China RMA Long-term Height Monitoring Program

中国地区监控组织
CHINA REGIONAL MONITORING AGENCY

China Regional Monitoring Agency(China RMA)

www.chinarma.cn

30 September 2016

Preface

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Dear All,

We apologize for the absence to this ASE Workshop, but we want to use this presentation to introduce China RMA's progress in promoting long-term height monitoring program, and we also want to take this opportunity to raise some problems and suggestions for your consideration.

We wish this workshop to be very successful! Thank you for all your efforts!

China RMA

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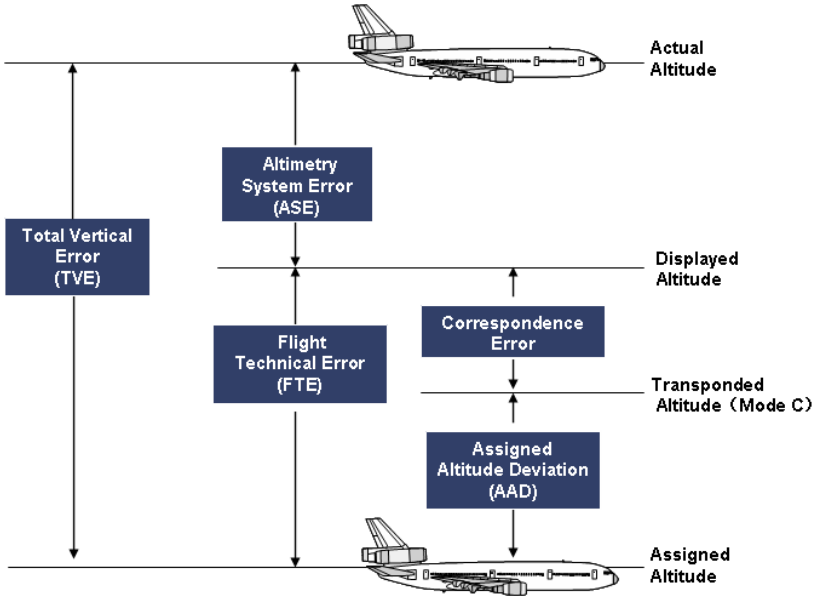
Long-term Height Monitoring Program

The need for RVSM Monitoring

The errors in the aircraft altimetry sensing systems are not apparent during routine operations as the altimeter displays to the aircrew and air traffic services (ATS) a level that includes these altimetry system errors (ASE).



Long-term Height Monitoring Program

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- **The need for RVSM Monitoring**

  As such, the presentation to the pilot and/or ATS is often different to the actual height of the aircraft. During routine calibration the aircraft systems are maintained on the ground while at rest, so the dynamic nature of ASE is not able to be seen.

Long-term Height Monitoring Program

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- **The need for RVSM Monitoring**

  Aircraft altimetry systems also utilize parts that:

  - wear over time (such as the pitot-static probe and portions of internal plumbing); and/or
  - are subject to damage (such as skin flexing/deformation during operations); and/or
  - are affected by modification of airframes (such as the application of paint, decals and branding marks or mounting of accessories or repairs such as boiler plating in the vicinity of the static pressure ports).

  All these activities are capable of producing significant error in true height.

Long-term Height Monitoring Program

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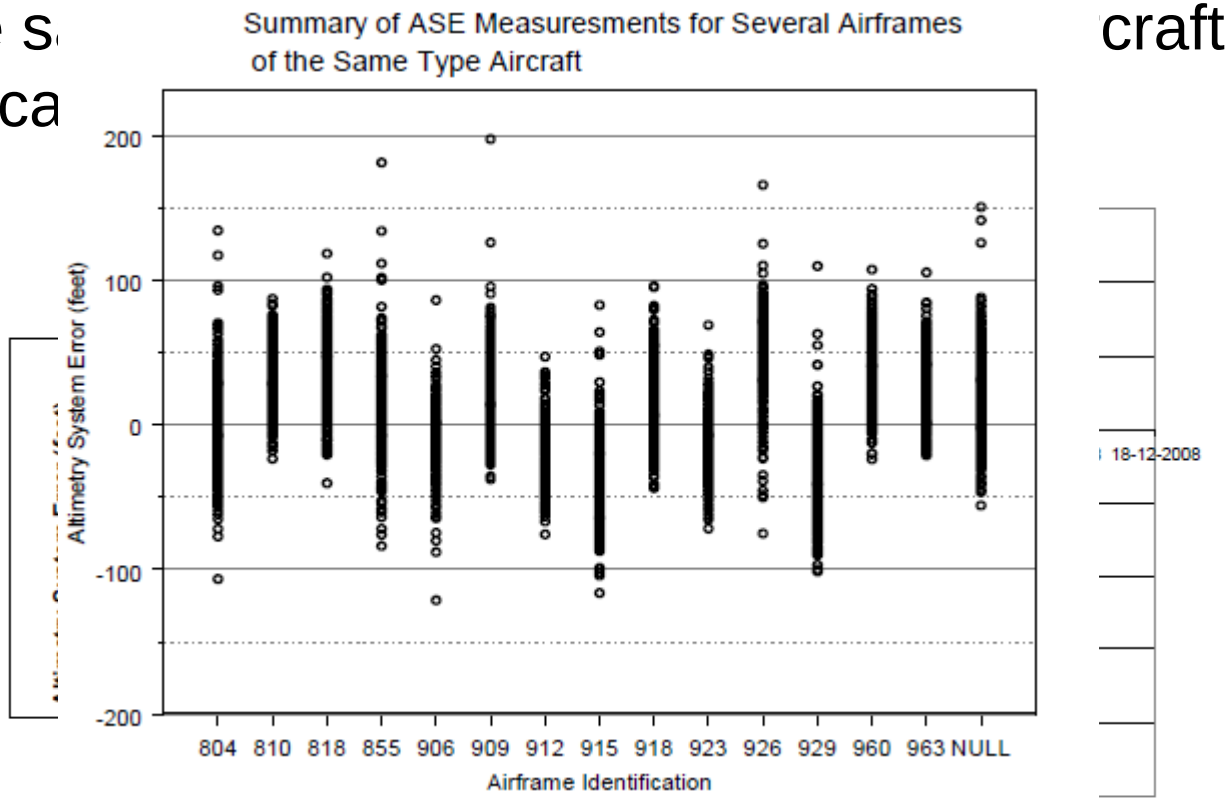
- **The need for RVSM Monitoring**

  ASE can vary over the population of operational aircraft
  of the s craft this
  error ca



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Long-term Height Monitoring Program

- Continued safe RVSM operations demand continuous high accuracy from altimetry systems
- additional provisions were included in Annex 6 effective November 2010 to ensure that global monitoring requirements were clearly defined. Additionally, amendments to Annex 11 have also been made that clarify regional monitoring responsibilities.

7.2.7 The State of the Operator that has issued an RVSM approval to an operator shall establish a requirement which ensures that two aeroplanes of each aircraft type grouping of the operator have their height keeping performance monitored, at least once every two years or within intervals of 1 000 flight hours per aeroplane, whichever period is longer. If an operator aircraft type grouping consists of a single aeroplane, monitoring of that aeroplane shall be accomplished within the specified period.

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Long-term Height Monitoring Program

- **Asia Pacific Region Long-term height monitoring Program:**

5.1 The implementation of long-term height monitoring requirements has placed significant additional responsibilities on operators, State approval authorities and RMAs alike. Within the Asia/Pacific Region, the RMAs in conjunction with the RMACG, RASMAG and APANPIRG have standardised on a set of RVSM MMRs that reflect the Annex 6 minimum requirements for long term monitoring, and support the intent of the Annex 11 requirements for the establishment of adequate monitoring programs.

Introduction to On-board Monitoring System

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- China RMA has two EGMU and two E^2GMU

Introduction to On-board Monitoring System

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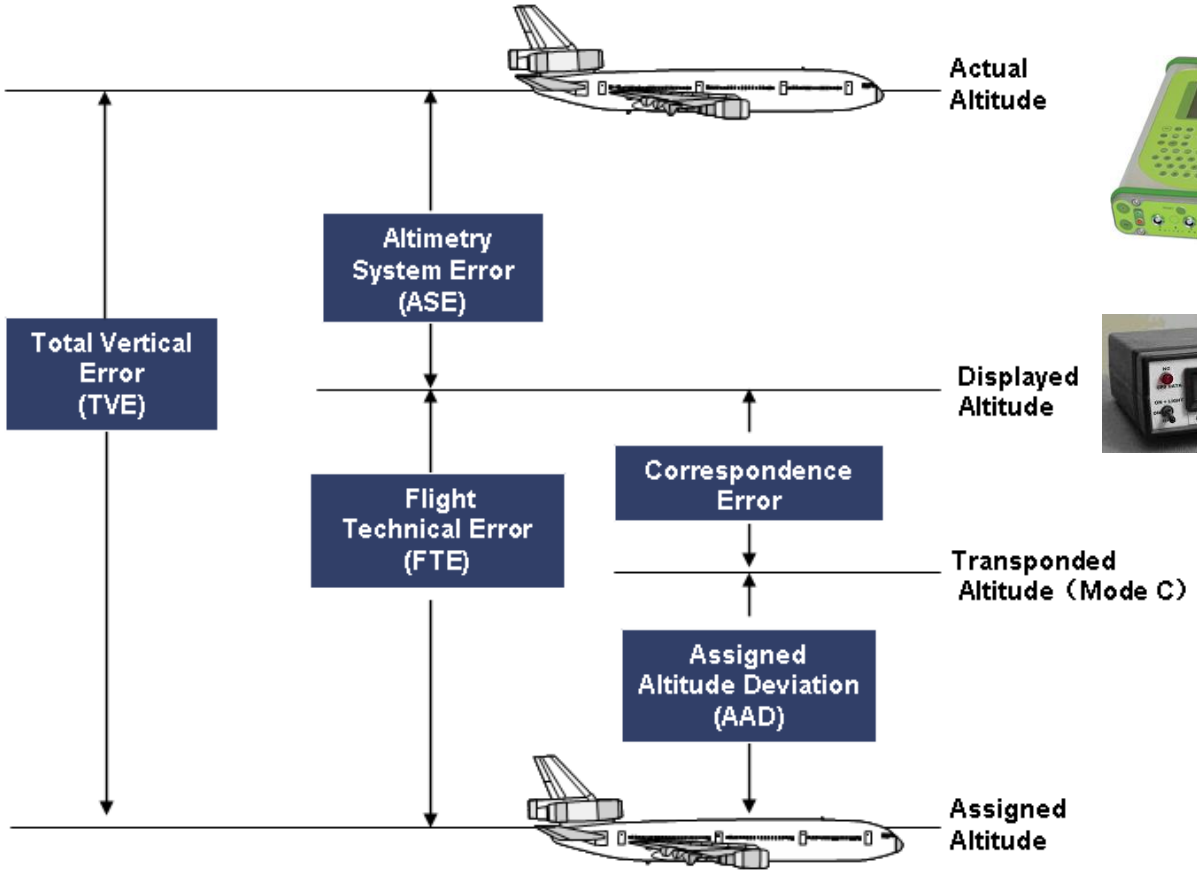
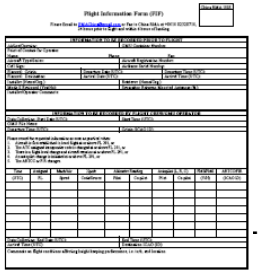
EGMU **E²GMU**





Introduction to AHMS

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- **AHMS**= ADS-B Height Monitoring System
- Advantages of using AHMS:
  - provide large volumes of data and information about the aircraft population and permit repeated measurements on individual airframes, which is highly beneficial in detecting trends in ASE performance
  - provide the continuous data streams necessary to determine aircraft group performance and ASE stability

Compared to

- **On-board Monitoring system:** EGMU monitoring addresses the basic MMR, it should be considered only as supplementary to ground-based monitoring

Introduction to AHMS

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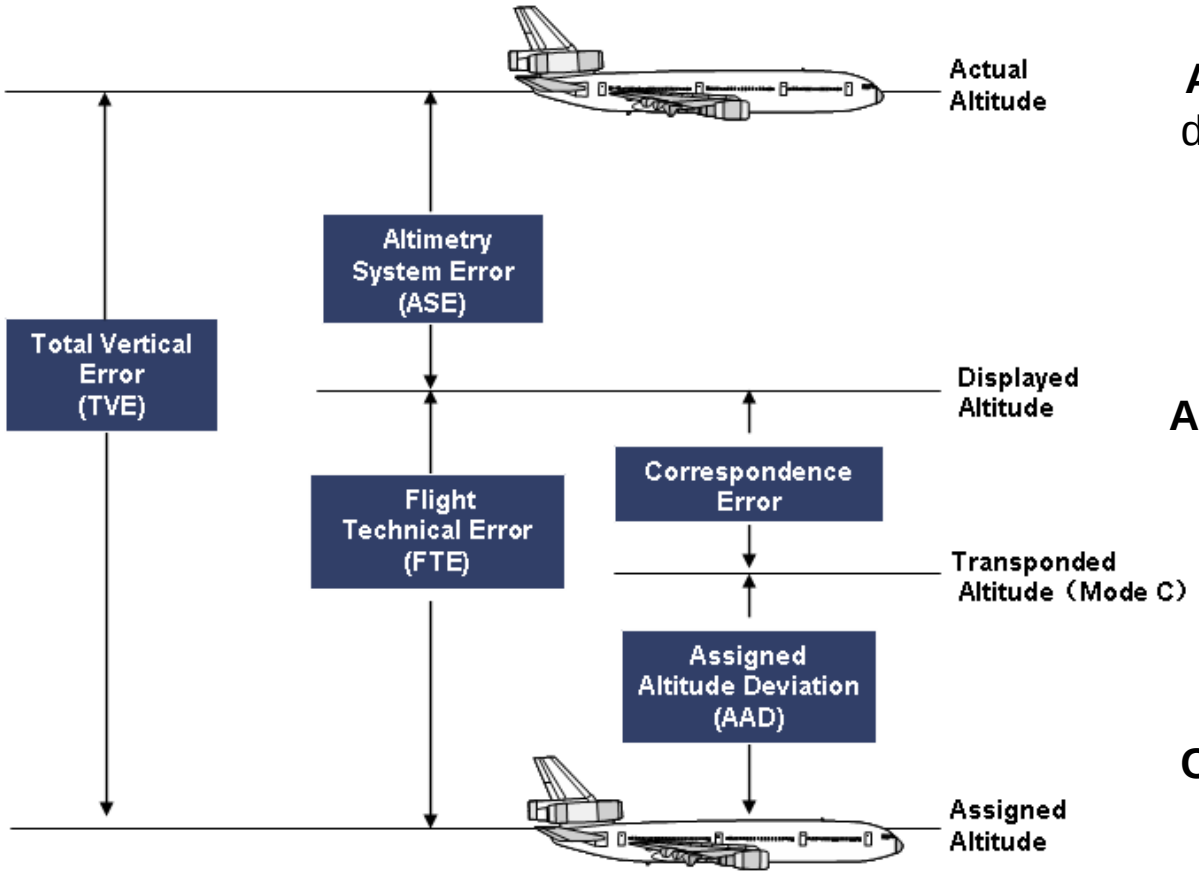
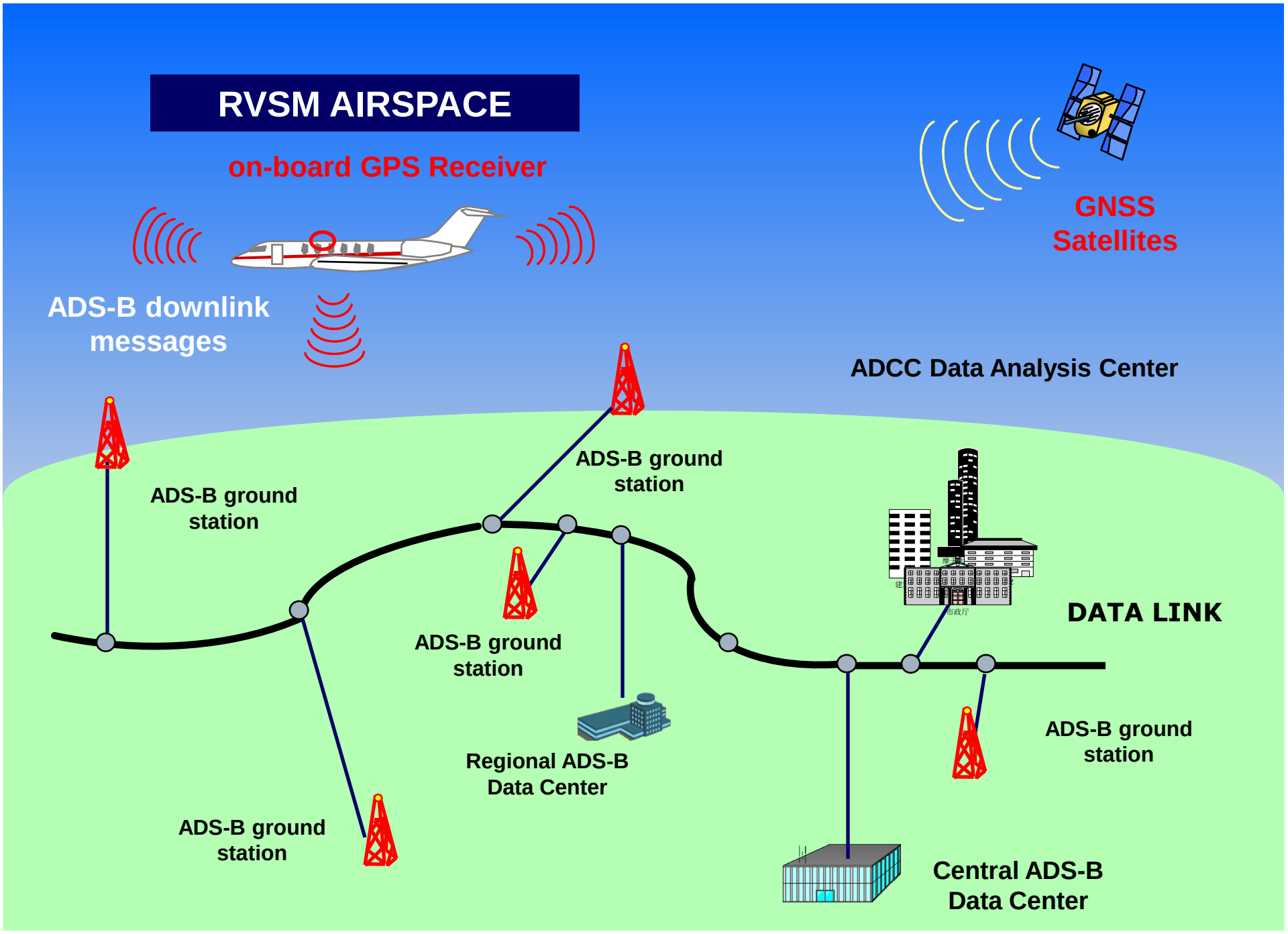


AHMS

ADS-B message: GPS-derived geometric height

ADS-B message: pressure altitude in reference to a standard atmosphere

Calculated from pressure altitude in the ADS-B message and the FLOS


RVSM AIRSPACE
on-board GPS Receiver
GNSS Satellites
ADS-B downlink messages
ADCC Data Analysis Center
ADS-B ground station
ADS-B ground station
ADS-B ground station
ADS-B ground station
ADS-B ground station
DATA LINK
Regional ADS-B Data Center
Central ADS-B Data Center

Introduction to AHMS

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- **AHMS monitoring process:**
  1. Extract and process ADS-B data from the ADS-B network each month. ASE calculations will be completed and reviewed to identify any airframes that may be indicating height-keeping errors close to or exceeding acceptable limits.
  2. Notify relevant State authorities of aircraft that demonstrate aberrant height-keeping capability so that those authorities may take corrective action as required by provisions of Annex 6.
  3. Provide report to operators and regional CAAs, and publish monitoring information on the security website on a three-month basis
  4. Provide ADS-B monitoring results using the agreed data format to other Regional Monitoring Agencies (RMAs)

Introduction to AHMS

ASE Calculation process

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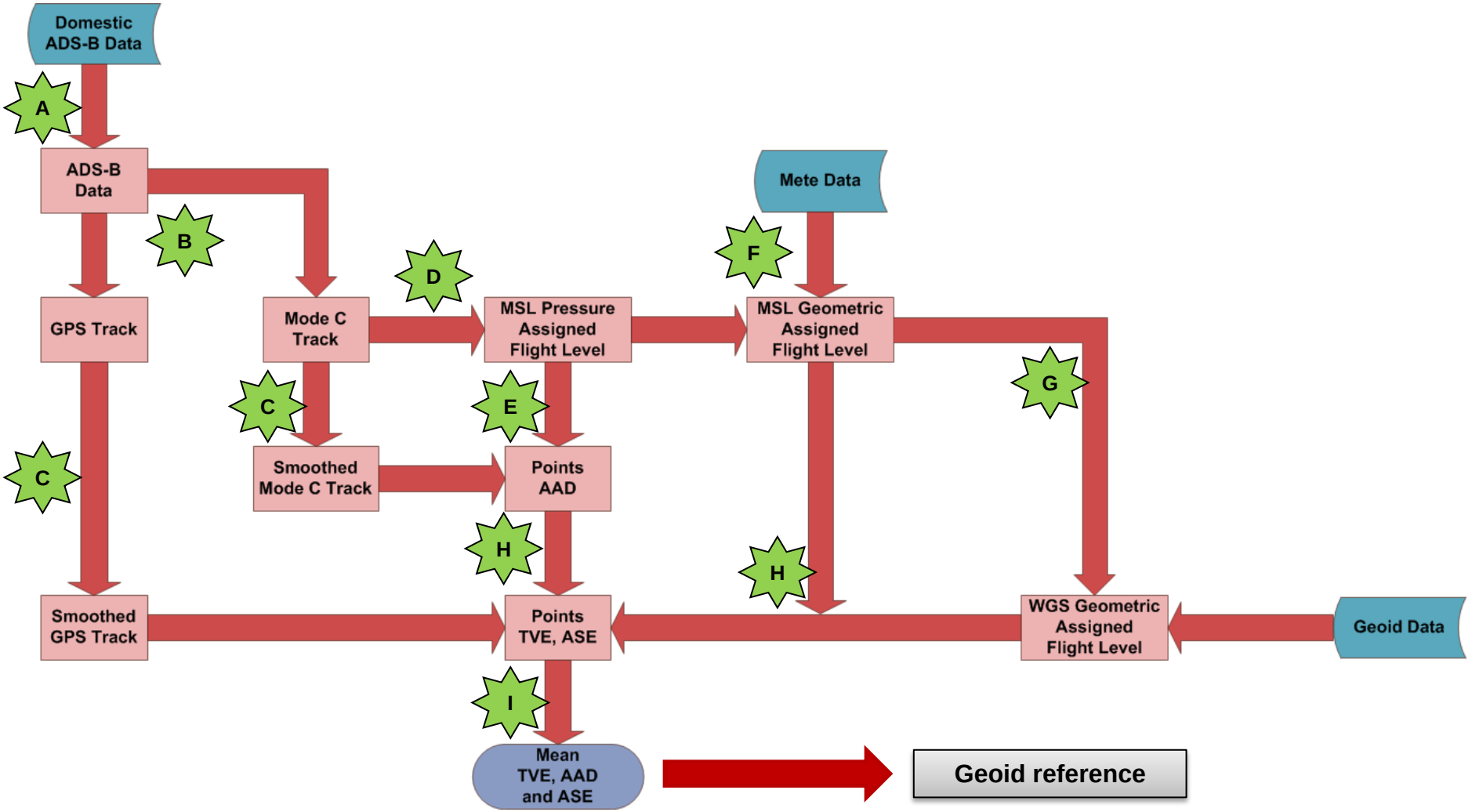

Introduction to AHMS

Geoid reference determination

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- **Geoid Assumption:**
  1. An aircraft will transmit geometric height as either HAMSL or HAE, depending on the GPS receiver. However, it is often not known which of these geoid assumptions is being used prior to our analysis and it must be determined from the ASE data.
  2. The following figure shows the contours of the difference between HAMSL and HAE overlaid on a map of Australia. These are contours of the separation between the Earth's geoid and the WGS 84 ellipsoid, referred to here loosely as 'geoid contours'. A contour of 150 ft means HAMSL=HAE+150 ft. The variation in the figure is from roughly -100 ft to 200 ft. The zero contour when HAMSL = HAE heads North-West from Tasmania. An aircraft traveling a route such as Perth to Cairns (SW to NE) would cross approximately 300 ft of geoid contours which is useful in evaluating an aircraft's geoid assumption.

Introduction to AHMS

Geoid reference determination

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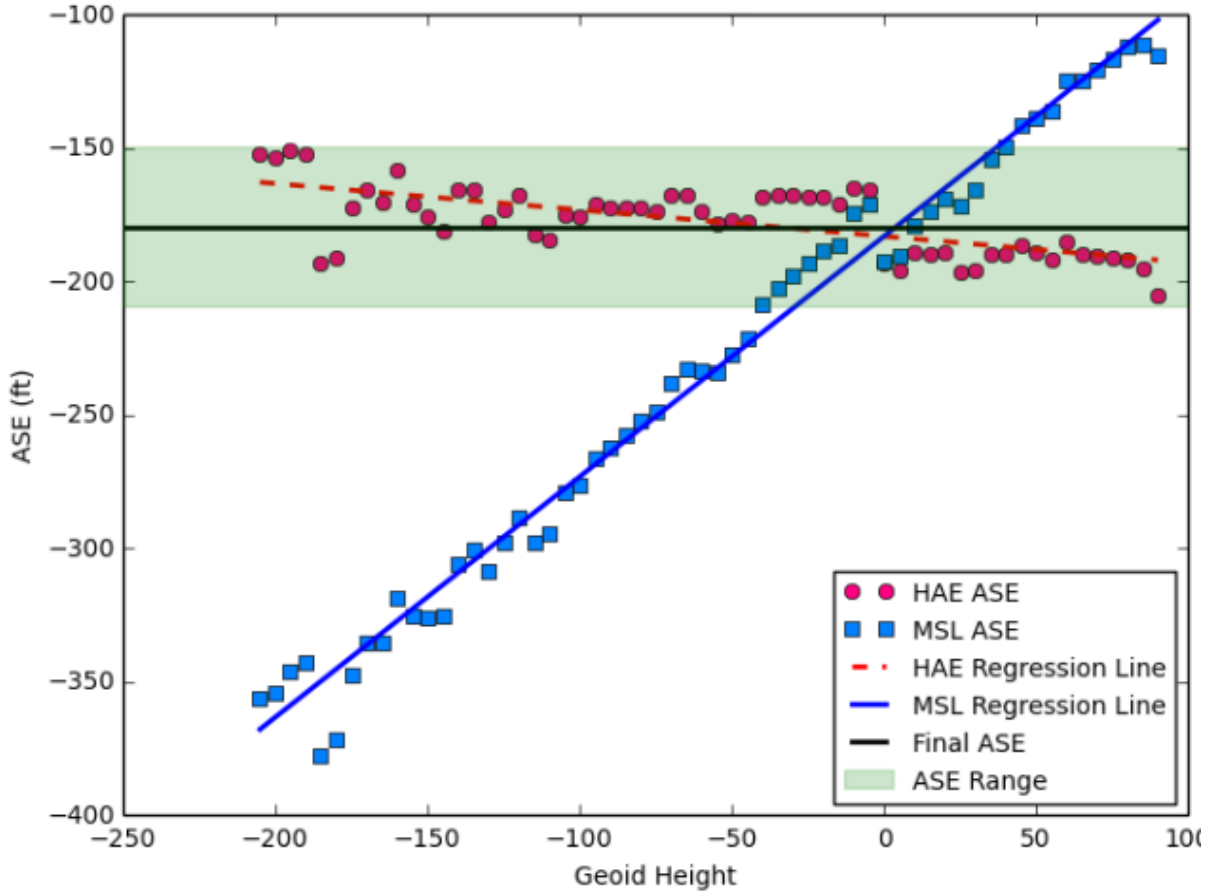
- **Geoid Assumption:**



Introduction to AHMS

ASE Data Analysis Software platform snapshot

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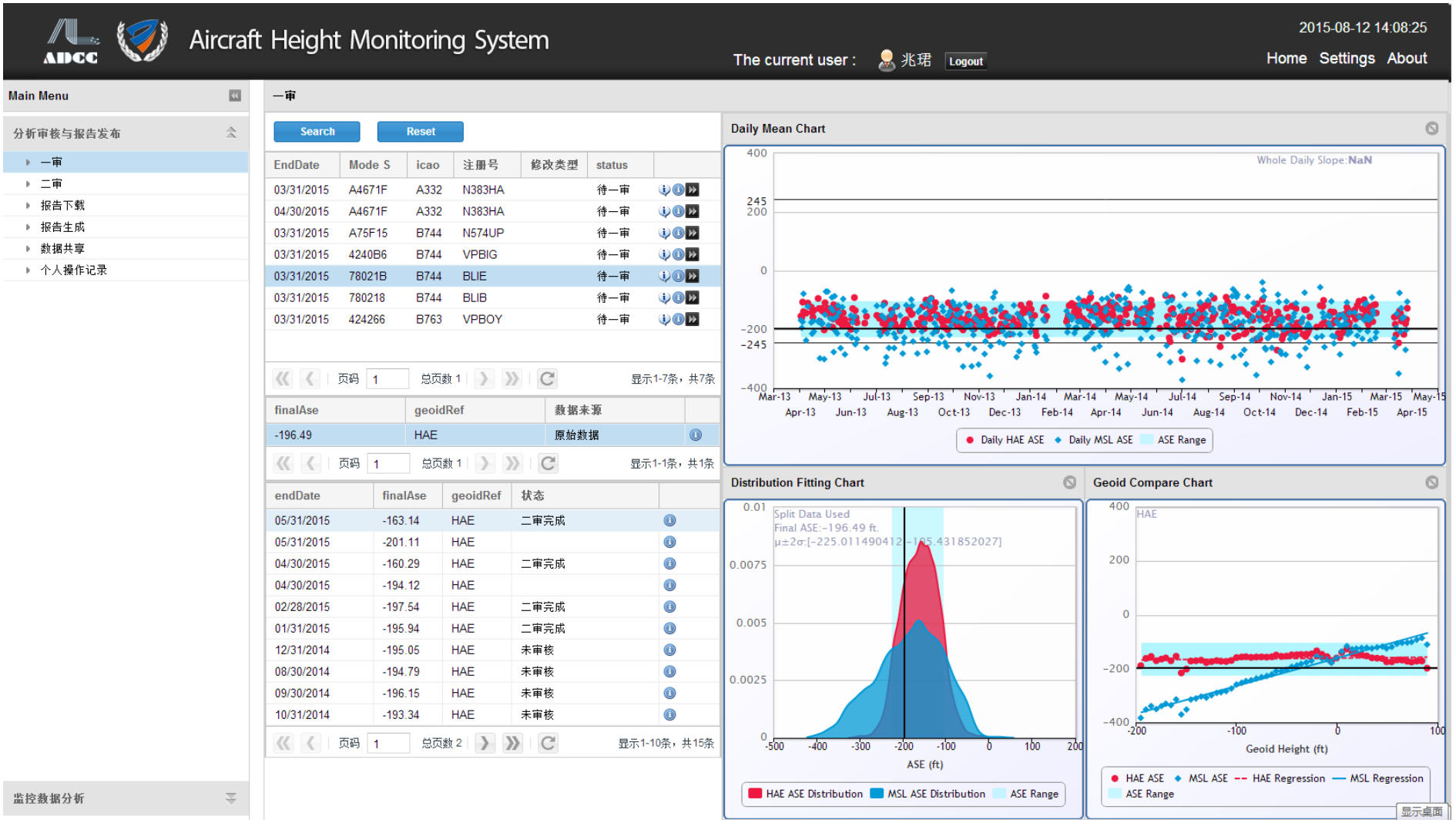
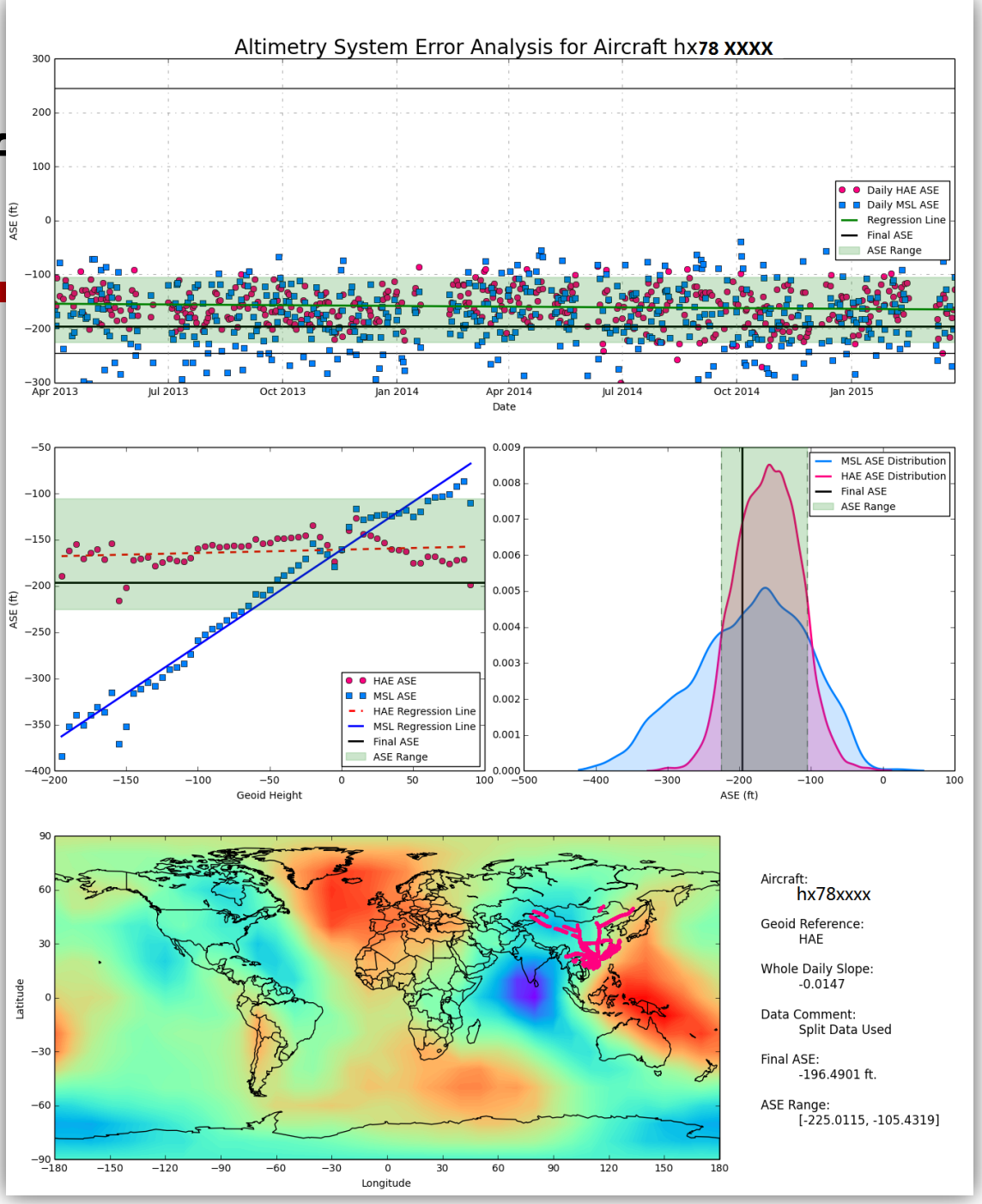


Introduction of

Analysis Plot

- **Analysis Plot**
  - ASE Daily mean chart
  - ASE Distribution fitting chart
  - ASE Geoid compare chart
  - Flight Track



Introduction of AHMS

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ADS-B Monitoring Report

- Monitoring report for operators
- Aberrant report
- Non-compliant report

Data Sharing

- Share ADS-B Monitoring results with other RMAs
- ADS-B monitoring results on request for operators outside China RMA's responsible area

ADS-B monitoring results can help operator to meet the Long-term height monitoring requirement.

How to get an aircraft ADS-B monitored in China

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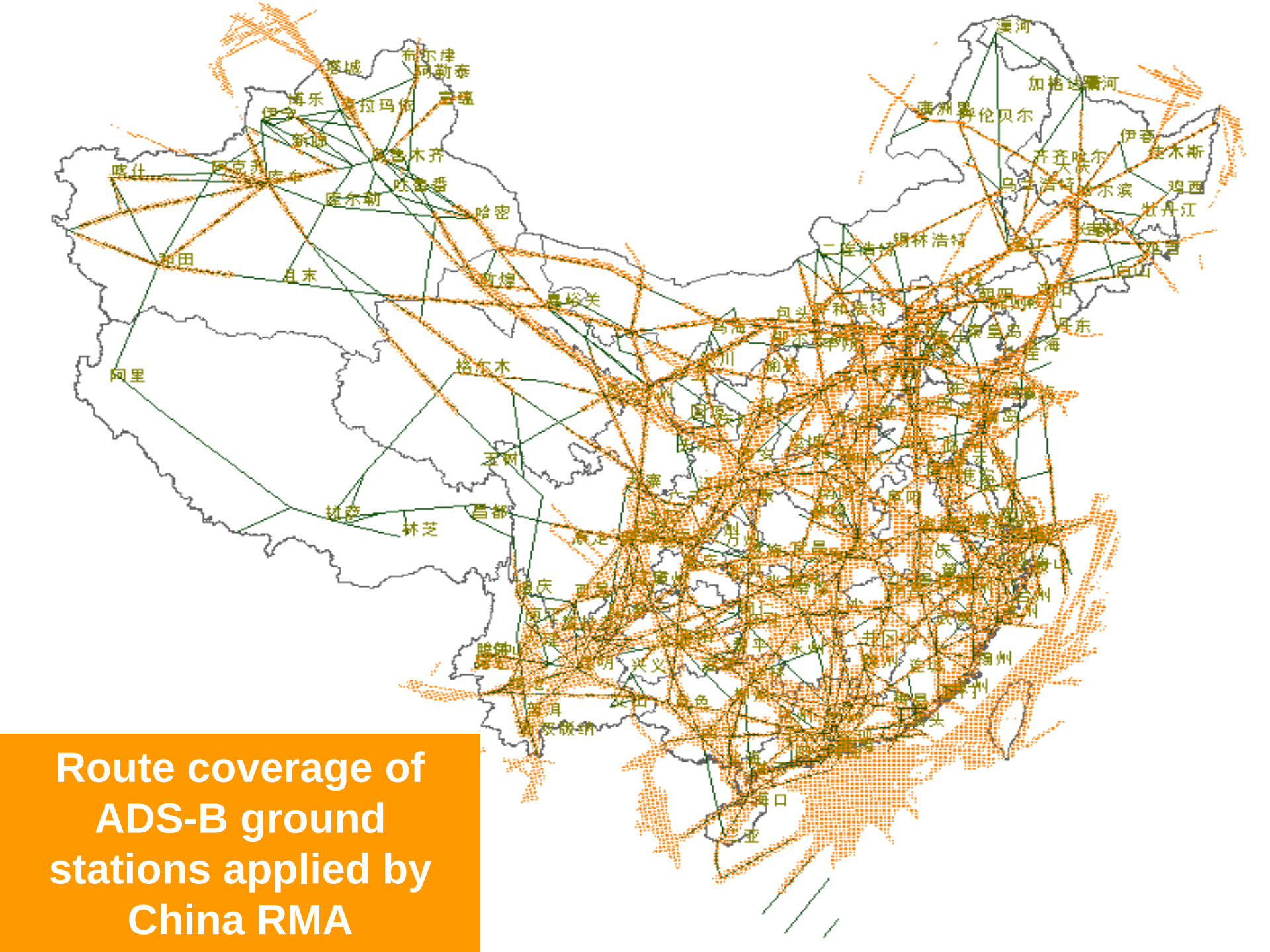
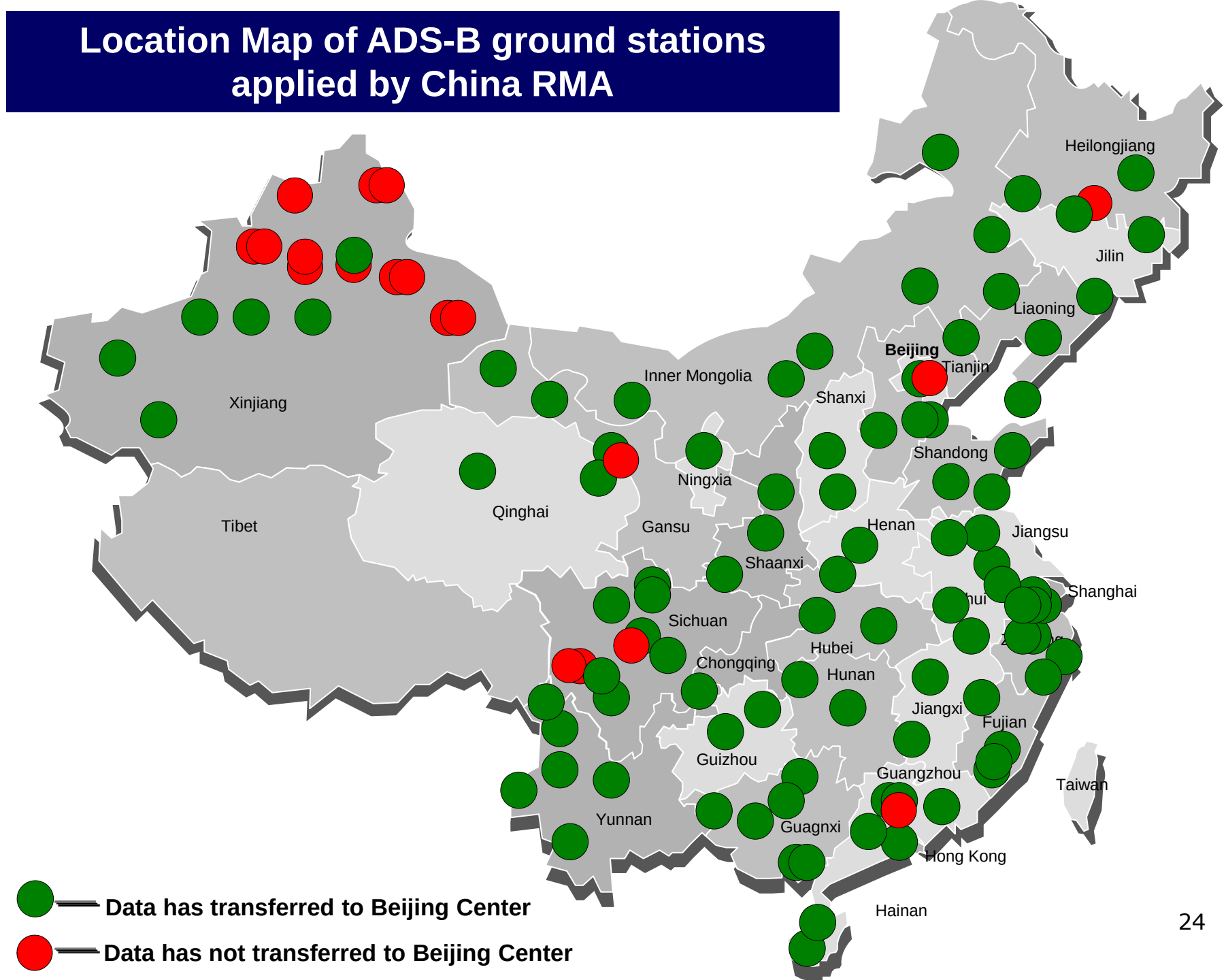
- Aircraft is ADS-B-equipped (ADS-B out)
- ADS-B function is enabled all the time during the flight in Chinese RVSM airspace
- Aircraft fly over ADS-B ground stations and maintain straight and level flight for a period of time
- Aircraft are able to broadcast messages to ADS-B ground stations


Route coverage of ADS-B ground stations applied by China RMA

Location Map of ADS-B ground stations applied by China RMA



Issue of Monitoring Burden

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- The reason to maintain a live monitoring burden list on-line is to provide the operators and responsible CAA inspectors with the progress for each operator-monitoring group meeting the long-term height monitoring program, so that both the operator/ inspectors and the China RMA can have a better coordination for the arrangement of monitoring schedule.

Issue of Monitoring Burden

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- Where: China RMA on-line data-exchange platform(user security website) :

  www.chinarma.cn/CRMA

- Update frequency: at least once a month
- What you can get from the monitoring burden:

  no. of registered aircraft under each monitoring group,

  the regno for aircraft that have valid monitoring records,

  no. of aircraft to be monitored under each monitoring group

Issue of Monitoring Burden

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How to produce the monitoring burden list

Monitoring Burden is produced on the basis of:

- all the available valid monitoring records (China RMA's and KSN-shared)
- Latest RVSM approval database maintained by China RMA
- Latest MMR table updated by RMACG

Issue of Monitoring Burden

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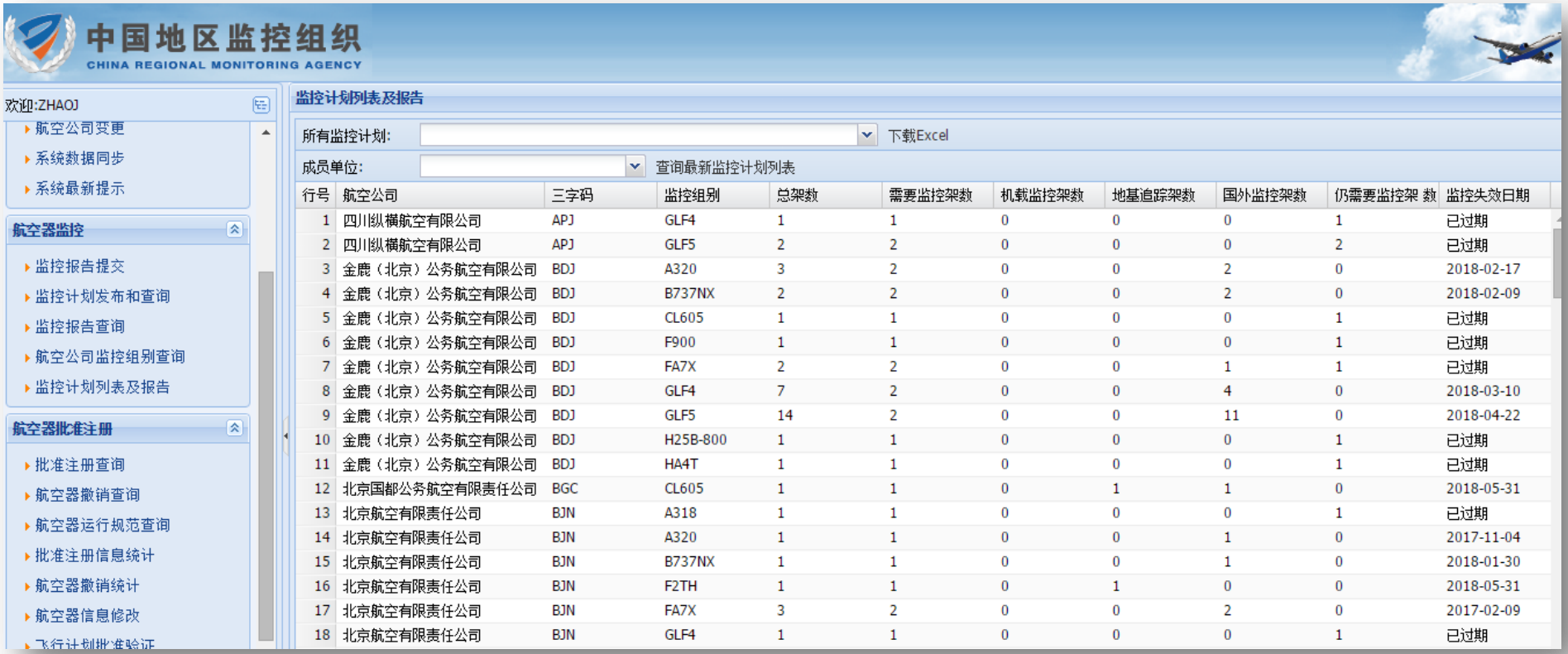

行号	航空公司	三字码	监控组别	总架数	需要监控架数	机载监控架数	地基追踪架数	国外监控架数	仍需要监控架 数	监控失效日期
1	四川纵横航空有限公司	APJ	GLF4	1	1	0	0	0	1	已过期
2	四川纵横航空有限公司	APJ	GLF5	2	2	0	0	0	2	已过期
3	金鹿（北京）公务航空有限公司	BDJ	A320	3	2	0	0	2	0	2018-02-17
4	金鹿（北京）公务航空有限公司	BDJ	B737NX	2	2	0	0	2	0	2018-02-09
5	金鹿（北京）公务航空有限公司	BDJ	CL605	1	1	0	0	0	1	已过期
6	金鹿（北京）公务航空有限公司	BDJ	F900	1	1	0	0	0	1	已过期
7	金鹿（北京）公务航空有限公司	BDJ	FA7X	2	2	0	0	1	1	已过期
8	金鹿（北京）公务航空有限公司	BDJ	GLF4	7	2	0	0	4	0	2018-03-10
9	金鹿（北京）公务航空有限公司	BDJ	GLF5	14	2	0	0	11	0	2018-04-22
10	金鹿（北京）公务航空有限公司	BDJ	H25B-800	1	1	0	0	0	1	已过期
11	金鹿（北京）公务航空有限公司	BDJ	HA4T	1	1	0	0	0	1	已过期
12	北京国都公务航空有限责任公司	BGC	CL605	1	1	0	1	1	0	2018-05-31
13	北京航空有限责任公司	BJN	A318	1	1	0	0	0	1	已过期
14	北京航空有限责任公司	BJN	A320	1	1	0	0	1	0	2017-11-04
15	北京航空有限责任公司	BJN	B737NX	1	1	0	0	1	0	2018-01-30
16	北京航空有限责任公司	BJN	F2TH	1	1	0	1	0	0	2018-05-31
17	北京航空有限责任公司	BJN	FA7X	3	2	0	0	2	0	2017-02-09
18	北京航空有限责任公司	BJN	GLF4	1	1	0	0	0	1	已过期

Coordination with regulators

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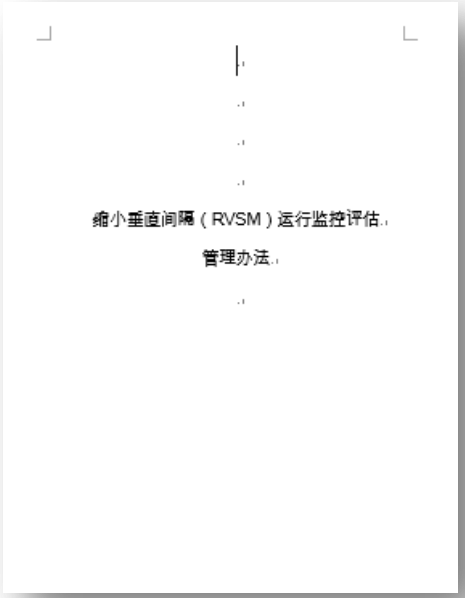
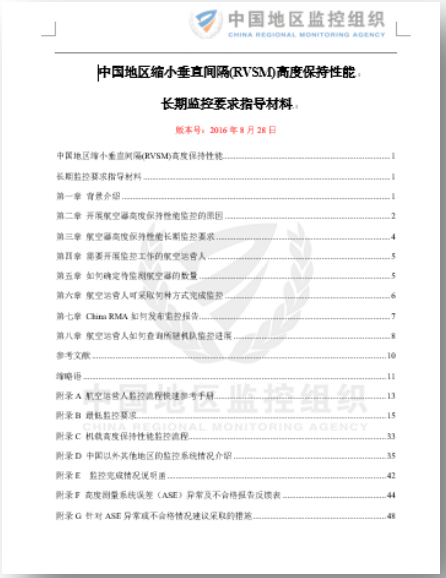
- Draft of RVSM China Long-term Height Monitoring Guidance
- Update of RVSM operational management procedure to incorporate requirement for long-term height monitoring


缩小垂直间隔（RVSM）运行监控评估
管理办法


中国地区缩小垂直间隔(RVSM)高度保持性能
长期监控要求指导材料
版本号：2016 年 8 月 28 日

Problems and Suggestions

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Suggestion 1: ICAO should raise the attention of State regulators to the importance of long-term height monitoring, and relevant procedures should be in place for non-compliance with monitoring requirement. A good example is the requirement in Doc 034 in Europe, and State should take more active actions.

Problems: RMAs promoted the LTHM program very actively, but still a number of operators don't get their aircraft monitored and no further actions taken by states.

Problems and Suggestions

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Suggestion 2: RMAs may consider to establish an ASE case study database to accumulate typical ASE problems and remedial actions together. This database can be very helpful for RMAs , operators and other relevant stakeholders to understand ASE problem, and learn from others good experience to improve altimetry system.

Problems: each individual RMA may not meet all the ASE problems, and may lack experience to give suggestions to some special ASE cases. There is no guidance for ASE causes and remedial actions. The only material that touch this point is RMACG/8 Flimsy 4 by Mr. Phil Evans

Problems and Suggestions

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Suggestion 3: RMAs may establish a channel to share large ASE problem with manufactures to raise their attention.

Problems: with time goes by, some monitoring groups begin to demonstrate increased rate of ASE deterioration. RMAs compare data with each other for this problem. If it is determined as a group error, it should draw the attention to manufactures immediately.

Problems and Suggestions

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Suggestion 4: With the development of ADS-B technology and application of DO-260A, DO-260B, there should be new criteria for data quality assurance of AHMS system.

Problems: when processing DO-260 data, RMAs use the NUC value to filter the data of good quality. But when processing DO-260A and DO-260B data, the NUC value is replaced with several other parameters. RMAs should pay attention to its influence to the AHMS system and consider the new criteria for data quality assurance.

China RMA Contact

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