

International Civil Aviation Organization

**The Twentieth Meeting of the Regional Airspace Safety Monitoring Advisory Group
(RASMAG/20)**

Bangkok, Thailand, 26-29 May 2015

Agenda Item 5: Airspace Safety Monitoring Activities/Requirements in the Asia/Pacific Region

ADS-B OUT DATA HEIGHT REFERENCE FOR MONITORING

(Presented by the United States)

SUMMARY

This information paper presents a summary of activity initiated in an attempt to establish a requirement for ADS-B Out data to provide aircraft geometric height in the Height Above Ellipsoid (HAE) reference frame.

INTRODUCTION

The Regional Airspace Safety Monitoring Advisory Group (RASMAG), the RASMAG Monitoring Agencies Working Group (MAWG) and the Regional Monitoring Agencies Coordination Group (RMACG) meetings have discussed the difficulty in using ADS-B Out data for estimating aircraft height-keeping performance. The determination of the aircraft reference height is possible in some regions but in some areas it is not possible to determine whether height above ellipsoid (HAE) or mean sea level (MSL) was used as the reference frame.

This paper provides the meeting with a summary of activity initiated in an attempt to guarantee a consistent height reference frame in ADS-B out data for purposes of monitoring Aircraft Altimetry System Error (ASE).

DISCUSSION

One of the key data fields in ADS-B out messages used to estimate aircraft ASE is the "Geometric Height Difference from Barometric" subfield. The description of this subfield is contained in paragraph 2.2.3.2.6.1.15 in both RTCA DO-260A and RTCA DO-260B:

"2.2.3.2.6.1.15 "Difference From Barometric Altitude" Subfield in Airborne Velocity Messages - Subtype "1"

The "Difference From Barometric Altitude" subfield is a 7-bit ("ME" bits 50 through 56, Message bits 82 through 88) field that is used to report the difference between Geometric (GNSS or INS) Altitude Source data and Barometric Altitude when both types of Altitude Data are available and valid. The difference between barometric altitude and GNSS Height Above Ellipsoid (HAE) is preferred. However, GNSS Altitude (MSL) may be used when airborne position is being reported using TYPE Codes 11 through 18. If airborne position is being reported using TYPE Codes 9 or 10, only GNSS Height Above the Ellipsoid (HAE) may be used. For TYPE Codes 9 and 10, if GNSS Height Above the Ellipsoid (HAE) is not available, then the Difference from Barometric Altitude subfield shall be set to ALL ZEROs. Note: The basis for the barometric altitude difference (either GNSS HAE or Altitude MSL) must be used consistently for the reported difference.

The above paragraph states that it is possible for the ADS-B derived geometric height of the aircraft to be given with reference to either MSL or HAE. It is very important for the height-keeping performance estimation process to identify exactly which reference (e.g., MSL or HAE) was used to provide the aircraft geometric height. If the wrong reference is assumed, significant errors can result in the estimate of aircraft height-keeping performance.

Both the FAA and EUROCONTROL have certification guidance for ADS-B Out installations that will guarantee HAE is used (e.g., FAA AC 20-165A, which applies to all U.S.-certified aircraft and the EASA CS-ACNS guidance document). It is likely that most manufacturers are building Version 2 ADS-B systems to comply with the superset of requirements in the FAA and EUROCONTROL documents. Both the FAA AC and EASA CS require that the Version 2 ADS-B Out system broadcast geometric altitude in the HAE reference frame, even if the position source delivers the data as MSL or Height Above the Geoid (HAG). The FAA AC 20-165A includes the statement:

"Do not interface a position source that provides HAG or Mean Sea Level (MSL) altitude to the ADS-B equipment unless the ADS-B equipment has the ability to determine the difference between an HAG and HAE input, and that the ADS-B equipment has demonstrated during design approval that it can properly convert HAG to HAE using the same model as the position source. It would also be acceptable to demonstrate that the error due to conversion of HAG to HAE does not cause the reported geometric accuracy to be exceeded."

These FAA and EUROCONTROL documents will help to ensure that HAE is the height reference used by 2020 in Europe and the United States. However, it does not guarantee that HAE will be the height reference used everywhere in the world or that the height reference will not be inadvertently changed after the installations are certified.

Due to the importance of the height-keeping performance monitoring requirements for the continued safe-use of the RVSM and the viability of using ADS-B data for operators to fulfill these requirements, the ICAO Aeronautical Surveillance Panel (ASP) Technical Subgroup (TSG) meeting was asked to consider that a HAE requirement be made explicit so that the States and RMAs can provide height-keeping performance monitoring to operators using ADS-B data.

The TSG meeting was held 23-27 June 2014 in Paris, France where it was recommended that the ICAO ASP consider that a HAE requirement be made explicit for ADS-B data. It was determined that modifications would be needed in RTCA DO-260B and ICAO Doc 9871. The Seventeenth Meeting of the ICAO ASP was held 22-26 September 2014 in Langen, Germany. WP/17 was presented to the meeting and is attached to this paper. (Note that the apparent text changes in WP/17 (pp. 5 & 6, in blue & red) are indeed intended by the author and were presented that way at the ASP meeting.)

The ASP17 Meeting Report stated that considerable discussion took place on the maturity of the proposed changes. This led to an action item for the TSG to further refine the change proposal, present an update at the next Aeronautical Surveillance Working Group (ASWG) meeting in April 2015, and to connect with RTCA/EUROCAE before the ADS-B Minimum Operational Performance Standards (MOPS) (DO-260B/ED-102A) are finalized. The April meeting of the ASWG agreed to the following Action Item:

***ASWG-01-15:** TSG to further develop the proposal given in WP11 (HAE in Geometric Altitude for Extended Squitter) and coordinate a formal change proposal with RTCA/EUROCAE when complete.*

In June 2015, the TSG meeting is expected to finalize the proposed change to Doc 9871 and then discuss the status of coordination activities with RTCA and EUROCAE. Once the changes are made by RTCA and EUROCAE are complete, a change to ICAO Doc 9871 will be prepared by the TSG for ASWG approval.

It appears that the necessary changes to ICAO Doc 9871 and RTCA DO-260B will take a few years to become effective. Therefore, in the short term, RMAs using ADS-B out for monitoring aircraft ASE should continue without the certainty of reference frame.

ACTION BY THE MEETING

The meeting is invited to:

note the information contained in this paper; and

discuss any relevant matters as appropriate.

— END —