International Civil Aviation Organization

Middle East Regional Monitoring Agency Board

Twentieth Meeting (MIDRMA Board/20)
(Muscat, Oman, 10 – 11 November 2024)

Agenda Item 4: RVSM Monitoring and related Technical Issues

ADSB HEIGHT MONITORING SYSTEM (AHMS)

(Presented by the MIDRMA)

SUMMARY

With ICAO's official approval of the ADS-B Height Monitoring methodology, it is now possible to use ADS-B data to calculate the Altimetry System Error (ASE). ICAO requires all aircraft operating in RVSM airspace to undergo regular monitoring of their height-keeping performance. Traditionally, methods like the Enhanced GPS Monitoring Unit (EGMU) and ground-based Height Monitoring Units (HMU) or Aircraft Geometric Height Measurement Elements (AGHME) were used to estimate ASE. The introduction of ADS-B data for monitoring height-keeping performance not only provides an additional surveillance method but also offers a new option to meet ICAO Annex 6 Part 1 requirements. Notably, there has been significant progress in this area. The MIDRMA team successfully conducted experimental analysis using Bahrain's ADS-B data, following extensive training, with outstanding results. States are encouraged to grant MIDRMA access to their archived ADS-B data to support monitoring RVSM-approved aircraft registered within and outside the ICAO Middle East region.

Action by the meeting is in paragraph 3.

REFERENCES

- MIDRMA Board/19 Meeting Report
- MID RVSM SMR 2023

1. INTRODUCTION

1.1 The Altimetry System Error (ASE) refers to the difference between the altitude shown on the altimeter, when set correctly, and the actual pressure altitude in undisturbed air. In RVSM airspace, precise height-keeping performance becomes even more critical. Aircraft rely on barometric altimeters to measure height and maintain standard pressure levels in RVSM airspace. However, errors in the aircraft's altitude-sensing system are not obvious during regular operations, since both the pilots and Air Traffic

Control see a flight level that already includes the ASE. As a result, the altitude displayed to the pilot and ATC differs from the aircraft's true altitude due to the presence of ASE.

2. DISCUSSION

2.1 The effective implementation of the ADS-B Height Monitoring System (AHMS) in the ICAO Middle East region represents a transformative step towards improving the safety, compliance, and efficiency of Reduced Vertical Separation Minimum (RVSM) operations. This system leverages the Automatic Dependent Surveillance-Broadcast (ADS-B) technology to monitor the vertical performance of RVSM-approved aircraft. AHMS offers numerous advantages over traditional height monitoring methods, including greater cost-efficiency, scalability, and ease of deployment.

2.2 With ADS-B technology widely adopted by aircraft operators, AHMS enables the Middle East Regional Monitoring Agency (MIDRMA) to monitor a significantly larger number of aircraft within the region and beyond. Unlike traditional methods such as ground-based height monitoring stations or airborne GPS measurements, ADS-B-based monitoring provides continuous surveillance data, allowing for comprehensive and real-time assessment of Altimetry System Error (ASE) and RVSM performance.

2.3 This system not only enhances the region's capacity to monitor aircraft but also ensures compliance with ICAO provisions—specifically those outlined in ICAO Annex 6, Part I, which governs the operation of aircraft engaged in international air navigation. By employing AHMS, MIDRMA is poised to enhance its oversight capabilities, optimize air traffic management (ATM) processes, and further strengthen the safety of RVSM operations across the ICAO Middle East region.

2.4 Training and capacity building

Over the past year, MIDRMA has made substantial progress in building the technical capacity required for ADS-B data analysis and implementation of AHMS. Key to this progress has been the comprehensive training program that was delivered to the MIDRMA Team. This training focused on:

a. data processing and analysis: MIDRMA team were trained to extract and handle archived ADS-B data, and conduct RVSM height monitoring assessments, and interpret ASE-related findings.
b. system architecture and integration: the training included detailed instructions on the ADS-B system architecture, allowing participants to understand how to extract and integrate ADS-B data for RVSM monitoring purposes.
c. data accuracy and verification: the training covered quality assurance protocols to ensure that data extracted from ADS-B systems meets ICAO standards for RVSM compliance monitoring.

2.5 Data analysis and experimental monitoring

Following the completion of the training programs, MIDRMA initiated a series of studies utilizing archived ADS-B data, particularly focusing on datasets obtained from Bahrain Archived ADS-B data. These studies were instrumental in evaluating the efficacy of ADS-B for detecting ASE in RVSM-approved aircraft. Several experimental monitoring exercises were conducted, with results affirming the high potential of ADS-B as a reliable tool for RVSM height monitoring. These experiments also provided critical insights into ASE detection precision:

a. ADS-B was found to deliver consistent and reliable ASE data, allowing MIDRMA to identify discrepancies in altimetry systems with higher accuracy.
b. real-time data utility: the continuous nature of ADS-B data allows for real-time monitoring, which is vital for identifying immediate RVSM compliance issues and addressing them proactively.

These findings underscore the value of ADS-B data in replacing or complementing traditional height monitoring methods, offering improved operational efficiency and cost savings for both MIDRMA and aircraft operators.

2.6 Development of training manuals and procedures

MIDRMA has developed a comprehensive training manual for the use of ADS-B in RVSM height monitoring. This document serves as a dynamic resource, updated regularly to reflect advancements in AHMS and best practices in RVSM compliance monitoring. The manual outlines the technical processes required for:

a. extracting ADS-B data from various sources;
b. conducting ASE analysis using the extracted data; and
c. submitting the data to MIDRMA's monitoring infrastructure.

This document is essential for ensuring that AHMS method aligned with the standardized procedures for ADS-B-based height monitoring, ensuring consistency and accuracy in data collection and analysis.

2.7 Request for upgraded Altimetry System Error (ASE) Software

To further enhance the precision of ASE detection, MIDRMA has formally requested the acquisition of upgraded ASE developer Software and the ASE processor from the Australian Monitoring Agency. These upgraded software are crucial for processing ADS-B data more effectively and delivering high-quality ASE reports.

The Australian Airspace Monitoring Agency is currently engaged in discussions with the U.S. Federal Aviation Administration (FAA) to secure the necessary approvals for granting MIDRMA access to these advanced software tools. The upgraded ASE software will enable MIDRMA to:

a. improve the accuracy of height deviation detection in RVSM operations;
b. optimize data processing speed; and
c. enhance reporting capabilities for regulatory oversight and operator compliance.

2.8 Collaboration with member States and access to archived ADS-B data

MIDRMA emphasizes the critical need for collaboration from all ICAO Middle East member States which have ADS-B system used for surveillance to ensure the success of AHMS implementation. Access to archived ADS-B data is essential for comprehensive RVSM height monitoring and ASE analysis. To this end, MIDRMA requests that Board members issue directives to their respective Civil Aviation Authorities (CAAs) to:

a. provide archived ADS-B data for aircraft under their jurisdiction;
b. facilitate the training of their engineers to extract and upload ADS-B data in accordance with MIDRMA’s requirements; and
c. ensure regular submission of ADS-B data for ongoing RVSM monitoring. This cooperation is fundamental to achieving a robust and region-wide AHMS, which will significantly enhance the safety and efficiency of RVSM operations across the Middle East region.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) review and discuss the contents of this working paper;

b) endorse and accelerate the implementation of AHMS across the Middle East region by ensuring that member states fully cooperate in providing archived ADS-B data for RVSM monitoring purposes; and

c) support the MIDRMA request to obtain the ADS-B analysis software from NARMO and AAMA to support the AHMS implementation within the MID Region; and

d) urge member States' Civil Aviation Authorities (CAAs) to support the training of their technical personnel in the extraction, processing, and submission of ADS-B data to MIDRMA.

- END -