International Civil Aviation Organization
CAR/SAM Regional Planning and Implementation Group (GREPECAS)
Seventeenth Meeting of the CAR/SAM Regional Planning and Implementation Group (GREPECAS/17)
(Cochabamba, Bolivia (Plurinational State of), 21 to 25 July 2014)

Agenda Item 3: Air navigation activities at global, intra-regional, and inter-regional level

3.3 Inter-regional air navigation activities

Activities carried out by CARSAMMA

(Presented by CARSAMMA)

SUMMARY

This working paper presents the activities carried out by CARSAMMA in relation to its duties and responsibilities, including Large Height Deviation (LHD) reports, processing of aircraft movements, and calculation of collision risk associated to the implementation of Reduced Vertical Separation Minima (RVSM) in the CAR/SAM Regions.

References:
- Doc. 9574 –RVSM Manual;
- AP/ATM/13 final report (Bogota, Colombia, 9-13 July 2007);
- Final report of the Third RMA Coordination Meeting (Montreal, Canada, 13-15 May 2008);
- Final report of the Seventh RMA Coordination Meeting (Beijing, China, 28 May to 1 June 2012);
- Final report of the Eighth RMA Special Meeting (Montreal, Canada, 8-12 April 2013)
- Final report of the Ninth RMA Special Meeting (Paris, France, 19-23 May 2014)

1. Introduction

1.1. The Caribbean and South American Regional Planning and Implementation Group (GREPECAS) has delegated to the Caribbean and South American Monitoring Agency (CARSAMMA) the safety monitoring function in support of the implementation and use of RVSM airspace in the Caribbean and South American Regions.

1.2. CARSAMMA acts as a regional monitoring agency (RMA) as foreseen in Doc 9574, and maintains a database of approvals granted to operators and aircraft for the use of RVSM airspace.

1.3. CARSAMMA uses the internationally accepted safety assessment process, with the introduction of Reduced Vertical Separation Minima (RVSM) in CAR/SAM airspace. The basic collision risk model (CRM) is used for estimating the total system risk attributable to all causes.

2. Air traffic movements

2.1 In order to estimate system risk, the CRM model requires many parameters that are derived from data sources provided to CARSAMMA. One of the parameters required by the CRM model is the CAR/SAM FIR aircraft movement files, such as the Data Collection Form (F0) that is available at the CARSAMMA website.

2.2 The Thirteenth Meeting of the GREPECAS Scrutiny Working Group (GTE/13), held in Lima, Peru, on 9-13 September 2013, was presented with a summary of the study on the need to clean up this data during the collection, preparation and analysis phases, showing the flaws in aircraft movement data submitted to CARSAMMA.

2.3 It is important to note that, due to the large amount of flawed data submitted, CARSAMMA must employ resources that could be used for other safety processes. It should be stressed that the letter sent by the ICAO Regional Offices requesting the delivery of this data contains detailed instructions for each specific case. CARSAMMA Form F0 contains detailed instructions for data submission.

2.4 It should be noted that without the proper information on air traffic movement, the vertical collision risk (CRM) calculation is significantly impaired. Only 42% of the information provided by SAM States and 78% of information provided by CAR States to CARSAMMA was used. Information details are contained in **Appendix A** to this working paper.

3. Non-RVSM approved aircraft operating in RVSM airspace

3.1 The Seventh RMA Coordination Meeting (RMACG/7), held in Beijing on 28 May to 1 June 2012, approved the annual request for information on aircraft movement in RVSM airspace over a period of one month, in the FIRs under the responsibility of each RMA, with a view to auditing RVSM airspace use by non-RVSM approved aircraft.

3.2 Based on the study conducted by CARSAMMA, during 2013, a total of 407 flights in the SAM Region and 157 in the CAR Region that were not in the global RVSM-approved aircraft database were analysed, corresponding to 0,18% and 0,44% of flights, respectively.

3.3 It is vital for Civil Aviation Authorities to offer CARSAMMA an effective point of contact to answer queries on the status of RVSM approval of aircraft that flew in RVSM airspace without being included in the RVSM approvals database. This point of contact must be able to promptly verify the actual status of RVSM approval and any measures that the CAA may have adopted in case the aircraft and/or operator are not RVSM-approved. More details on the audit conducted by CARSAMMA can be found in Appendix A to this working paper.

4. Large height deviations (LHDs)

4.1 One of the parameters required by the CRM model is the total number of hours flown at an incorrect level per year. In order to have a precise estimation of risk, CARSAMMA requires monthly information on Large Height Deviations (LHDs) in RVSM airspace within the Flight Information

Regions (FIRs). LHD records contain the necessary information for estimating the annual number of hours flown at incorrect levels within RVSM airspace.

4.2 At the AP/ATM/13 meeting (Bogota, Colombia, 9-13 July 2007), the States were reminded again that they should continue providing CARSAMMA with monthly LHD reports to facilitate RVSM airspace safety monitoring. The form for completing LHD data is contained in **Appendix B**.

4.3 The Third RMA Special Meeting (Montreal, Canada, 13-15 May 2008) noted that the specific problems of RVSM airspaces throughout the world were similar. Regarding large height deviations (LHDs), the consensus was that the problems faced in the execution of the operational assessment process were the same, even for EUROCONTROL and the FAA. Regardless of economic conditions, installed capacity, or dissemination of LHD data completion rules, some civil aviation organisations of the signatory States were not fulfilling their duties and responsibilities concerning RMA activities and, on the other hand, there was a lack of awareness amongst controllers, pilots and those responsible for the process during the first stages of data collection. Thus, the CAR and SAM Regions have a high percentage of LHDs (58%) that cannot be used for safety assessment calculations due to missing or incorrect information inserted in the LHD form.

4.4 System risk is directly proportional to the total amount of time flown at incorrect levels. The calculation of such time is one of the key elements for determining whether or not the estimated system risk will meet the target level of safety (**TLS**), using the CRM model. The amount of time flown at incorrect levels is estimated based on LHD reports received during the specified time interval. Thus, the large number of LHDs that cannot be used in the CRM significantly affects the reliability of the calculated values.

4.5 More information on the number of LHDs not used in the CRM, the location of the points experiencing the highest number of LHDs, the most common types of LHDs, and flight time at incorrect levels, appears in Appendix A to this working paper.

4.6 As an urgent measure to mitigate the problems identified in the completion of air traffic movement and LHD forms, CARSAMMA has taken the initiative of organising a meeting of focal points of the CAR and SAM States, scheduled to be held in Rio de Janeiro, 11 to 13 August 2014.

5. Safety assessment

5.1 The activities of an RMA (like CARSAMMA) include the continuous assessment of the safe use of RVSM airspace using quantitative methods (CRM) to assess collision risk. For the quantitative assessment, the REICH Vertical Collision Risk Model recommended by ICAO is used. This is a math-intensive model whereby, after processing the data on aircraft movement received from FIRs (spreadsheets containing data on flights conducted in RVSM airspace – form F0), the target level of safety (TLS) for the flight region concerned is calculated. Several calculation tools and databases are used for conducting the various calculations during the process, employing many expert hours in the analysis.

5.2 The RVSM safety assessment is carried out continuously over a period of twelve months.

5.3 Technical and Total Risks were estimated for the CAR/SAM FIRs after processing all the data received and compiled by CARSAMMA, using the specific CRM software.

5.4 The Technical Risk of the CAR/SAM FIR meets the TLS value of no more than 2,5 x 10^{-9} fatal accidents per flight hour due to loss of 1000-ft vertical separation and all other causes. The Operational Risk has no predetermined limit value, in accordance with ICAO 9574.

5.5 In 2013, the preliminary Total Risk estimated, prior to the analysis by the Scrutiny Working Group for the FIRs under consideration was 1,19 x 10^{-8}, which is **above** the TLS of 5,0 x 10^{-9}. Such value may vary, depending on the results of the Fourteenth GTE Meeting.

5.6 In summary, according to the CRM model, the CAR/SAM RVSM airspace has an estimated annual collision risk that exceeds that recommended by ICAO (TLS = 5 x 10^{-9}), taking into account the CRM methodology.

CAR/SAM RVSM Airspace – Estimated annual flight hours = 157.438:46 hours – *(Note: Time estimated based on November 2013 sample)*			
Source of Risk	**Estimated Risk**	**TLS**	**Observation**
Technical Risk	**9,10 x 10^{-12}**	**2,5 x 10^{-9}**	**Below**
Operational Risk	**1,19 x 10^{-8}**	-	-
Total Risk	**1,19 x 10^{-8}**	**5,0 x 10^{-9}**	**Above**

Annual risk estimates for CAR/SAM RVSM airspace in 2013

6. **Conclusion**

6.1 Studies conducted by CARSAMMA showed that the CAR and SAM Regions continue to have an estimated annual collision risk above that recommended by ICAO (TLS = 5 x 10^{-9}).

6.2 It is noted that the high rate of errors in the completion of air traffic movement and LHD forms is causing serious problems to the work carried out by CARSAMMA, jeopardising the credibility of safety assessment calculations made by the Agency.

6.3 Close contact between CARSAMMA and the civil aviation authorities of the States is of vital importance in order to obtain the data required to fulfil its duties and responsibilities and to clarify any doubts on the status of RVSM approval of aircraft and operators.

6.4 Accordingly, urgent measures need to be taken so that States will send the information required by CARSAMMA in an accurate manner, so that it may fulfil its duties and responsibilities as foreseen in ICAO documentation and as coordinated at RMA coordination meetings held under the auspices of ICAO Headquarters.

7. **Suggested action**

7.1 The Meeting is invited to:

a) take note of the information contained in this working paper;

b) establish a GREPECAS project concerning training of CARSAMMA focal points in CAR and SAM States with the purpose of mitigating problems related to the completion of air traffic movement and LHD forms.

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APPENDIX A

CARSAMMA Activities

1. Air Traffic Movements

1.1 In order to estimate system risk, the CRM model requires many parameters that are derived from data sources provided to CARSAMMA. One of the parameters required by the CRM model is the CAR/SAM FIR aircraft movement files, such as the Data Collection Form (F0) that is available at the CARSAMMA website. This information must contain all aircraft movements over a particular month and be sent to CARSAMMA for processing. These files are also used for RVSM airspace auditing.

1.2 The Thirteenth Meeting of the GREPECAS Scrutiny Working Group (GTE/13) held in Lima, Peru, on 9-13 September 2013 was presented with a summary of the study on the need to clean up this data during the collection, preparation and analysis phases, showing the flaws in aircraft movement data submitted to CARSAMMA.

1.3 It is important to note that, due to the large amount of flawed data submitted, CARSAMMA must employ resources that could be used for other safety processes. It should be stressed that the letter sent by the ICAO Regional Offices requesting the delivery of this data contains detailed instructions for each specific case. CARSAMMA Form F0 contains detailed instructions for data submission. **Figure 1** below shows the main data.

FIR IDENTIFICATION:											
DATE	AIRCRAFT REGISTRATION	TYPE OF AIRCRAFT	AD OF ORIGIN	AD OF DESTINATION	POINT OF ENTRY INTO RVSM AIRSPACE	TIME AT POINT OF ENTRY	FL AT THE POINT OF ENTRY	AIRWAY AT THE POINT OF ENTRY	POINT OF EXIT OF RVSM AIRSPACE	TIME AT POINT OF EXIT	FL AT POINT OF EXIT
02/12/12	N275HZ	LJ60	KBCT	SVMI	VESKA	23:57	390	UA315	REPIS	00:38	390

Figure 1 – Aircraft movement report

1.4 In summary, the effort (approximately one month) devoted to cleaning up aircraft movement data sent by the States to CARSAMMA could be avoided if the procedures described in CARSAMMA Form F0 completion instructions were followed.

1.5 It should be noted that, without aircraft movement information, the Vertical Collision Risk (CRM) calculation process is significantly impaired, requiring form CARSAMMA a greater effort to fulfil its tasks.

1.6 The Seventh RMA Coordination Meeting (RMACG/7), held in Beijing on 28 May to 1 June 2012, approved the annual request for information on aircraft movement in RVSM airspace over a period of one month, in the FIRs under the responsibility of each RMA, with a view to auditing RVSM airspace use by non-RVSM approved aircraft. This work was done by CARSAMMA, with the support of ICAO Lima and Mexico Offices, resulting in several papers (WPs) that were subsequently presented by CARSAMMA at GTE meetings and at the RMACG/8 (Canberra - 2013) and RMACG/9 (Paris - 2014) meetings.

1.7 **Table 1** shows the number of CAR/SAM FIRs that sent the requested files, the total number of recorded flights, the number and percentage of aircraft not included in global RVSM databases, and the audit.

		2011	2012	2013
FIR that sent Movement	SAM	17	9	21
	CAR	4	2	4
	∑	**21**	**11**	**25**
Total of Flights	SAM	166.284	134.345	221.611
	CAR	54.549	16.772	35.549
	∑	**220,833**	**151,117**	**257,160**
Out of Database	SAM	474	168	407
	CAR	112	106	157
	∑	**586**	**274**	**564**
% Out of Database	SAM	0.00215	0.001251	0.00184
	CAR	0.00051	0.00632	0.00442
	∑	**0.00265**	**0.001813**	**0.00219**

Table 1 – Non-RVSM approved aircraft in 2011, 2012, and 2013

1.8 The reports containing the list of non-certified aircraft were sent to the ICAO Lima and Mexico Offices, to the civil aviation authorities of registration of the aircraft for the respective arrangements, and were also submitted at international meetings attended by CARSAMMA. This parameter was considered in the Vertical Risk Calculation Model.

1.9 **Table 2** shows more details of the same audit conducted in 2013.

REGION	STATE	FIR	DELIVERED	PROCESSED	# FLIGHTS	NO RVSM	%
SAM	ARGENTINA	CORDOBA	ok	ok	3781	2	0.000528961
		EZEIZA	ok	ok	7340	17	0.002316076
		MENDOZA	ok	ok	3275	90	0.027480916
		RESISTENCIA	ok	ok	2899	9	0.003104519
		COMODORO	ok	ok	1763	69	0.039137833
SAM	BOLIVIA	LA PAZ	ok	ok	2683	2	0.000745434
SAM	BRAZIL	ATLANTICO	ok	ok	31970	14	0.000437911
		RECIFE	ok	ok			
		AMAZONICA	ok	ok	22414	0	0
		BRASILIA	ok	ok	65535	25	0.000381476
		CURITIBA	ok	ok	37495	61	0.001626884
SAM	CHILE	PUNTA ARENAS	ok	ok	448	3	0.006696429
		SANTIAGO	ok	ok	9748	13	0.001333607
		ANTOFAGASTA	ok	ok			
		ISLA DE PASCUA	ok	ok			
		PUERTO MONTT	ok	ok	689	1	0.001451379
SAM	COLOMBIA	BARRANQUILLA	ok	ok	6397	15	0.002344849
		BOGOTA	ok	ok	7333	3	0.00040911
SAM	ECUADOR	GUAYAQUIL					
SAM	GUYANA	GEORGETOWN					
SAM	FRENCH GUYANA	CAYENNE					
SAM	PANAMA	PANAMA					

REGION	STATE	FIR	DELIVERED	PROCESSED	# FLIGHTS	NO RVSM	%
SAM	PARAGUAY	ASUNCION	ok	ok	1063	55	0.051740357
SAM	PERU	LIMA	ok	ok	13234	15	0.001133444
SAM	SURINAME	PARAMARIBO					
SAM	URUGUAY	MONTEVIDEO	ok	ok	3544	13	0.003668172
SAM	VENEZUELA	MAIQUETIA					
	SUBTOTAL SAM		**21**	**21**	**221611**	**407**	**0.001836551**
CAR	COCESNA	CENTRAL AMERICA	ok	ok	11457	37	0.003229467
CAR	CUBA	HAVANA	ok	ok	15767	41	0.002600368
CAR	HAITI	PORT AU PRINCE	ok	ok	3090	61	0.0197411
CAR	JAMAICA	KINGSTON					
CAR	DOMINICAN REP.	SANTO DOMINGO					
CAR	TRINIDAD & TOBAGO	PIARCO	ok	ok	5235	18	0.003438395
CAR	NETHERLANDS ANTILLES	CURACAO					
	SUBTOTAL CAR		**4**	**4**	**35549**	**157**	**0.004416439**
		TOTAL CARSAM	**DELIVERED**	**PROCESSED**	**# FLIGHTS**	**NO RVSM**	**%**
			25	**25**	**257160**	**564**	**0.002193187**

		# TOTAL FLIGHTS	APPROVED	%
RVSM	SAM	221611	221204	0.998163449
	CAR	35549	35392	0.995583561
	TOTAL	257160	256596	0.997806813
		# TOTAL FLIGHTS	NO RVSM	%
NO RVSM	SAM	221611	407	0.001836551
	CAR	35549	157	0.004416439
	TOTAL	257160	564	0.002193187

Table 2 – Audit of non-RVSM approved aircraft in 2013

2. Large Height Deviations (LHD)

2.1 One of the parameters required by the CRM model is the total number of hours flown at an incorrect level per year. In order to have a precise estimation of risk, CARSAMMA requires monthly information on Large Height Deviations (LHDs) in RVSM airspace within the Flight Information Regions (FIRs). LHD records contain the necessary information for estimating the annual number of hours flown at incorrect levels within RVSM airspace.

2.2 At the AP/ATM/13 meeting (Bogotá, Colombia, 9-13 July 2007), the States were reminded again that they should continue providing CARSAMMA with monthly LHD reports to facilitate RVSM airspace safety monitoring.

2.3 The Third RMA Special meeting (Montreal, Canada, 13-15 May 2008) noted that the specific problems of RVSM airspaces throughout the world were similar. The differences in terms of efficacy of the data collection process become apparent when considering the investment and operational structure installed in each Region, which are directly related to the economic power of signatory States. Regarding large height deviations (LHDs), the consensus was that the problems faced in the execution of the operational assessment process were the same, even for EUROCONTROL and the FAA. Regardless of economic conditions, installed capacity, or dissemination of LHD data completion rules, some civil

aviation organisations of the signatory States were not fulfilling their duties and responsibilities concerning RMA activities and, on the other hand, there was a lack of awareness amongst controllers, pilots and those responsible for the process during the first stages of data collection.

2.4 LHD records contain details about the occurrences that resulted in height deviations of 300 ft or more within RVSM airspace. Occurrences resulting from turbulence or other time-related causes (code "D"), reactions to ACAS/TCAS warnings (alerts) (code "F"), deviations due to contingencies (code "G"), and operational errors must be included in LHD records. CARSAMMA stresses that, even if there are no LHD occurrences during the month, the States need to send a report indicating the absence of occurrences (NIL).

2.5 System risk is directly proportional to the total amount of time flown at incorrect levels. The calculation of this time is one of the key elements for determining whether or not the estimated system risk will meet the target level of safety (**TLS**), using the CRM model. The amount of time flown at incorrect levels is estimated based on LHD reports received during the specified time interval.

2.6 **Table 3** presents a summary of time parameters and level crossings in LHDs received by CARSAMMA from January 2011 to December 2013. The total amount of time (in seconds) and the incorrect levels are shown for each monthly LHD record.

	Time(same) in seconds			Time(opp) in seconds			Level (same)			Level (opp)		
	2011	**2012**	**2013**	**2011**	**2012**	**2013**	**2011**	**2012**	**2013**	**2011**	**2012**	**2013**
ene	5927	10366	24714	300	260	60	34	49	43	38	55	44
feb	7028	21012	35938	210	385	230	39	47	43	42	51	47
mar	3890	6085	22255	30	480	240	20	37	58	21	42	61
abr	4733	7729	10273	130	300	190	35	32	41	37	35	45
may	68576	3005	46301	180	660	445	35	20	57	37	22	63
jun	4005	7440	25950	220	0	370	32	17	61	35	17	66
jul	41209	7040	16185	440	105	570	27	31	46	27	34	49
ago	3324	5000	20305	30	405	150	10	41	55	10	44	55
sep	1030	20420	25330	0	210	216	12	33	53	12	36	55
oct	4408	3747	8720	60	116	270	28	21	64	29	23	67
nov	6528	4141	9310	170	120	130	31	27	38	35	30	39
dic	10700	3720	10655	420	90	390	53	21	67	56	22	72
TOTAL	**161358**	**99705**	**255936**	**2190**	**3131**	**3261**	**356**	**376**	**626**	**379**	**411**	**663**
	2011	**2012**	**2013**	**2011**	**2012**	**2013**	**2011**	**2012**	**2013**	**2011**	**2012**	**2013**
	Time flown in the same direction			Time flown in opposite direction			Level crossings in the same direction			Level crossings in the opposite direction		

Table 3 – Time parameters and level crossings in the LHDs received by CARSAMMA by month/year in CAR/SAM airspace

Table 4 presents the categories of LHD codes, including the cause of each deviation.

Code	Cause of large height deviations (LHDs)
A	Flight crew failing to climb/descend the aircraft as cleared
B	Flight crew climbing/descending without ATC clearance
C	Entry into airspace at incorrect flight level
D	Deviation due to turbulence or other weather-related cause
E	Deviation due to equipment failure
F	Deviation due to collision avoidance system warning (ACAS/TCAS)

Code	Cause of large height deviations (LHDs)
G	Deviation due to aircraft contingency
H	Aircraft not RVSM approved
I	ATC loop error (*e.g.*: the pilot misinterprets clearance message or ATC issues incorrect clearance)
J	Incorrect operation of airborne equipment, including incorrect operation of fully operational FMS or navigation system (*e.g.*: by mistake, the pilot operates the INS equipment incorrectly)
K	Incorrect transcription of ATC clearance or re-clearance to the FMS
L	Incorrect information transcribed to the FMS (*e.g.*: flight plan followed rather than ATC clearance, or original clearance followed instead of re-clearance)
M	Error in transition message between ATC units (coordination error)
N	Lack of coordination by the transferring ATC unit
O	Other
P	Unknown

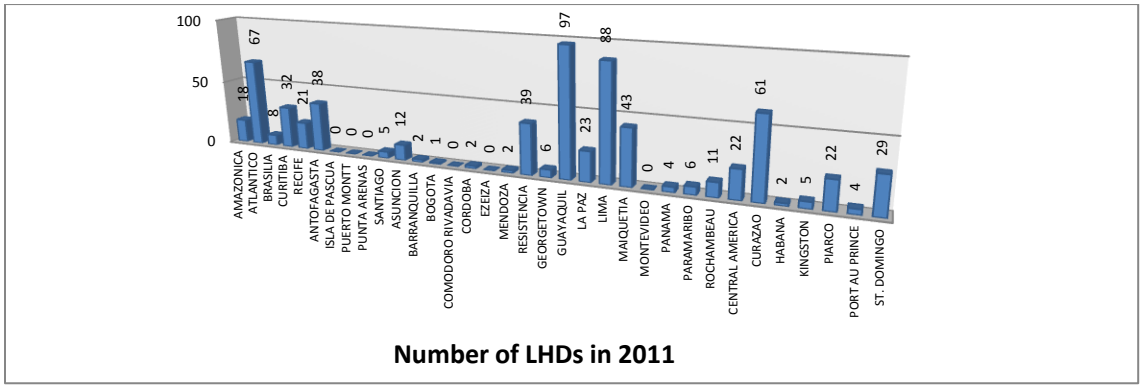
Table 4 - Categories of LHD codes in RVSM airspace

2.7 **Table 5** presents the evolution of LHDs between 2011 and 2013, by category, in the CAR/SAM Regions.

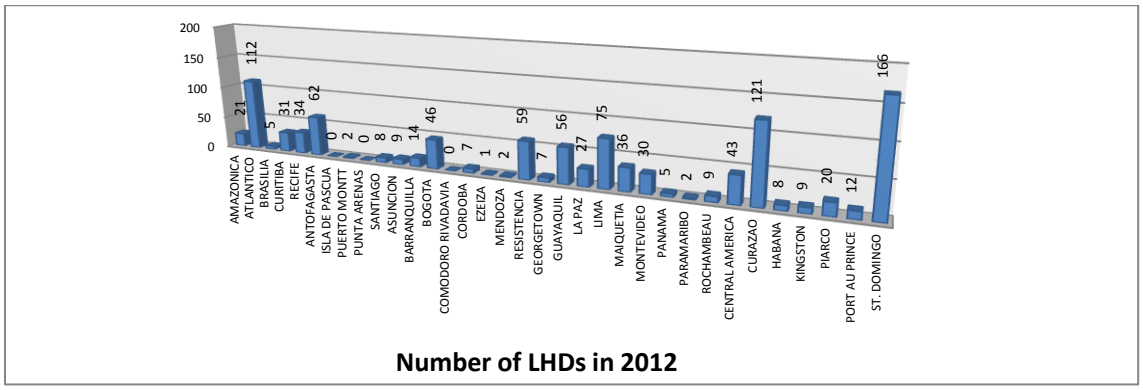
YEARS	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	TOTAL
2011	2	5	8	7	1	1	-	1	-	1	-	1	411	205	1	1	**645**
2012	5	7	1	3	4	8	-	5	3	-	-	3	404	240	3	1	**687**
2013	9	18	2	4	5	1	-	2	2	4	2	1	613	402	-	-	**1065**
Total	**16**	**30**	**11**	**14**	**10**	**10**	**0**	**8**	**5**	**5**	**2**	**5**	**1428**	**847**	**4**	**2**	**2397**

Table 5 – Yearly evolution of LHDs

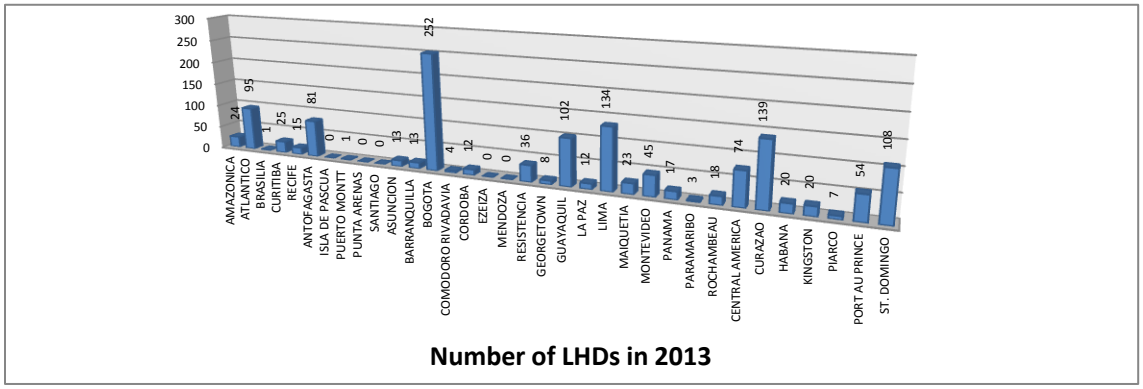
2.8 **Graphs 1, 2** and **3** present LHD reports submitted by CAR/SAM FIRs between 2011 and 2013. It is very important to highlight that the identification of errors and the completion of LHD forms demonstrate the commitment of FIRs to safety. It should be noted that the FIR preparing the LHD report normally identifies the error of the adjacent FIR when the aircraft enters its airspace.



Graph 1 - LHD records submitted by CAR/SAM FIRs in 2011

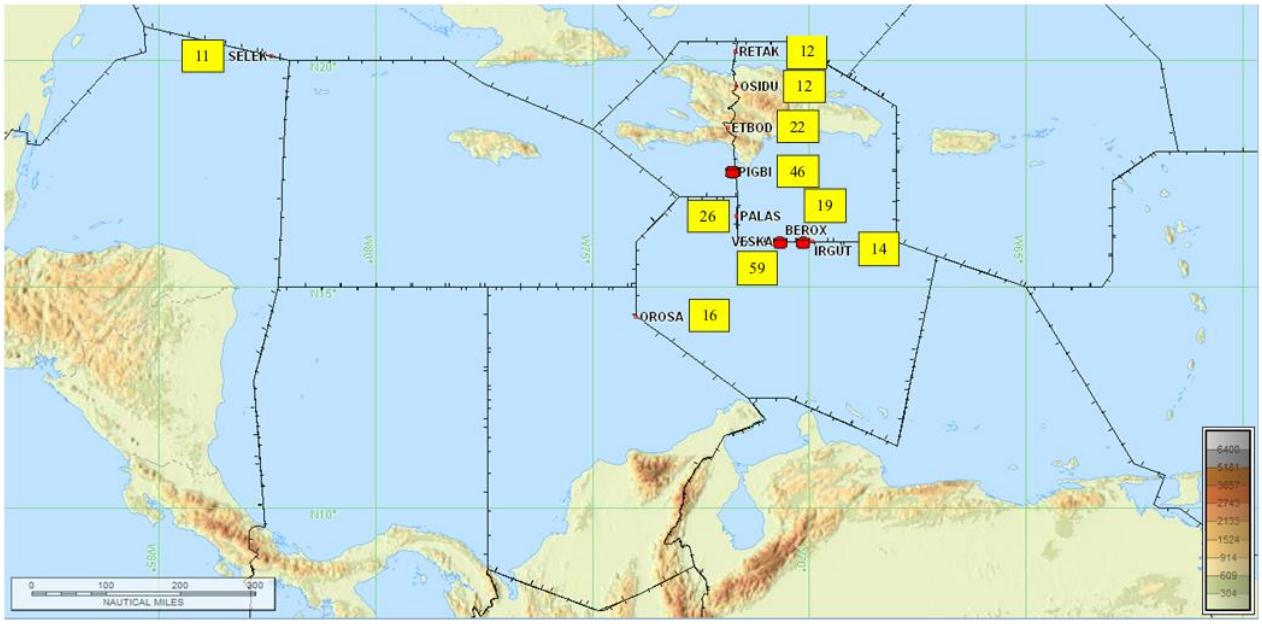


Graph 2 - LHD records submitted by CAR/SAM FIRs in 2012

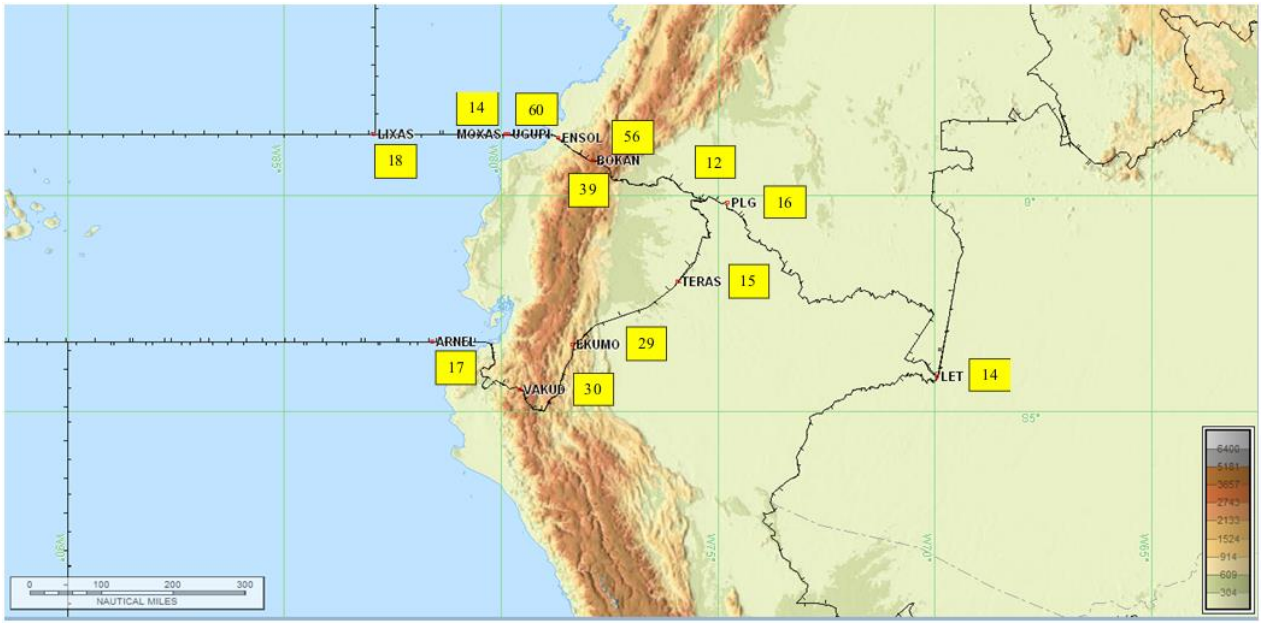


Graph 3 - LHD records submitted by CAR/SAM FIRs in 2013

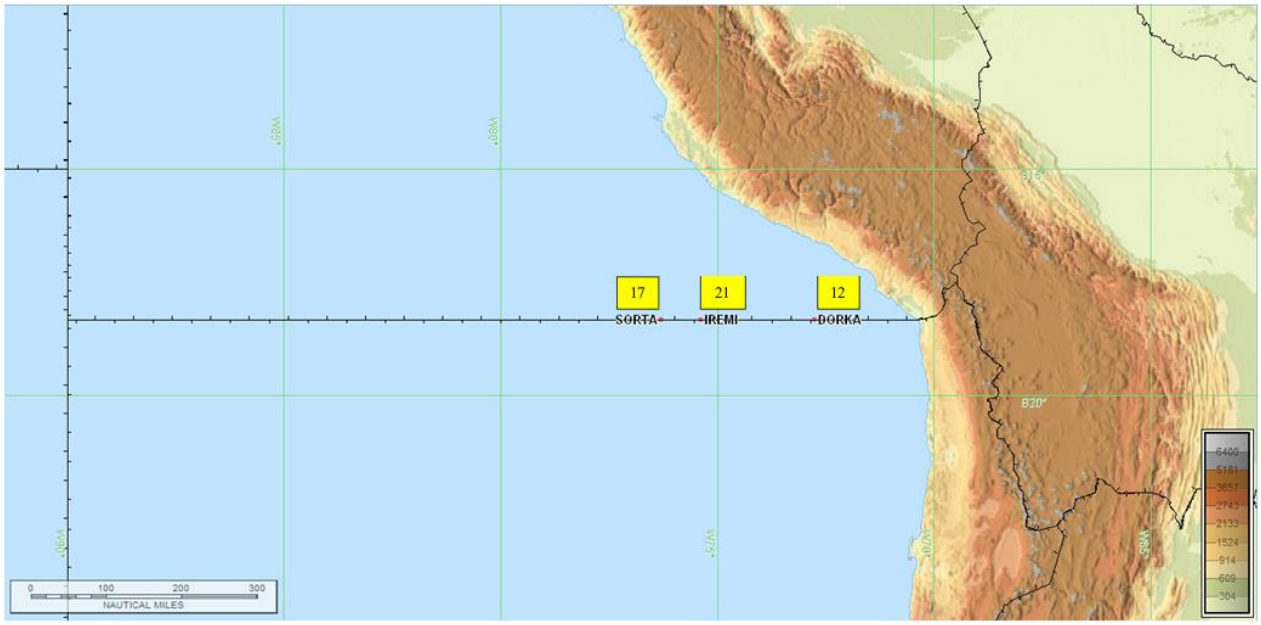
2.9 Graphs **4, 5, 6** and **7** show the location of the most frequent LHD reports in the CAR/SAM FIRs during 2013 alone. The yellow boxes show the number of LHDs received by CARSAMMA.



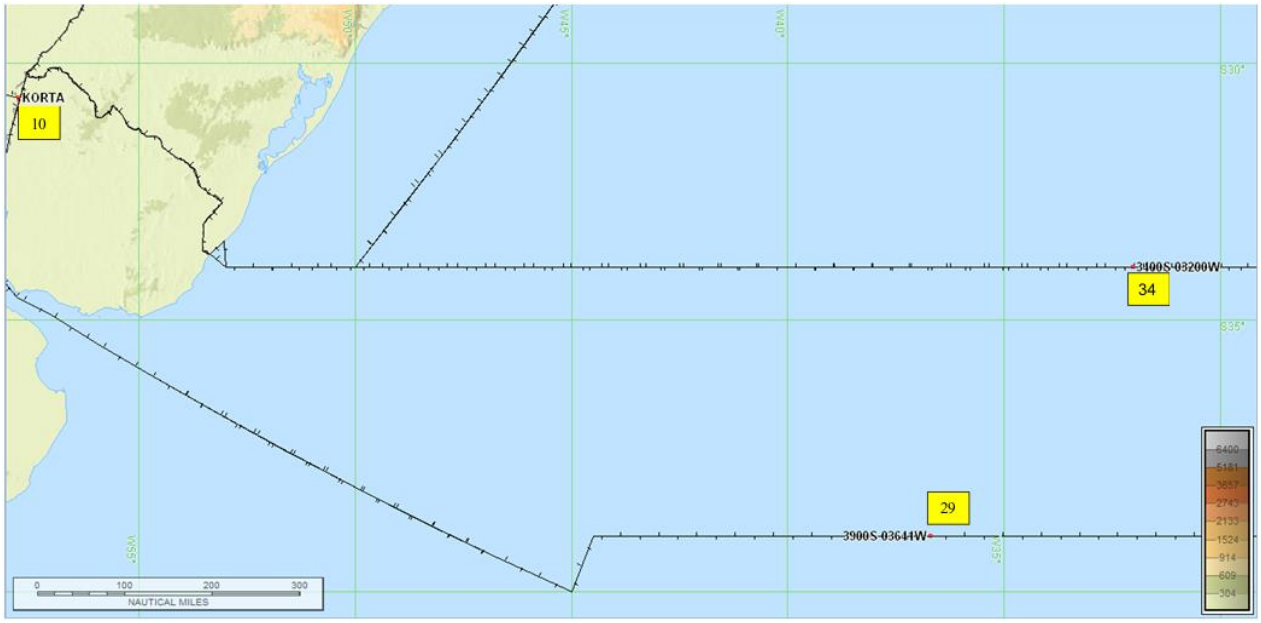
Graph 4 – Location of most frequent LHDs sent during 2013



Graph 5 – Location of most frequent LHDs sent during 2013



Graph 6 – Location of most frequent LHDs sent during 2013



Graph 7 – Location of most frequent LHDs sent during 2013

3. Safety Assessment

3.1 Once in possession of LHD and aircraft movement reports, CARSAMMA applies SMS systems on a monthly basis to obtain the location of LHDs that have contributed most to increasing the Risk Value in our Regions. **Table 3** and **Figure 2** show the occurrence and location of these LHDs.

MONTH	TOTAL LHDs	DURATION Total (min.)	DURATION Mean (min.)	RISK (SMS) Medium	Highest RISK	LHD sequence/Year
AUGUST 12	80	90	1.13	20.58	55	714/2012
SEPTEMBER 12	118	344	2.92	17.97	46	839/2012
OCTOBER 12	100	239	2.39	21.39	46	884/933/2012
NOVEMBER 12	133	177	1.80	21.05	46	1054/2012
DECEMBER 12	106	159	2.25	21.83	60	1158/2012
JANUARY 13	114	412	3.62	24.93	51	1/2/45/80/2013
FEBRUARY 13	87	614	7.07	26.41	51	138/172/2013
MARCH 13	111	371	3.35	28.62	60	302/2013
APRIL 13	125	174	1.40	24.76	51	395/404/419/2013
MAY 13	136	779	5.73	27.78	61	464/2013
JUNE 13	113	438	3.88	25.81	60	673/2013
JULY 13	127	268	2.12	27.41	51	692/703/713/724/2013
TOTAL	1350	4065	3.14	24.05	61	

Table 3 – Occurrence of LHDs

Figure 2 – Location of LHDs (highest risk)

3.2 The activities of an RMA (like CARSAMMA) include the continuous assessment of the safe use of RVSM airspace using quantitative methods (CRM) to assess collision risk. For the quantitative assessment, the REICH Vertical Collision Risk Model recommended by ICAO is used. This is a math-intensive model whereby, after processing the data on aircraft movement received from FIRs (spreadsheets containing data on flights conducted in RVSM airspace - Form F0), the target level of safety (TLS) for the flight region concerned is calculated. Several calculation tools and databases are used for conducting the various calculations during the process, employing many expert hours in the analysis.

3.3 The RVSM safety assessment is carried out continuously over a period of twelve months.

3.4 Special attention should be paid to ensuring that:

- All aircraft operating in airspace with reduced vertical separation minima are RVSM-certified;
- The aircraft certification is still valid;
- The target level of safety (TLS) of $5x10^{-9}$ fatal accidents per flight hour (to monitor height-keeping performance of a representative sample of aircraft) is being met;
- The use of RVSM does not increase the level of risk due to operational errors and contingency procedures;
- There is evidence of aircraft altimetry system stability (ASE);
- The introduction of RVSM does not increase risk factors due to operational errors and flight contingencies, in accordance with a predetermined level of statistical confidence;
- Possible additional effective safety measures are adopted to reduce the risk of collision and to meet safety objectives;
- Air traffic control procedures continue to be effective.

3.5 Technical and Total Risks were estimated for the CAR/SAM FIRs after processing all the data received and compiled by CARSAMMA, using the specific CRM software.

3.6 The Technical Risk of the CAR/SAM FIR meets the TLS value of no more than 2,5 x 10^{-9} fatal accidents per flight hour due to loss of 1000-ft vertical separation and all other causes.

3.7 The Operational Risk has no predetermined limit value, in accordance with ICAO Doc 9574.

3.8 The Total Risk estimated for the FIRs under consideration is 1,19 x 10^{-8}, which is **above** the TLS of 5,0 x 10^{-9}.

3.9 **Figure 3** shows the consolidated collision risk for the CAR/SAM FIRs in 2013, showing the estimated vertical collision risk by FIR. It should be understood that the FIR that completes the LHD report is at a higher risk, but generally due to failures caused by the FIR of the adjacent airspace.

3.10 In summary, according to the CRM model, the CAR/SAM RVSM airspace has an estimated annual collision risk above that recommended by ICAO (TLS = 5) (**Table 7**).

CAR/SAM RVSM Airspace – Estimated annual flight hours = 157.438:46 hours – *(Note: Time estimated based on November 2013 sample)*			
Source of Risk	**Estimated Risk**	**TLS**	**Observation**
Technical risk	**$9{,}10 \times 10^{-12}$**	**$2{,}5 \times 10^{-9}$**	**Below**
Operational risk	**$1{,}19 \times 10^{-8}$**	-	-
Total risk	**$1{,}19 \times 10^{-8}$**	**$5{,}0 \times 10^{-9}$**	**Above**

Table 7 – Annual risk estimates for CAR/SAM RVSM airspace in 2013

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APPENDIX B

CARSAMMA F4 FORM
LARGE HEIGHT DEVIATION FORM
REPORT OF LARGE HEIGHT DEVIATION OF 300 FT OT MORE BETWEEN FL 290 AND FL 410

Report to the Caribbean and South American Monitoring Agency (CARSAMMA) of a height deviation of 300ft or more, including:

1) Those due to TCAS/ACAS;
2) Turbulence and contingency events; and
3) Operational errors resulting in flight at an incorrect level or coordinated by ATC units.

NOTE: The ATC Units are requested to inform CARSAMMA the LHD reports by the 10th day of the following month even if **NO** deviation occurs.

Name of FIR _____ .

Please complete Section I or II as appropriate.

SECTION I:

There were NO reports of large altitude deviation for the month/year _____ .

SECTION II:

There was (were) ____ report(s) of a height deviation of 300ft or more between FL 290 and FL410. Details of the height deviation are attached (Large Deviation Report Form).

(Please use a separate form for each report of height deviation).

SECTION III:

When complete, please return to the following address by the next business day:
CARIBBEAN AND SOUTH AMERICA MONITORING AGENCY - CARSAMMA
AV. GENERAL JUSTO, 160/Térreo - CENTRO
22295-090 - RIO DE JANEIRO - RJ
Telefone: (55-21) 2101-6358 Fax: (55-21) 2101-6293
E-Mail: carsamma@decea.gov.br

NOTES TO AID COMPLETION OF CARSAMMA F4 FORM

SPECIFICATION OF THE FIELDS:

1. ENTER TODAY´S DATE.
2. ENTER THE 4 (FOUR) LETTER ICAO IDENTIFIER FOR THE FIR OR ENTER THE NAME OF THE REPORTING UNIT.
3. ENTER THE OPERATOR´S 3 (THREE) LETTER ICAO IDENTIFIER. FOR INTERNATIONAL GENERAL AVIATION, ENTER "IGA".
4. ENTER THE CALL SIGN AND THE ACFT REGISTRATION NUMBER.
5. ENTER THE ICAO DESIGNATOR AS CONTAINED IN ICAO DOC 8643, E.G., FOR AIRBUS A320-211, ENTER A320; FOR BOEING B 747-438, ENTER B744.
6. ENTER "YES" OR "NO". IF "YES", INFORM THE FLIGHT LEVEL.
7. ENTER THE DATE OF OCCURRENCE.
8. ENTER THE TIME UTC OF OCCURRENCE.
9. ENTER THE OCCURRENCE POSITION (FIX, LAT/LONG OR RADIAL AND NAUTICAL MILES).
10. SELECT ONE OPTION IF: **IMC** - INSTRUMENT CONDITION, **VMC** – VISUAL CONDITION.
11. ENTER THE CLEARED ROUTE OF FLIGHT (IN CASE OF DIRECT OR ALEATORIC FLIGHTS, ENTER "DCT").
12. ENTER THE CLEARED FLIGHT LEVEL.
13. ENTER THE ESTIMATED DURATION AT INCORRECT FLIGHT LEVEL (IN SECONDS).
14. ENTER THE OBSERVED DEVIATION IN FEET (FOR UPWARDS DEVIATIONS, WRITE "+", FOR DOWNWARDS DEVIATIONS, WRITE "-").
15. ENTER THE OTHER TRAFFIC INVOLVED, IF ANY (CALL SIGN, REGISTRATION NUMBER, FLIGHT LEVEL, AIRCRAFT TYPE, ROUTE and DISTANCE).
16. ENTER THE CAUSE OF DEVIATION ACCORDING TO THE TABLE BELOW:

A - Failure to climb / descend as cleared.	**I -** ATC system loop error; (e.g.: Pilot misunderstands clearance message or ATC issues incorrect clearance).
B - Climb / descend without ATC clearance.	**J -** Equipment control error encompassing incorrect operation of fully functional FMS or navigation system; (e.g.: By mistake the pilot incorrectly operates INS equipment).
C - Entry into airspace at an incorrect flight level.	**K -** Incorrect transcription of ATC clearance or re-clearance into the FMS.
D - Deviation due to turbulence or other weather related cause.	**L -** Wrong information faithfully transcribed into the FMS; (e.g.: Flight plan followed rather than ATC clearance or original clearance followed instead of re-clearance).
E - Deviation due to equipment failure.	**M -** Error in ATC-unit to ATC-unit transition message.
F - Deviation due to collision avoidance system (ACAS/TCAS) advisory.	**N -** Negative transfer received from transitioning ATC-unit.
G - Deviation due to contingency event.	**O -** Other.
H - Aircraft not approved for operation in RVSM restricted airspace.	**P -** Unknown.

17. ENTER THE OBSERVED/REPORTED FINAL FLIGHT LEVEL, PROVIDING THE SOURCE OF INFORMATION (MODE C AND/OR PILOT).
18. and 19. SELECT ONE OF THE OPTIONS: IF THE AIRCRAFT WAS ABOVE OR BELOW THE CLEARED LEVEL.
20. SELECT ONE OF THE OPTIONS: IF THE FL COMPLIED WITH THE ICAO ANNEX 2 TABLES OF CRUISING LEVELS.
21. WRITE A BRIEF DESCRIPTION OF DEVIATION.
22. WRITE THE CREW COMMENTS, IF ANY.

The information contained in this form is confidential and will be used for statistical safety analysis purposes only.

CARSAMMA F4 FORM
LARGE HEIGHT DEVIATION

Report to the CARSAMMA of an altitude deviation of 300ft or more, including those due to TCAS, Turbulence and Contingency Events

1. Today's date:	2. Reporting Unit:		
DEVIATION DETAILS			
3. Operator Name:	4. Call Sign: ACFT Registration Number:	5. Aircraft Type:	6. Mode C/ADS Displayed: ❑ Yes. Which FL? _____ ❑ No.
7. Date of Occurrence:	8. Time UTC:	9. Occurrence Position (lat/long or Fix):	10. Weather Conditions: ❑ VMC ❑ IMC
11. Cleared Route of Flight:			
12. Cleared Flight Level:	13. Estimated Duration at Incorrect Flight Level (seconds):		14. Observed Deviation (+/- ft):
15. Other Traffic Involved and Distance:			
16. Cause of Deviation (*brief title*): (Examples: ATC Loop Error, Turbulence, Weather, Equipment Failure)			
AFTER DEVIATION IS RESTORED			
17. Observed/Reported Final Flight Level*: *Please indicate the source of information: ❑ Mode C ❑ ADS ❑ Pilot ❑ Other	Mark the appropriate Box 18. Is the FL above the cleared level: ❑ 19. Is the FL below the cleared level: ❑		20. Did this FL comply with the ICAO Annex 2 Tables of Cruising Levels? ❑ Yes ❑ No

NARRATIVE
21. Detailed Description of Deviation (*Please give your assessment of the actual track flown by the aircraft and the cause of the deviation.*)

22 - CREW COMMENTS (IF ANY)

When complete, please return to the following address by the next business day:
CARIBBEAN AND SOUTH AMERICA MONITORING AGENCY - CARSAMMA
AV. GENERAL JUSTO, 160/Térreo - CENTRO
22295-090 - RIO DE JANEIRO - RJ
Telefone: (55-21) 2101-6358 Fax: (55-21) 2101-6293
E-Mail: carsamma@decea.gov.br