International Civil Aviation Organization

Twenty-Ninth Meeting of the Regional Airspace Safety Monitoring Advisory Group (RASMAG/29)

Bangkok, Thailand, 19 – 22 August 2024

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

CHINA RMA ADS-B HEIGHT MONITORING SYSTEM (AHMS) UPGRADE

(Presented by China RMA)

SUMMARY

China RMA has been using AHMS for aircraft height keeping performance (HKP) monitoring since 2014, and upgraded AHMS in 2022. This paper presents an introduction of the reasons for upgrading AHMS, main optimizations or changes made, and ASE comparison between the ordinary and improved ASE calculation methods.

1. INTRODUCTION

1.1 At the 2023 RASMAG/28 meeting, MAAR presented a report on Long-Term Height Monitoring (LTHM) compliance in the Asia Pacific (APAC) region. The report unveiled that China RMA was still carrying a monitoring burden of 29%, which was relatively high compared to other peer agencies in the region. When asked for reasons, China RMA mentioned that its AHMS was undergoing an upgrade. Now, China RMA has finished its upgrade and began using the upgraded AHMS for aircraft height monitoring.

1.2 This paper presents the reasons for upgrading AHMS, the main optimizations or changes made, and an ASE comparison between the ordinary and improved ASE calculation methods.

2. DISCUSSION

The reasons for upgrading AHMS

2.1 As more and more aircraft operate in RVSM airspace, the amount of monitoring data is increasing rapidly. This puts pressure on the current database storage, making it essential to switch to a new database. Moreover, the source of raw ADS-B data and the meteorological data format used for ASE calculation have changed. There are also some new functional requirements, Python version compatibility issues, and so on. All of these prompted China RMA to upgrade AHMS.

Main optimizations or changes made during AHMS upgrade

2.2 Based on the reasons for upgrading AHMS, China RMA conducted in-depth analysis and research, then improved algorithms and optimized programs. The main optimizations or changes made during AHMS upgrade are as follows:

a) The source of raw ADS-B data has been aligned to that of the ATMB, with higher quality, and it is more flexible for querying and storing.

b) The interval of ASE generation has changed. The old system generates an average value for each minute to estimate the ASE for every aircraft and have the data stored in the database, while upgraded AHMS can store ASE values of every flight track point.

c) The meteorological data format has changed from ATB to GRIB2. During the 2016 SASP/1 and 2017 SASP-WG/29 meeting, China gave HKP analysis using GRIB2 and ATB data in terms of single aircraft and overall aircraft, which elucidates ASE resolved by GRIB2 data shows the same stable results in analysis.

d) The ASE calculation method has improved.

2.3 **Figure 1** shows the original (ordinary) ASE calculation process. It can be found that ASE is estimated by subtracting AAD from TVE with different units, TVE denotes geometric difference, and AAD denotes pressure difference.

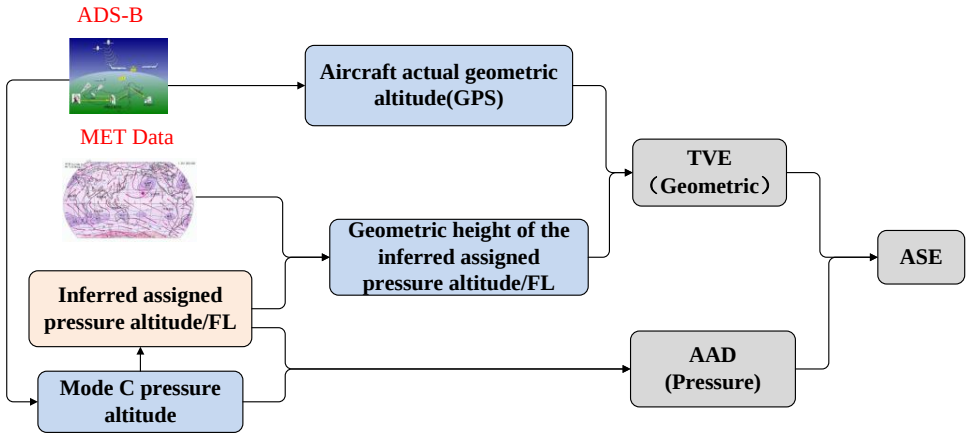

Figure 1: The original (ordinary) ASE calculation process

2.4 **Figure 2** shows the improved ASE calculation process. It can be found that ASE is estimated by subtracting AAD from TVE with the same units. Both TVE and AAD denote geometric deference, so this ASE value must be geometric deference.

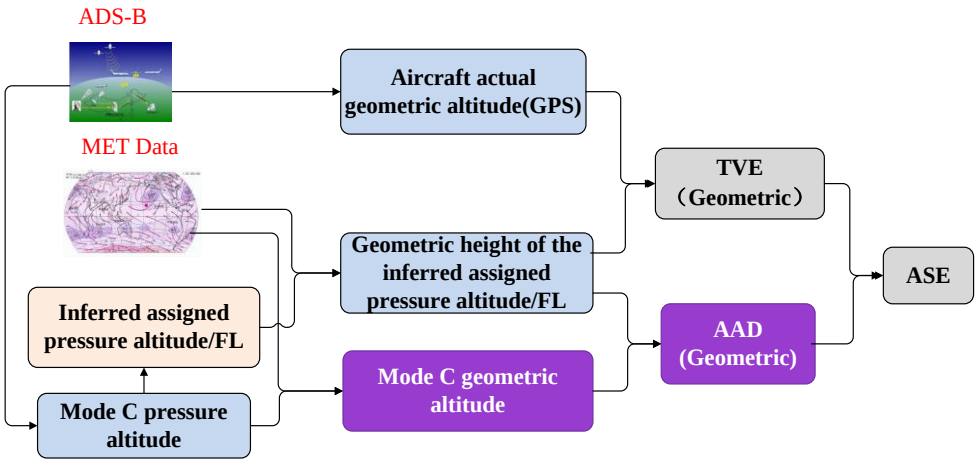

Figure 2: The improved (new) ASE calculation process

2.5 Original AHMS only uses the ASE calculation method described in **Figure 1**, while upgraded AHMS can use the methods described in **Figure 1** and **Figure 2**. By comparing the ASE

value calculated by the two methods, it can find the result difference, and further verify the accuracy of the data.

a) The upgraded AHMS can calculate the ASE of an aircraft at any flight moment in RVSM airspace, including straight and level flight, ascent, and descent. The original AHMS only can calculate the ASE value when the aircraft is at a straight and level flight stage. The ASE of aircraft at the ascent and descent stages can be used for future research.

ASE comparison between two methods

2.6 **Figure 3** shows the histogram of the ASE difference calculated by two methods. The x-axis represents the ASE difference between the ordinary method and the new method. The monitoring data comes from 9150 aircraft flying Chinese RVSM airspace from the period of August 2023 to December 2023. In Figure 3, it can be seen that though there are some large differences, most of the examples show smaller differences, and the average of the ASE difference is -0.85.

2.7 According to the statistics, among 9150 aircraft, 119 of which had an ASE absolute value above 20, which means 98.7% are under 20. This percentage is consistent with that reflected by Figure 3. It should be noted that the upgraded AHMS can store ASE values of every flight track point, the unit of which is second. When the number of flight track points in one straight-level flight segment is more than 180, the upgraded AHMS can generate one ASE measurement.

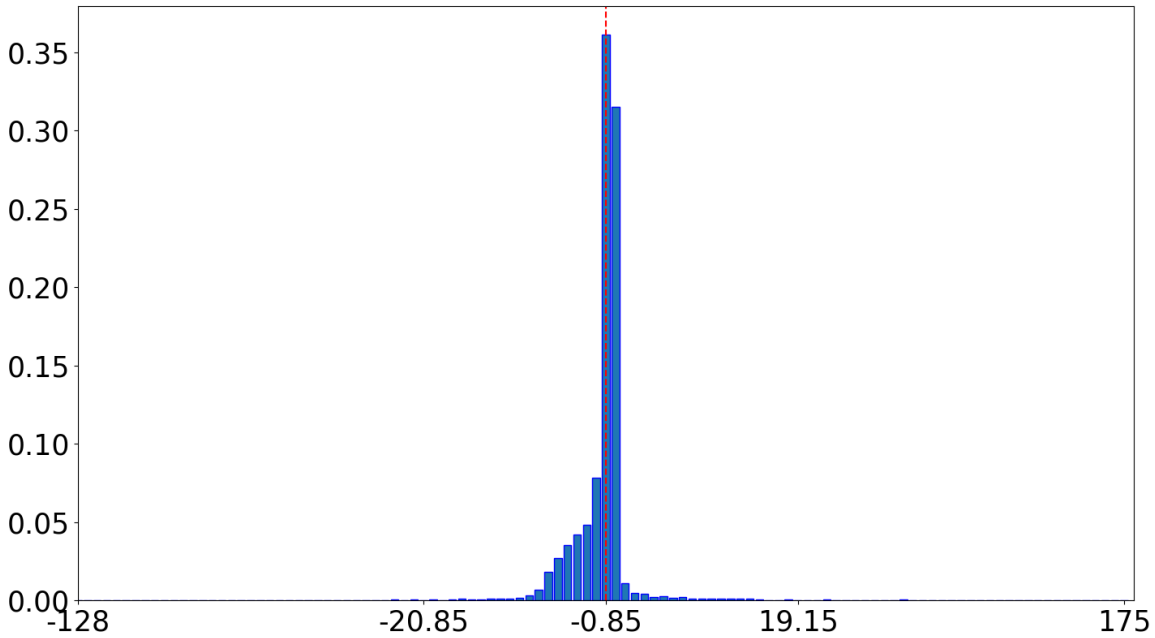

Figure 3: Histogram of ASE difference calculated by two methods

2.8 **Figure 4** and **Figure 5** separately show the comparison of ASE means and standard deviation of some monitoring groups calculated by two methods. Ranked by the number of aircraft flying in Chinese RVSM airspace in each group, the groups in the following two figures are ranked in the top 20. Both the ASE mean and standard deviation calculated by two methods for the top 20 groups are very consistent.

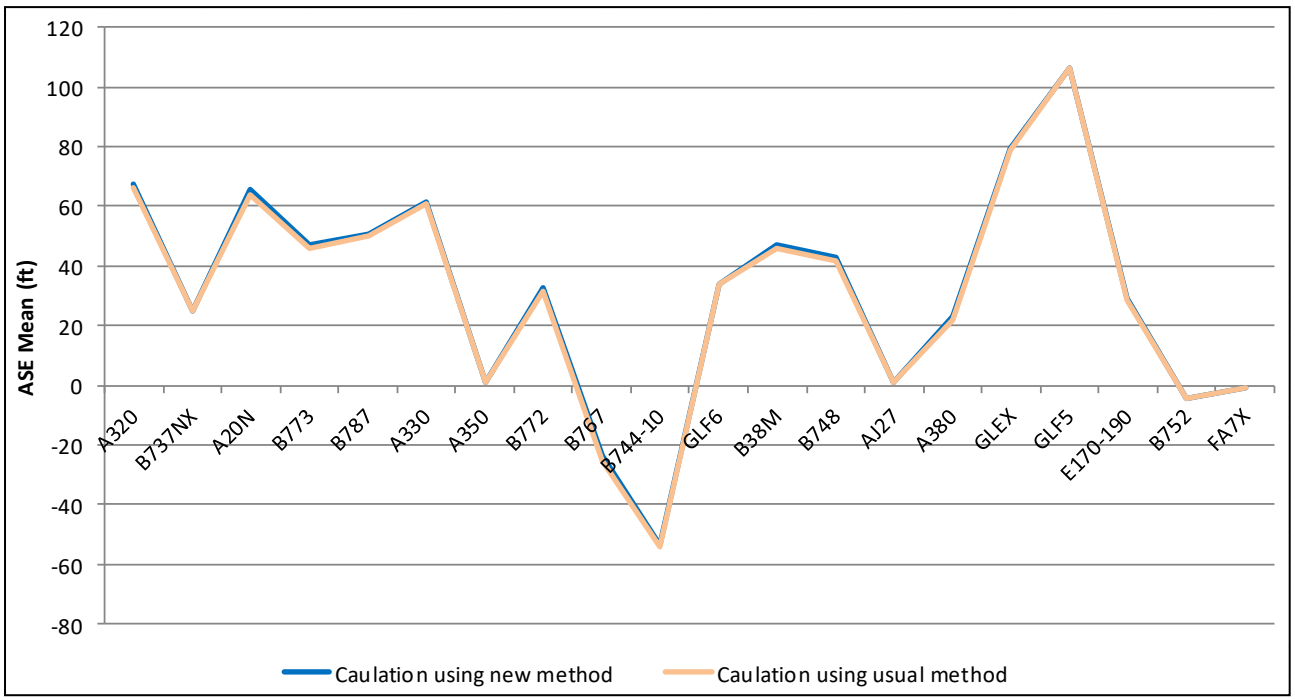

Figure 4: Comparison of ASE mean calculated by two methods

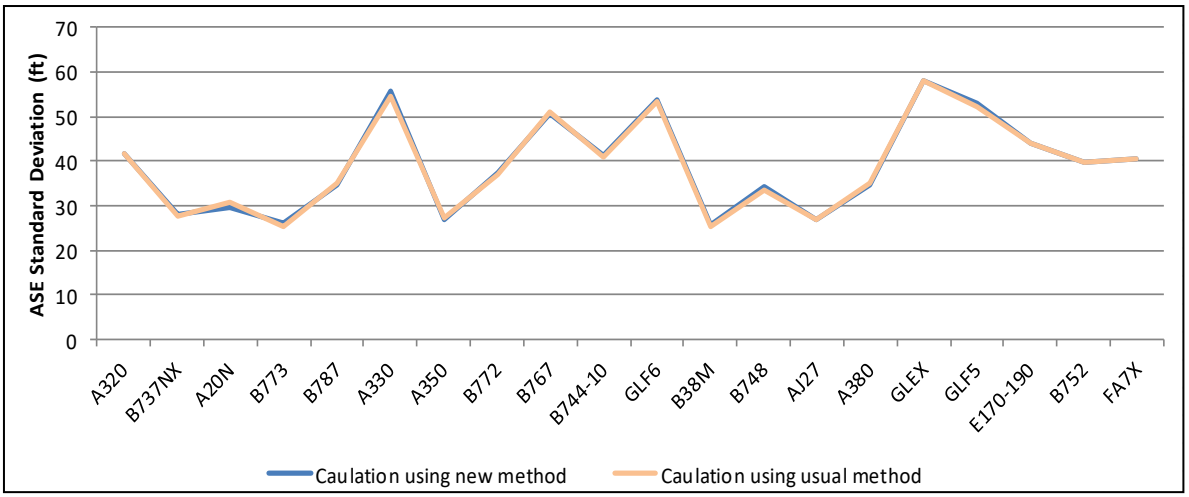

Figure 5: Comparison of ASE standard deviation calculated by two methods

3. Conclusion

3.1 There are two methods used to estimate ASE. The ordinary method is that ASE is estimated by subtracting AAD from TVE with different units, AAD is a pressure unit, and TVE is a geometric unit; the new method is that ASE is estimated by subtracting AAD from TVE with the same units, both are geometric units. Although there are significant differences in the use of units between the two methods, the calculated ASE values are almost identical.

3.2 China RMA has used the upgraded AHMS to conduct monthly ASE performance analysis for aircraft HKP monitoring and share the results on the ICAO portal, and the monitoring burden of China RMA has significantly decreased, please refer to another paper submitted by China RMA for burden information.

4. ACTION BY THE MEETING

4.1 The meeting is invited to:

a) review the information provided in the paper; and

b) discuss any relevant matters as appropriate.

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