 Himawari-9

The status of Himawari-9 is normal, with no significant anomalies since CGMS-50. The following webpage provides information of irregular events, processing events and data outages of the satellite:

Himawari-9 Event Log, MSC/JMA
https://www.data.jma.go.jp/mscweb/en/oper/event_H9.html

2.1.2 Impact on spacecraft due to space weather

Space weather related spacecraft anomalies (Items in bold are required)

During the reporting period, no anomalies were confirmed in relation to space weather-related events.

Table 2.2 Source: Recommendations for Contents of Anomaly Database for Correlation with Space Weather Phenomena, P. O'Brien, J.E. Mazur, T. Guild, November 2011, AEROSPACE Report No.TOR-2011(3903)-5.

1. Date and Universal Time of the anomaly	**2. Fully specified location of the anomaly** (spacecraft location)	**3. Velocity or orbital elements at time of the anomaly**	4. Eclipse state of the vehicle (full, penumbra, partial, none)	5. Vector to Sun in spacecraft coordinates	6. Velocity vector of spacecraft in spacecraft coordinates	7. Initial guess at type of anomaly (See taxonomy below)	8. Estimated confidence of that guess	9. Anomaly category (e.g., affected system or kind of disruption)	10. Vehicle identity	11. Notes (e.g. unusual operational states or recent changes to operations (recent commands, attitude scheme, etc.)

Taxonomy of Satellite Anomalies Caused by In Situ Charged Particle Environment (to be used for column 7):

1. Electrostatic discharge (charging)
    - 1.1 Surface charging
        - 1.1.1 Plasma sheet (subauroral)
        - 1.1.2 Auroral
    - 1.2 Internal charging
        - 1.2.1 Subsurface charging (e.g., beneath blanket)
        - 1.2.2 Deep charging (e.g., inside a box)
2. Single-Event Effects
    - 2.1 Protons
        - 2.1.1 Solar proton event
        - 2.1.2 Geomagnetically trapped protons
    - 2.2 Heavy ions
        - 2.2.1 Galactic Cosmic Rays
        - 2.2.2 Solar energetic particles
        - 2.2.3 Geomagnetically trapped heavy ions
3. Total Dose
    - 3.1 Long-term dose accumulation (multiple causes combined)
    - 3.2 Short-term (days or less) dose accumulation
        - 3.2.1 Solar protons
        - 3.2.2 Geomagnetically trapped protons
        - 3.2.3 Geomagnetically trapped electrons

2.1.3 Ground segment matters

The availability of the Himawari-8 and -9 ground systems was normal during the reporting period.

2.1.4 Data transmission

JMA mainly distributes Himawari-8 and -9 data in two ways. One is the HimawariCast, by which primary sets of imagery are disseminated as operational meteorological services via a commercial communication satellite. The other is the HimawariCloud, by which full sets of imagery are delivered to National Meteorological and Hydrological Services (NMHSs) via a private Internet cloud service. JMA upgraded both systems in FY 2019. See CGMS-51-JMA-WP-07 for more information on Himawari-8 and -9 data provision.

2.1.5 Projects, services

2.1.5.1 Data Collection System

Himawari-8 and -9 currently support the Data Collection Service. Monthly reports on Himawari-8 and -9's IDCS are available at
Monthly Operation Report, MSC/JMA
https://www.data.jma.go.jp/mscweb/en/oper/opr_report.html.

See the CGMS-51-JMA-WP-02 for more information on Himawari-DCS.

2.1.5.2 Space Environment Data Acquisition

Himawari-8 and -9 have instruments to sense proton and electron flux for satellite housekeeping known as SEDA (Space Environment Data Acquisition). SEDA text data acquired from the satellites are provided to the National Institute of Information and Communications Technology (NICT) to support near-real-time space environment monitoring and forecasting. For more information, see the NICT Space Weather Information Center Web page at https://aer-nc-web.nict.go.jp/himawari-seda/.

2.1.5.3 HimawariRequest Service

In January 2018, JMA launched a new international service "HimawariRequest", in collaboration with the Australian Bureau of Meteorology. The service allows NMHS users in Himawari-8 and -9 coverage area to request Target Area observation covering a 1,000 km x 1,000 km area every 2.5 minutes.

As of 23 May 2023, JMA had taken 22 registrations from NMHSs in RA II and RA V, and opened the service to the seventeen whose preparations for request submission were complete. There have been 206 international requests since the commencement

of the service, among which 185 have been accepted. Table 2.3 shows numbers of international requests and accepted requests received so far.

Table 2.3: HimawariRequest status

	International requests	Accepted requests
2018	10	8
2019	47	36
2020	39	38
2021	45	41
2022	32	30
2023 (as of 23 May)	33	32

JMA provides information on past, current and planned observation schedules for target-area observation, including that conducted under the HimawariRequest service, at:

- Past: https://www.data.jma.go.jp/mscweb/data/himawari/obs_info_tg_en.html,
- Current: https://www.data.jma.go.jp/mscweb/data/himawari/sat_tga.php,
- Planned: https://www.data.jma.go.jp/sat_info/data/Request/RequestStatus.html.

See CGMS-51-JMA-WP-08 for more information on the status of JMA HimawariRequest service.

3 FOLLOW-ON SATELLITE HIMAWARI-10

In FY 2018, JMA began consideration of the Himawari-8 and -9 follow-on program. The Implementation Plan of the Basic Plans on Space Policy devised by the Strategic Headquarters for National Space Policy under the Japanese government's Cabinet Office states that "By FY2023 Japan will start manufacturing the Geostationary Meteorological Satellite that will be the successor to Himawari-8 and -9, aiming to put it into operation in around FY2029". Against this background, JMA completed a contract for Himawari-10 in March 2023 and began related manufacture.

JMA plans the operation of a seamless geostationary earth orbit satellite system in consideration of the CGMS baseline and the WMO Vision for WIGOS in 2040, including the deployment of hyperspectral infrared sounders across the full geo-ring. In addition to visible/infrared imager operation, infrared sounder usage is planned for Himawari-10 mission to help improve JMA services in extreme weather monitoring, nowcasting and numerical weather prediction. The Space Environmental Suite developed by the Ministry of Internal Affairs and Communications (MIC) and the National Institute of Information and Communications Technology (NICT) will also be mounted on the satellite as hosted payload.

The Himawari series of satellites have been used widely in East Asia and the Western Pacific, representing an indispensable part of this international infrastructure.

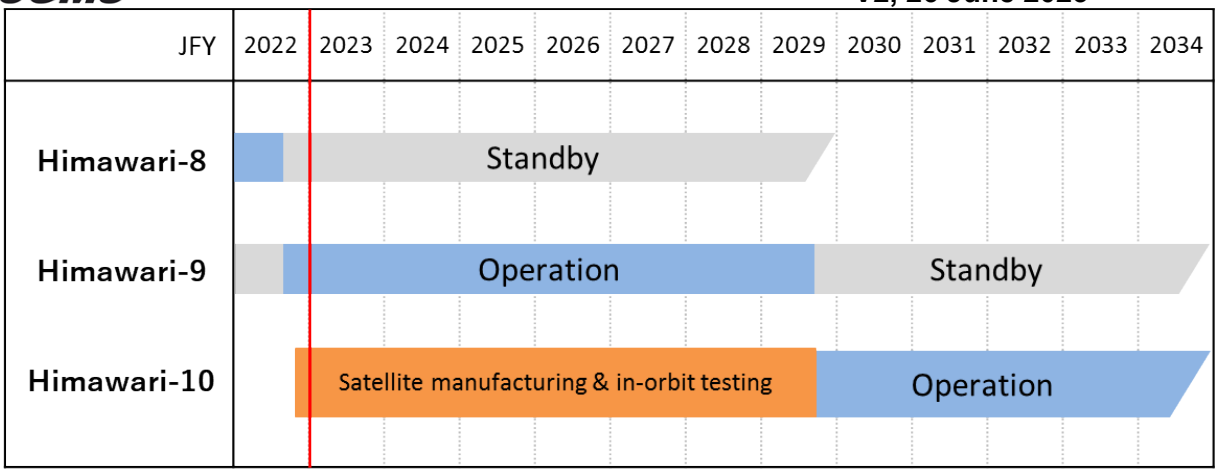

Figure 2: Himawari-8/9 and Himawari-10 timeline

4 CONCLUSIONS

Himawari-8 and -9 are operating normally with no significant anomalies, and JMA now operates the related HimawariRequest service to help mitigate disaster conditions in the Asia-Pacific region. A seamless switch from Himawari-8 to -9 was conducted in December 2022, with parallel provision of Himawari-9 data prior to the switch for user readiness. The agency contracted manufacturing of the follow-on satellite Himawari-10 in March 2023, with initiation of operation scheduled for FY 2029. Himawari-10 is scheduled to carry a visible/infrared imager as well as an infrared sounder and a space environmental suite.