International Civil Aviation Organization

The 18th Meeting of the Regional Airspace Safety Monitoring Advisory Group (RASMAG/18)

Bangkok, Thailand, 01 – 04 April 2013

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

AAMA's EVALUATION OF ALTIMETRY SYSTEM ERROR USING ADS-B

(Presented by Australia/AAMA)

SUMMARY

This paper presents an update on Altimetry System Error calculations using ADS-B data collected and processed by the Australian Airspace Monitoring Agency (AAMA). The data includes analysis of international operators and aircraft and includes data made available by Monitoring Agency Asia Region (MAAR). Data was collected from January 2010 through to end of February 2013.

This paper relates to –

Strategic Objectives:

A: ***Safety*** *– Enhance global civil aviation safety*

Global Plan Initiatives:

GPI-2 Reduced vertical separation minima

1. INTRODUCTION

1.1 This paper deals with the AAMA's monitoring activity of Altimetry System Error (ASE) using ADS-B. In undertaking this activity, the AAMA has developed means by which to determine the geoid height reference of the aircraft. This is the height assumption of the GNSS system as Height Above Mean Sea Level (HAMSL) or Height Above Ellipsoid (HAE). The difference between HAE and HAMSL varies over the Earth's surface by +/- 200 ft.

1.2 The data was divided into that obtained from Airservices' ADS-B network and data from a small number of ground-stations in Indonesia (Bali) but used by Australian ATC. Aircraft that were seen only in this Indonesian data were not examined in our monitoring analysis. Data from the Indonesian ground stations were used as part of the ASE analysis for aircraft also seen in Australia, in order to assist in determining the geoid height reference.

1.3 In December 2012 MAAR visited the AAMA and provided a snapshot of their current ASE results. This aided greatly in determining the geoid for some aircraft and was included in our analysis with their permission. The importance of regional cooperation and data sharing cannot be overstated, as it enables monitoring agencies utilising ADSB monitoring to more easily determine the geoid height reference by providing a greater geographical range and an improved estimation of the ASE.

1.4 The study involves 3692 aircraft from the combined AAMA, Indonesian and MAAR data sets, from 1 January 2010 to 28 February 2013, with 122 operators and in excess of 2.5 billion separate data points. The data resulted in 660 million minutes of monitoring output.

1.5 Calculation of ASE from ADS-B benefits from large data sets with the averaging procedure greatly improving the accuracy of the ASE measurement. A large contribution to the ASE estimation error comes from the finite discretisation of the meteorological data both in time and space. Obtaining a wide range of data from different time and spatial regions greatly enhances the ASE accuracy.

2. DISCUSSION

2.1 The following statistics summarise the data samples:

- 1795 aircraft were seen in the AAMA data sample
- 2817 aircraft were also seen in the MAAR data sample
- 1148 aircraft were seen in the Indonesian data
- 1023 = number of common aircraft in AAMA and MAAR samples
- 848 = number of common aircraft in AAMA and Indonesian samples
- 820 = number of common aircraft in Indonesian and MAAR samples
- 2094 = number of aircraft in combined AAMA and Indonesian sample (AAMA/IND)
- 1219 = number of aircraft in common with AAMA/IND and MAAR
- 3692 = number of aircraft in all AAMA, MAAR and Indonesian data sets

2.2 Of the 1795 aircraft seen by the AAMA, approximately:

- 75% used the HAMSL as a geoid reference
- 20% used the HAE as a geoid reference
- 1% used variable height references (switched between HAMSL/HAE)
- 4% had an undetermined height reference
- 122 operators had aircraft monitored

2.3 The following table (**Attachment 1**) considers summaries of fleet characteristics seen in the data sample. Note that this table records all aircraft in our sample. Some aircraft will have insufficient data or geoid reference to enable accurate ASE measurement.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper; and

b) discuss any relevant matters as appropriate.

Attachment 1:

Fleet characteristics in AAMA data sample, sorted numerically by number of aircraft

	A330	B737NX	B744-10	B772	B773	A320	MD11	B744-5	A340	A346	A380	B767	BE20	F100	UNK	BE30	B748	E170	PC12	Other	Total
TOTAL	311	229	223	181	174	154	102	68	57	43	38	31	31	27	27	14	11	10	8	56	1795
QFA	18	53	14					13			12	17								1	128
SIA	19		9	41	31						17										117
UAE				19	76				9		9									1	114
CPA	30		30					14									8				82
KAL	17	1	37	14	1			4													74
VOZ	5	58																8		1	72
JST	11					56															67
FDX							64														64
MAS	21	12	12	17											1						63
GIA	15	43																			58
THA	9		14	14	6			4	4	6											57
BAW			33	9				14													56
ETD	16				12				7	5											40
IGA		12	4			3						1	2	2	1					13	38
UPS							38														38
ANZ			4	8	5	13		3				4									37
CCA	25		1		8										3						37
TGW						35															35
CES	24								5	4											33
UNK						1							4	1	14	1	1			7	29
UAL		5	14					9													28
CAL	20								6												26
CSN	24			2																	26
RFDS													18			2			6		26
QTR				8	16																24
VIR										19											19
SAA									9	9											18
GTI			13					4													17
JSA						17															17
SQC			14					1													15
UTY														12						3	15
CLX			13														1				14
JAL				8	4							2									14
SLK						14															14
HVN	9			4																	13
LNI		13																			13
RAAF		2														8				3	13
AAR	4			8																	12
EVA	11																				11
DAL				10																	10

	A330	B737NX	B744-10	B772	B773	A320	MD11	B744-5	A340	A346	A380	B767	BE20	F100	UNK	BE30	B748	E170	PC12	Other	Total
HAL	9																				9
ACA				6	2																8
PAL	4				4																8
QNZ		8																			8
XAX	8																				8
AWQ						7															7
JTE															7						7
OZW														7							7
MAU	2								4												6
PAC			6																		6
PBN		6																			6
RBA				6																	6
LAN									5												5
NHN														5							5
VAU					5																5
ACI	2					1						1									4
PBI		4																			4
REU					4																4
Scoot				4																	4
ANG		2										1									3
ARG									3												3
CFH													3								3
CHH	3																				3
CKS																				3	3
MIL								1				1				1					3
NJS																				3	3
PEARL																2				1	3
TOM																				3	3
AMSA																				2	2
ANO																		2			2
BOE																				2	2
CSH												2									2
HDA			1					1													2
HFY									2												2
KKK	1			1																	2
MLM						2															2
SAZ																				2	2
THT									2												2
USN		2																			2
UZB												2									2
VJS																				2	2

	A330	B737NX	B744-10	B772	B773	A320	MD11	B744-5	A340	A346	A380	B767	BE20	F100	UNK	BE30	B748	E170	PC12	Other	Total
AGC	1																				1
ARES																				1	1
AVMA																				1	1
AVN		1																			1
AWK																				1	1
BKP						1															1
BOM																				1	1
BTV						1															1
CEB						1															1
CSC	1																				1
CZO	1																				1
DAW			1																		1
DHK																				1	1
FJI		1																			1
GFA						1															1
GSS																	1				1
GZP		1																			1
HINT													1								1
ICE																				1	1
MEA	1																				1
MMZ				1																	1
MTJ		1																			1
NCA			1																		1
NJI															1						1
PVJ		1																			1
QAF									1												1
QWA													1								1
RMF		1																			1
ROJ		1																			1
RON																				1	1
SAPF																			1		1
SAS													1								1
SKTK													1								1
SOO				1																	1
TSO			1																		1
TVS		1																			1
VJT																				1	1
WAPF																			1		1
WFBN																				1	1
WHT						1															1
WOA			1																		1