



*International Civil Aviation Organization*

**Middle East Regional Monitoring Agency Board**

**Twenty-first Meeting (MIDRMA Board/21)**  
*(Cairo, Egypt, 14 – 15 January 2026)*

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**Agenda Item 5: RVSM Monitoring and related Technical Issues**

**EXPLORING RVSM EXPANSION ABOVE FL410**

*(Presented by the MIDRMA)*

**SUMMARY**

This working paper presents information on recent studies and technical exchanges conducted by the Federal Aviation Administration (FAA), the North American Approvals Registry and Monitoring Organization (NAARMO), and NAV CANADA concerning the possible extension of Reduced Vertical Separation Minimum (RVSM) operations above Flight Level 410.

The work, discussed during the 2025 Altimetry System Error (ASE) Technical Interchange Meeting held in Seattle, USA, examined ASE behavior, aircraft performance, and certification considerations at altitudes between FL420 and FL510.

The purpose of this paper is to inform MIDRMA Member States of this international initiative, evaluate its potential implications for future RVSM safety monitoring and airspace design within the ICAO Middle East Region, and propose that the MIDRMA closely monitor developments and coordinate with the Regional Monitoring Agency Coordination Group (RMACG) and the ICAO SASP on this matter.

Action by the meeting is at paragraph 3.

**REFERENCES**

- FAA/NAARMO ASE Technical Interchange Meeting, Seattle, 9–11 September 2025
- ICAO Doc 9574 — Manual on a 300 m (1 000 ft) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive
- ICAO Doc 9937 — Regional Monitoring Agency Manual
- IFATCA Technical Review, 2024 — Review of RVSM Above FL410 Study Activities

**1. INTRODUCTION**

1.1 The Reduced Vertical Separation Minimum (RVSM) has been successfully implemented between FL290 and FL410 across all ICAO regions, providing significant airspace capacity and fuel-efficiency benefits while maintaining the Target Level of Safety (TLS).

1.2 As operational experience and aircraft capabilities have evolved, discussions have emerged at the ICAO Separation and Airspace Safety Panel (SASP) and within the North American region regarding the potential to expand RVSM above FL410, where separation currently reverts to 2,000 ft.

1.3 The FAA, NAARMO, and NAV CANADA have initiated detailed analyses and data-collection efforts to assess ASE performance and operational feasibility above FL410. A dedicated ASE Technical Interchange Meeting (TIM) was convened in Seattle in September 2025 to consolidate results from these studies and to identify challenges, including aircraft certification, flight-planning codes, and meteorological modelling at higher altitudes.

1.4 The MIDRMA, as the Regional Monitoring Agency for the ICAO Middle East Region, considers it important to remain informed and technically aligned with these global studies, as any future expansion of RVSM levels will directly influence regional monitoring procedures, risk modelling, and height-keeping methodologies (including the AHMS).

## 2. DISCUSSION

### *Overview of the FAA/NAARMO Study*

2.1 The FAA presentation at the Seattle 09 – 11 September 2025 ASE TIM titled “Observed ASE Performance Above FL410” reported that over 52,000 flights were observed between FL420 and FL510 during the first half of 2025 in U.S. airspace. This represented approximately 5 % of total upper-airspace traffic.

2.2 The analysis compared ASE and Total Vertical Error (TVE) values across different aircraft types (Airbus, Boeing, and Gulfstream). The results indicated that many modern aircraft maintain acceptable ASE performance beyond FL410, though additional verification would be required before safety standards could be extended operationally.

### *Meteorological and Data Modelling Studies*

2.3 Additional studies compared the use of different meteorological data sources, such as the Global Data Assimilation System (GDAS) and the Meteomatics Weather API / Model to calculate ASE corrections at higher altitudes. The results showed only minor variation, suggesting both datasets could be suitable for ASE modelling above FL410.

Note 1: When MIDRMA computes ASE using ADS-B Height Monitoring System (AHMS), the atmospheric pressure and temperature profiles at each aircraft’s location and time are taken from these models.

Better meteorological resolution = more accurate ASE and fewer false deviations in height-keeping performance.

Note 2: More information about the Global Data Assimilation System (GDAS) and the Meteomatics Weather API / Model is available in **Appendix A** of this working paper.

2.4 This is relevant to the MIDRMA’s ongoing ADS-B Height Monitoring System (AHMS) development, as accurate meteorological modelling directly affects ASE calculation from ADS-B data.

### *Certification and Operational Considerations*

2.5 The discussions in Seattle highlighted several challenges:

- a. Aircraft types not originally certified for RVSM above FL410 may require re-certification or additional airworthiness demonstration; and

- b. Air traffic management systems and flight-planning tools may need to recognize a distinct RVSM filing code for aircraft authorized above FL410; and
- c. Controller training and airspace design would need review to ensure correct vertical separation logic is maintained.

*Potential Benefits*

- 2.6 The primary drivers for considering an RVSM extension include:
- a. Increasing airspace efficiency in congested North Atlantic and transcontinental corridors; and
  - b. Fuel-saving opportunities for long-range business jets and commercial aircraft operating at optimal cruise altitudes; and
  - c. Alignment with modern airframe and avionics performance capabilities that routinely support altitudes up to FL490 or FL510.
  - d. These same benefits could apply to the Middle East Region, where many States operate long-range fleets and upper-airspace structure could benefit from higher-level optimization in the future.

*Data Requirement for MIDRMA Studies*

2.7 To evaluate ASE and aircraft performance above FL410 within the ICAO Middle East Region, the MIDRMA intends to initiate regional research activities using its ADS-B data processing and height-monitoring tools.

2.8 For this purpose, all MIDRMA Member States are requested to provide monthly traffic data or flight movement extracts for aircraft operating above FL410, covering both domestic and overflying operations.

2.9 These datasets will be analysed by the MIDRMA to study height-keeping behaviour, ASE characteristics, and traffic distribution trends at these altitudes. To facilitate the process, each State will be provided access credentials to securely upload data into the dedicated MIDRMA servers already established for such analytical work.

2.10 Based on all the above, the meeting is invited to review the following proposed Conclusion:

***DRAFT CONCLUSION 21/XX: MONITORING OF INTERNATIONAL STUDIES  
ON RVSM ABOVE FL410***

*That:*

- a) *the MIDRMA continue to coordinate with ICAO SASP, the FAA/NAARMO, and other RMAs to remain informed on progress and potential implications for the Middle East Region; and*
- b) *MIDRMA Member States provide monthly traffic data for aircraft operating above FL410 to support the MIDRMA's research and analysis activities in this domain.*

**3. ACTION BY THE MEETING**

3.1 The meeting is invited to:

- a) note the information provided in this paper on the FAA/NAARMO and NAV CANADA initiatives to study RVSM expansion above FL410;
- b) encourage the MIDRMA to maintain coordination with the ICAO SASP and relevant RMAs on this subject;
- c) support the MIDRMA's plan to conduct regional studies using AHMS and ADS-B data to analyse ASE and height-keeping performance above FL410; and
- d) agree in the draft conclusion in para 2.6 above; and urge all MIDRMA Member States to submit monthly aircraft movement data for operations above FL410 to the MIDRMA for research, analysis, and contribution to the global studies on the possible RVSM expansion.

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**Appendix A****Information and Comparison Between the Global Data Assimilation System (GDAS) and the Meteomatics Weather API / Model**1- **GDAS: Global Data Assimilation System**

Developer: Meteorological profiles were derived from GDAS (Global Data Assimilation System), produced by the U.S. National Centres for Environmental Prediction (NCEP) under the National Oceanic and Atmospheric Administration (NOAA)

Type: Global numerical weather model (freely available)

Purpose: GDAS is a global meteorological dataset that combines real weather observations (from aircraft, satellites, radiosondes, etc.) with a numerical weather prediction model to produce atmospheric profiles of the following:

- a. Pressure,
- b. Temperature,
- c. Humidity,
- d. Wind, and
- e. Geopotential height.

These parameters are critical for RVSM ASE calculations, because ASE depends on the difference between pressure altitude (from aircraft baro systems) and geometric altitude (from GPS or ADS-B) — both of which are affected by atmospheric conditions.

Key characteristics:

- i. Free and widely used by RMAs and aviation meteorological centres.
- ii. Provides global coverage, updated every 6 hours.
- iii. Resolution: typically, 0.25°–1° grid (~25–100 km).
- iv. Used by FAA, NAARMO, MAAR, and MIDRMA (via AHMS) for ASE modelling and height-keeping studies.

## 2- **Meteomatics Weather API / Model**

Developer: Meteomatics AG (Switzerland)

Type: Commercial high-resolution meteorological data and model API

Purpose: Meteomatics provides high-resolution weather data through a unified API service, blending multiple global and regional numerical weather prediction models (ECMWF, ICON, GFS, etc.) and observations to give very fine-grained atmospheric profiles — often down to 1 km or less.

Key advantages over GDAS:

- a. Higher spatial and temporal resolution (as frequent as 1-hour updates).
- b. Interpolated for specific coordinates (useful when analysing aircraft positions).
- c. Used increasingly by FAA and other RMAs for cross-verifying ASE computations, since fine vertical resolution improves accuracy of temperature and pressure gradients at high altitudes.

In the Seattle 2025 FAA presentation:

- a. GDAS and Meteomatics were compared as two meteorological inputs for ASE calculations.
- b. The conclusion was that differences between the two models were minor and within acceptable tolerance validating that either can be used for AHMS ASE estimation.

<b>Parameter</b>	<b>GDAS</b>	<b>Meteomatics</b>
<b>Source</b>	NOAA (U.S. government)	Meteomatics AG (Commercial)
<b>Access</b>	Free, public	Subscription/API
<b>Coverage</b>	Global	Global, with local refinement
<b>Resolution</b>	Moderate (25–100 km grid)	High ( $\approx$ 1 km grid)
<b>Update Frequency</b>	Every 6 hours	1-hour or better
<b>Use in RVSM</b>	Standard reference model	High-Resolution Validation Tool

Comparison Table between GDAS and Meteomatics