



International Civil Aviation Organization

**THE EIGHTH MEETING OF THE ASIA/PACIFIC GBAS/SBAS
IMPLEMENTATION TASK FORCE (GBAS/SBAS ITF/8)**

(Melbourne, Australia, 12-14 May 2026)

Agenda Item 4: Updates on GBAS/SBAS system and States' implementation status

Update on SBAS Implementation Status in Japan

(Presented by Japan)

SUMMARY

This paper provides an update on the current status of the Satellite-Based Augmentation System (SBAS) in Japan.

1. INTRODUCTION

- Japan's Satellite-Based Augmentation System (SBAS), the Michibiki Satellite-based Augmentation Service (MSAS), was upgraded to MSAS Version 3 (MSASv3) in March 2025. This upgrade improved positioning accuracy and service stability, supporting the continued implementation and use of LP/LPV approach procedures in Japan.
- LP/LPV approach procedures had already been introduced in Japan on a phased basis, supported by operational assessments and appropriate mitigation measures. In October 2025, SBAS services commenced via Quasi-Zenith Satellite Michibiki No.6 (QZS-6). Since that time, SBAS services have been provided using a dual-satellite configuration consisting of QZS-3 and QZS-6.
- At present, LP/LPV approach procedures are published at 25 airports throughout Japan.

2. Transition to a Three-GEO SBAS Configuration and Introduction of LPV200

Following the unsuccessful launch of Quasi-Zenith Satellite Michibiki No.5 in December 2025, the launch schedule of Quasi-Zenith Satellite Michibiki No.7 (QZS-7), which is planned for SBAS utilization, has been deferred.

The launch of QZS-7 is currently planned for later in 2026. Service provision using a three-GEO SBAS configuration is expected to commence during 2027, supporting further improvements in service availability and future expansion of LPV200 operations.

The current operational status of the SBAS satellites is as follows:

- ◆ PRN 129 from QZS-6 located at 90.5°E: Operational
- ◆ PRN 137 from QZS-3 located at 127°E: Operational
- ◆ PRN 139 from QZS-7: Awaiting launch

Under the current LPV250 (VAL = 50 m) criteria, terrain and obstacle constraints prevent the Decision Height (DH) from being reduced to 250 ft at some airports.

Japan plans to introduce LPV200 (VAL = 35 m) approach procedures for the first time in 2027. Initial implementation is planned at runways currently served only by non-precision approach procedures, particularly at regional and remote island airports. The objective is to reduce the DH closer to 250 ft and to improve operational availability under adverse meteorological conditions.

The timeline for implementing SBAS CAT I operations on precision approach runways is still under consideration.

3. Evaluation of Vertical Position Accuracy for LPV200 Service Provision

In order to support the provision of LPV200 (VAL = 35 m) services, evaluations of vertical position accuracy are currently being conducted.

Figure 1 presents the position accuracy prior to the MSAS upgrade, while Figure 2 shows the position accuracy following the upgrade to MSASv3.

Note: The vertical position error is indicated in blue.

As illustrated in Figure 2, instances were observed in which the vertical position error at the CHMS reference station exceeded 10 m. Subsequent investigations indicated that one of the three antenna systems installed at the CHMS reference station was being affected by nearby vegetation.

However, since the installation site is adjacent to an area designated as a World Natural Heritage Site, vegetation cannot be removed due to the need to protect rare wildlife and flora.

As a countermeasure, the correction calculation parameters were modified, resulting in improved positional accuracy; it was confirmed that the vertical position performance of the SBAS signal-in-space (SIS) was less than 4 meters at all observation points.

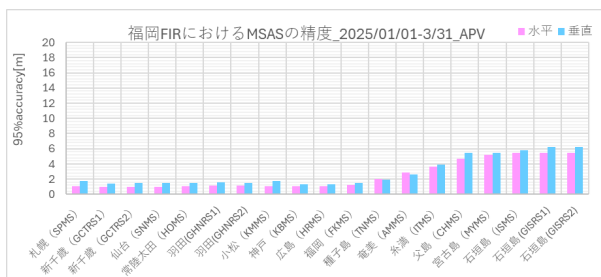


Figure 1: MSAS Position Accuracy (1 Jan – 31 Mar 2025)

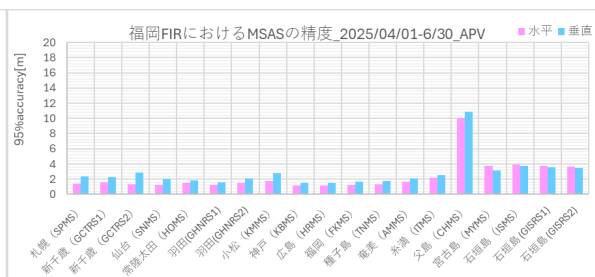


Figure 2: MSAS Position Accuracy (1 Apr – 30 Jun 2025)

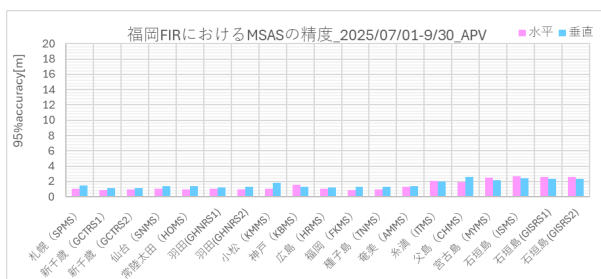


Figure 3: MSAS Position Accuracy (1 Jul – 30 Sep 2025)

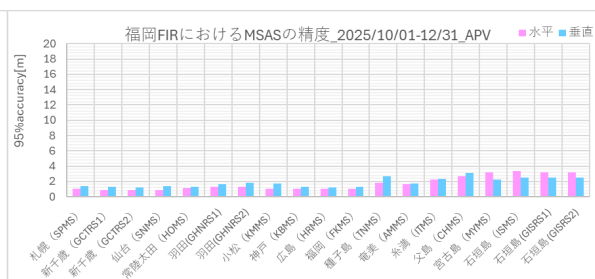


Figure 4: MSAS Position Accuracy (1 Oct – 31 Dec 2025)

In accordance with Annex 10, Volume I, Attachment D, paragraph 3.39, consideration should be given to ensuring that the Vertical Navigation System Error (VNSE) does not exceed 10 m when providing LPV200 services.

Although the MSAS equipment deployed in Japan was designed and developed to support LPV200 (VAL = 35 m) operations, Japan intends to conduct periodic and continuous performance assessments of vertical position accuracy using all epochs observed at the reference stations.

Figure 5 presents a histogram based on all epochs collected during a three-month observation period. The dataset comprised approximately 180 million epochs.

Japan’s current analysis system aggregates all available reference-station data for statistical evaluation. In this configuration, exclusion of individual reference stations requires careful manual processing and verification. For this reason, the dataset used for this interim analysis included some data from reference stations outside Japan, and Vertical Error values exceeding 10 m were identified in a limited number of epochs.

Further analysis is being conducted carefully to identify the reference stations contributing to these values. The geographical areas in which LPV200 (VAL = 35 m) procedures may be established will be determined only after the necessary validation has been completed, so that operational safety is not affected.

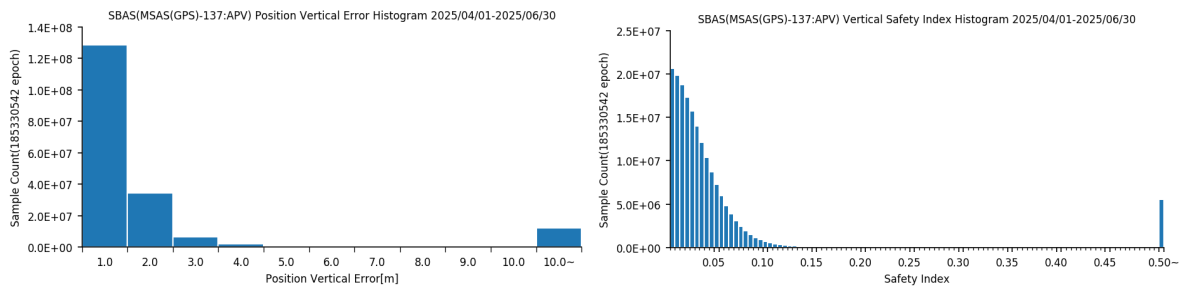


Figure 5: Position Vertical Error Histogram / Safety Histogram (1 Apr – 30 Jun 2025)

4. MSAS Integrity and Availability

Following the upgrade to MSASv3, MSAS integrity has remained at 100 per cent, consistent with previous performance. Adequate safety margins have also been confirmed. Figures 6 and 7 present Stanford charts for ISMS, the southernmost reference station in Japan, illustrating integrity performance and safety margins at this location.

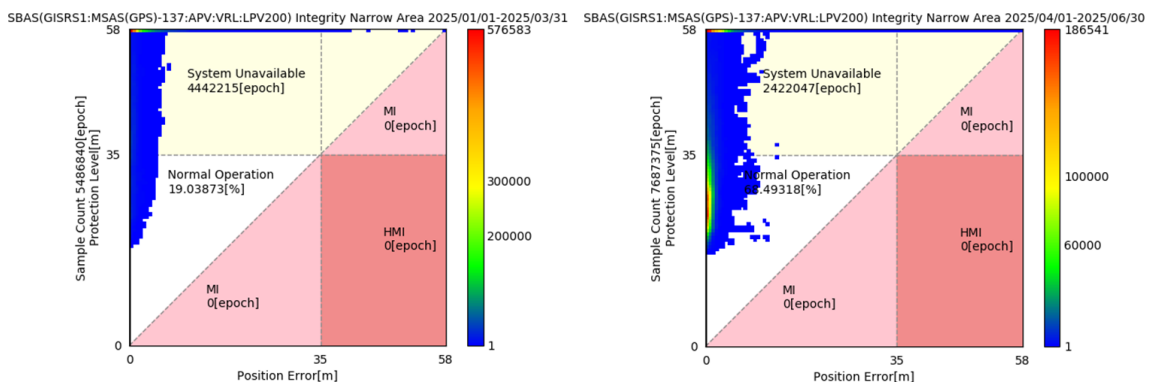


Figure 6: Stanford Chart for the ISMS Reference Station (left: 1 Jan – 31 Mar 2025; right: 1 Apr – 30 Jun 2025)

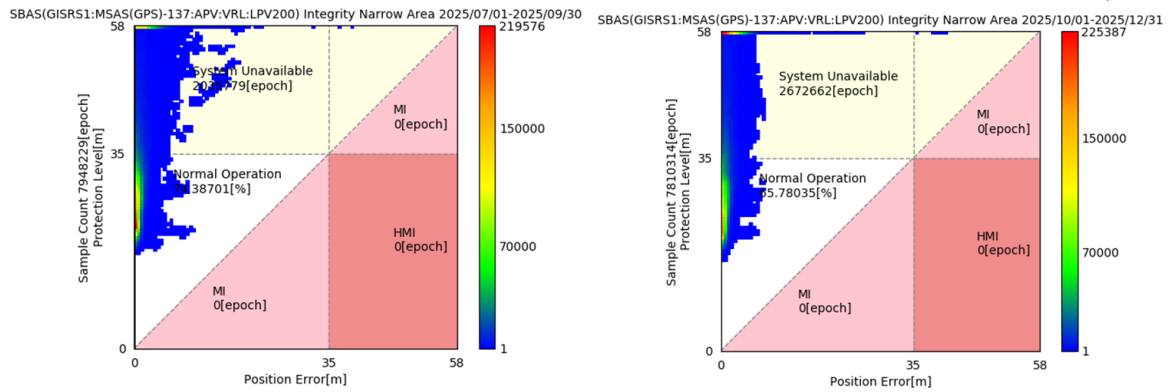


Figure 7: Stanford Chart for the ISMS Reference Station (left: 1 Jul – 30 Sep 2025; right: 1 Oct – 31 Dec 2025)

Taking advantage of these safety margins, Japan plans to implement a software update in the first half of 2027 to optimize the User Differential Range Error (UDRE) calculation algorithm, with the aim of achieving a limited improvement in availability.

5. LP/LPV Operational Status

As of January 2026, LP/LPV approach procedures have been implemented at 25 airports throughout Japan, with a cumulative total of 8,903 confirmed LP/LPV operations.

Subsequent to the upgrade to MSASv3, improvements in positioning accuracy and service stability have resulted in an increasing trend in LP/LPV utilization, with approximately 400 to 500 LP/LPV approaches conducted per month.

In Japan, Aeronautical Information Circular (AIC) No. 013/22 requires operators utilizing LP/LPV approaches to report monthly utilization statistics. These reports are also used to support causal analysis in the event of abnormalities encountered during approach operations.

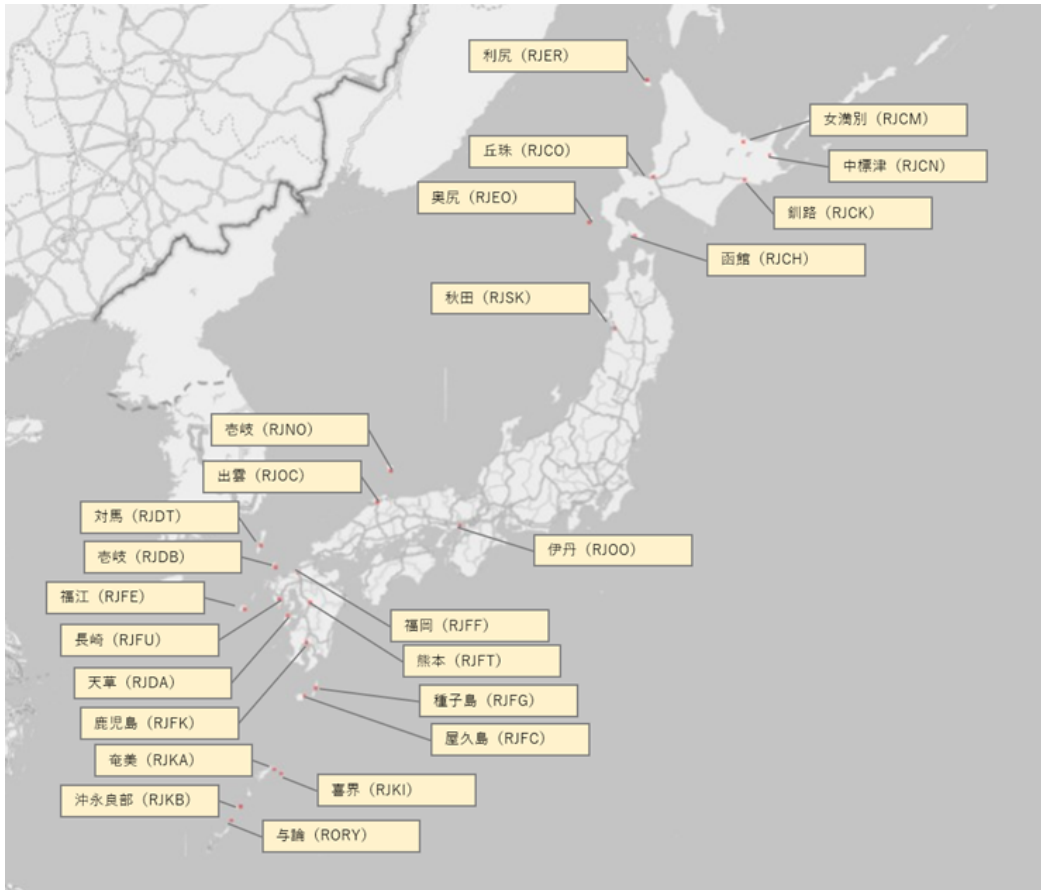


Figure 8: Aerodromes in Japan with Published LPV Approach Procedures (25 Aerodromes)

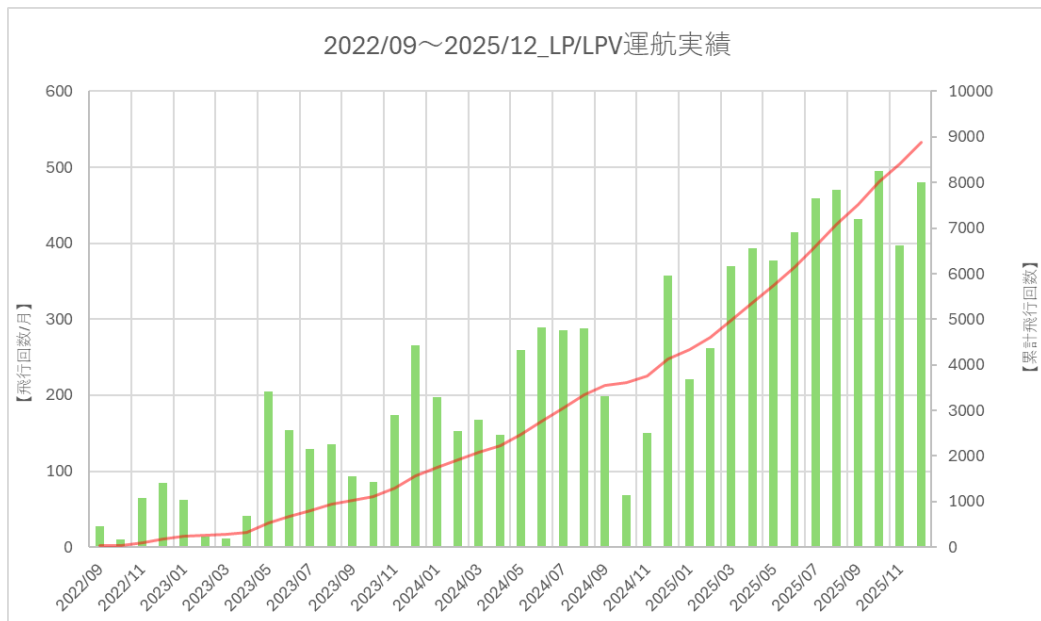


Figure 9: Cumulative Number of LP/LPV Approaches in Japan

6. Introduction of RNP-to-LPV Procedures

In March 2026, Japan introduced its first RNP-to-LPV approach procedures utilizing RF leg capability. By enabling a curved transition to the final approach segment while retaining SBAS-based LPV guidance on final approach, these procedures provide greater design flexibility than standalone LPV procedures. In suitable airport environments, they are also expected to reduce track miles, thereby improving operational efficiency and contributing to reduced fuel consumption, emissions, and noise impact.

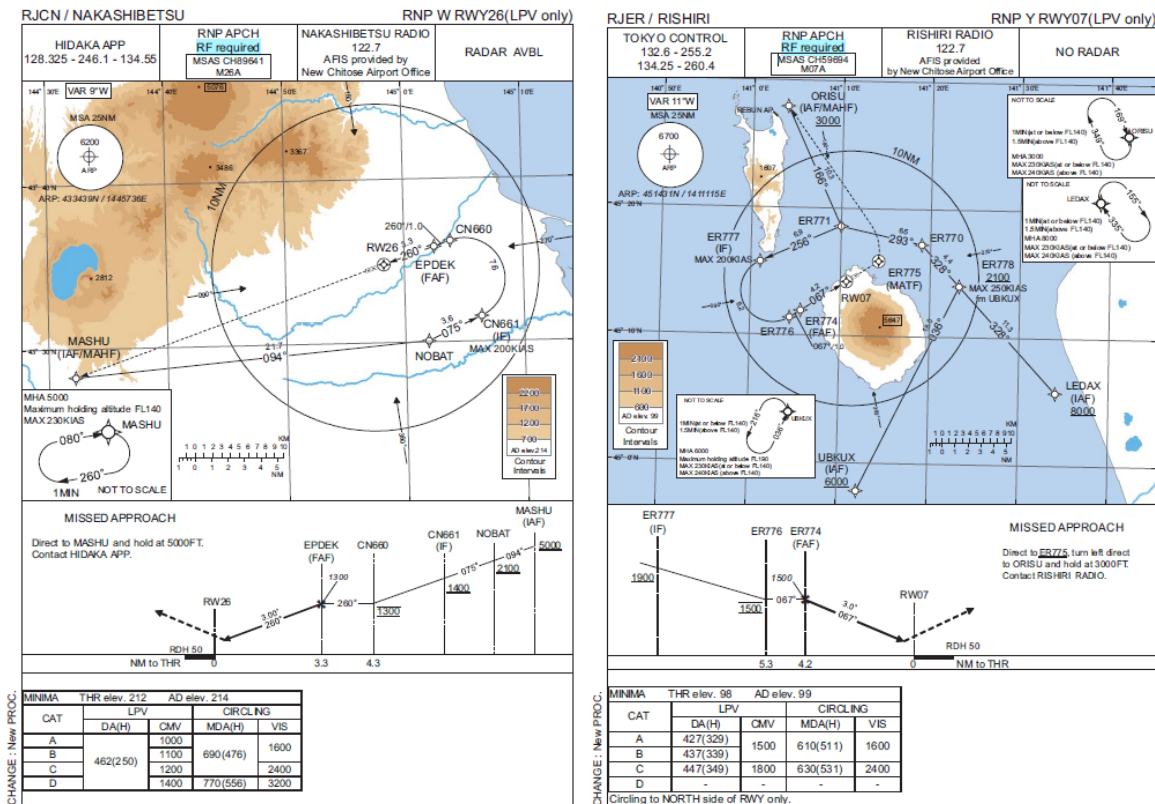


Figure 10: RNP-to-LPV Approach Procedure Chart

7. MSAS Prediction Information and NOTAMs

In addition to the provision of RAIM prediction information via NOTAM, Japan also provides MSAS prediction information via NOTAM.

Pursuant to guidance issued by the regulatory authority, LP/LPV approach operations are prohibited while an MSAS outage NOTAM is in effect.

As shown in Figure 11, the number of MSAS prediction NOTAMs issued has shown a decreasing trend. This reduction is considered to be attributable to both the upgrade to MSASv3 and a decrease in the level of recent solar activity.

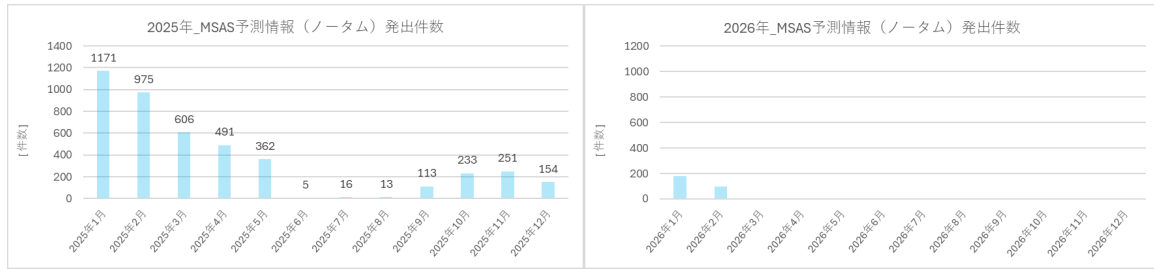


Figure 11: Trend in the Number of MSAS Prediction NOTAMs Issued

8. Ionospheric Effects and Operational Mitigations

Due to Japan’s geographical orientation extending from north to south, southern regions are more susceptible to ionospheric disturbances associated with solar activity.

In northern regions, MSAS prediction information achieves an accuracy rate close to 100 per cent. In contrast, in southern regions such as Yoron Airport (RORY), the prediction accuracy is approximately 85 per cent (based on LPV250 prediction results for the period from 10 March to 31 December 2025).

Operational experience in Japan has confirmed the occurrence of unpredictable MSAS service outages caused by regional and seasonal ionospheric characteristics resulting from solar activity. In such cases, MSAS continuity performance requirements may not be fully met.

Accordingly, appropriate operational mitigation measures have been implemented in accordance with Annex 10, Volume I, Attachment D, paragraph 3.4.3.4.

9. Operational Requirements

In accordance with regulatory guidance, operators are required to file flight plans such that either the destination aerodrome or the alternate aerodrome does not rely on GNSS-based approach procedures.

In addition, operators are required to conduct flight planning based on MSAS prediction information provided via NOTAM.

10. ACTION REQUIRED BY THE MEETING

The meeting is invited to:

- a) note the update on the current status of MSAS in Japan, including the progress toward LPV200 implementation, recent operational experience, and the mitigation measures applied in response to ionospheric effects; and
- b) discuss any relevant matters as appropriate.
