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**CAR/SAM Planning and Implementation Regional Group (GREPECAS)  
Twenty Fourth Scrutiny Working Group Meeting (GTE/24)  
Mexico City, Mexico, 5 to 9 August 2024**

**Agenda Item 3: Review of the Results of Large Height Deviation (LHD) and the Collision Risk Model (CRM) Analysis**

**SAFETY EVALUATION OF THE RVSM AIRSPACE OF THE CAR/SAM FIR**

(Presented by CARSAMMA)

<b>EXECUTIVE SUMMARY</b>	
This Paper presents a summary of the Large Height Deviation (LHD) reports received by CARSAMMA, and the analysis with the OSMS/SMS methodology proposed by ICAO and reaffirmed during the GREPECAS meeting as a recommendation for its application by CARSAMMA in the CAR/SAM Regions.	
<i>Strategic Objectives:</i>	<ul style="list-style-type: none"><li>• Safety</li></ul>
<i>References:</i>	<ul style="list-style-type: none"><li>• DOC 9574 – Manual on a minimum vertical separation of 300 m (1000 ft) between FL290 and FL410 inclusive.</li><li>• DOC 9937 – Operational procedures and methods for regional surveillance agencies regarding the use of a minimum vertical separation of 300m (1000 feet) between FL290 and FL410 inclusive.</li><li>• 2023 Large Height Deviations (LHD) Report.</li></ul>

**1. Introduction**

1.1 This report provides a summary of the safety assessment of RVSM airspace in CAR/SAM FIRs. This safety assessment covers the 12 months of 2023.

**2. Presentation of data**

2.1 Several LHD reports accumulated during these 12 months and having a risk value between 39 and 51 were used in this security assessment. For more details on the reports, the FIRs involved, the risk value and duration, see the **Annex** to this working paper.

### 3. Summary of LHD occurrences

3.1 Table 1 shows the summary of the LHD reports that arrived, those validated by CARSAMMA, the total duration in minutes, the median duration for each of them and the median VR - associated with monthly LHDs.

Observation<sup>1</sup>: The VRs for January and August will not be included in the analysis because they are outside the scope of the study (see item 4.3 and Table 4).

Observation<sup>2</sup>: LHDs classified with the "L" code were those in which, on the day of the flight, the aircraft did not have the RVSM status approval certification in force. Therefore, in addition to the coding sent by the PoC, these reports were also classified with the code "L" (An aircraft that is not RVSM approved and is provided RVSM separation).

MES	CANTIDAD DE REPORTE LHD RECIBIDOS	CANTIDAD DE REPORTE LHD VALIDADOS + CODIGOS "L" GERADOS	DURACIÓN TOTAL (min.)	DURACIÓN MEDIA (min.)	RIESGO MEDIANO	MAYOR VALOR DE RIESGO
JANEIRO	67	57 + 3 = 60	49,0	0,82	19,7	34
FEVEREIRO	77	66 + 5 = 71	99,0	1,39	19,8	39
MARÇO	68	50 + 7 = 57	323,5	5,68	23,8	51
ABRIL	74	60 + 6 = 66	85,0	1,29	21,8	46
MAIO	78	63 + 10 = 73	107,0	1,47	21,2	46
JUNHO	51	37 + 5 = 42	78,0	1,86	23,4	46
JULHO	61	46 + 3 = 49	96,7	1,97	21,2	51
AGOSTO	35	25 + 4 = 29	29,2	1,01	21,3	31
SETEMBRO	48	35 + 6 = 41	67,0	1,63	21,3	41
OUTUBRO	58	37 + 11 = 48	65,0	1,35	23,6	41
NOVEMBRO	54	46 + 19 = 65	80,0	1,23	23,2	47
DEZEMBRO	62	54 + 15 = 69	73,0	1,06	22,3	41
<b>TOTAL</b>	<b>733</b>	<b>670</b>	<b>1.150,3</b>	<b>1,72</b>	<b>21,8</b>	

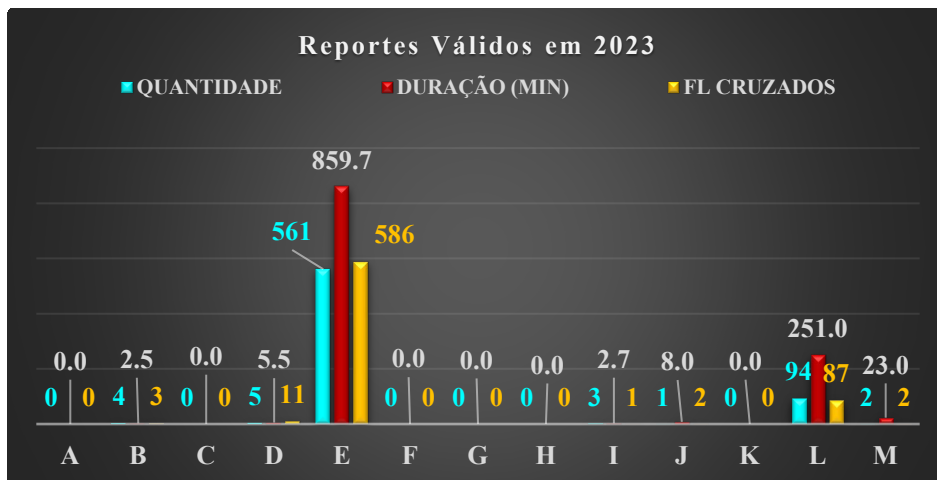
Tabla 1: Número de LHD, duración (min), duración media, riesgo medio y VR más alto por mes.

3.2 In figure 1 below, we have the FIRs in the CAR/SAM Regions and the number of LHDs reported by them in 2023, that is, the number of times that that FIR was affected by the failure of a neighbouring FIR.



Figure 1: Number of LHDs reported per FIR in 2023.

3.3 Graph 2 shows the number of LHD reports, the total duration (in minutes) associated with the LHD, the number of flight levels crossed without authorization and the total VR, by LHD code in 2023.



Graph 2: Summary of LHD occurrences, duration, crossover levels and total VR by LHD code

3.4 LHDs with Code "E" (error/failure/no coordination between ATC organizations) were the most frequent in 2023, with 561 incidents, followed by Code "L" (non-RVSM approved aircraft), with 94 incidents. The high number of "E" Codes demonstrates the need to improve coordination between adjacent air traffic agencies, which could be achieved through awareness raising and coordination training among controllers. Despite the use of a tool for automatic transfers (AIDC or AMHS), this system still depends on human interaction and failures may exist.

#### 4. Assessment of Risk Value (VR)

4.1 This section updates the results of the RVSM airspace safety assessment in the CAR/SAM FIRs. Therefore, the methodology for assessing risk value (OSMS/SMS) is applied to the internationally accepted safety assessment of this airspace.

4.2 The quantity and starting material for estimating the values of each parameter inherent to the internationally accepted risk value (VR), which were used to carry out the safety assessment in the RVSM space, are summarized in the following formula and described in table 3.

$$VR = (P * D * S) + R + W + T$$

Parameter	Description	Value
<b>VR</b>	Risk Value	To calculate
<b>P</b>	Probability of occurrence in the Position	Varies from 1 to 5 points
<b>D</b>	Duration of the event	Varies from 1 to 3 points
<b>S</b>	Severity or Severity of the Event (code)	Varies from 1 to 5 points
<b>R</b>	Point WITH or WITHOUT RADAR or ADS coverage	WITH coverage = 0 point WITHOUT coverage = 5 points
<b>W</b>	Weather Conditions (METEOROLOGY)	VMC = 0 / BMI = 5
<b>T</b>	Other Transit (if any)	WITH RADAR or ADS = 5 WITHOUT RADAR or ADS = 10
	<b>TOTAL</b>	<b>Maximum of 100 points</b>

Table 3: Calculation of Risk Value parameters

4.3 The results of the CAR/SAM airspace safety assessment were distributed by FIR in the following table, all values of our sample with VR between 39 and 51 points.

MÊS / FIR	LoS	SPIM	SAEU	SAVU	SBCW	MPZL	SKED	SEFG	SLLF	TJZS	MTEG	SVZM	TTZP	SBAZ	SACU	SCFZ
JAN	20															
FEV	20	#141 VR = 39														
MAR	20		#150 VR = 51	#151 VR = 46	#155 VR = 46	#159 VR = 46	#202 VR = 51	#206 VR = 39								
ABR	20							#217 VR = 46	#237 VR = 39	#270 VR = 41	#286 VR = 39					
MAI	20	#325 VR = 39 #347 VR = 46		#336 VR = 46								#363 VR = 39				
JUN	20						#397 VR = 39	#409 VR = 46					#384 VR = 44			
JUL	20												#476 VR = 51 #476L VR = 42			
AGO	20															
SET	20										#513 VR = 41					
OUT	20						#575 VR = 39		#563 VR = 39	#571 VR = 41					#572 VR = 39	#607 VR = 39
NOV	20	#652 VR = 39							#636 VR = 39 #650 VR = 47		#627 VR = 39 #632L VR = 39					
DEZ	20						#681 VR = 39 #712 VR = 41		#693 VR = 39 #708 VR = 39			#675 VR = 39		#706 VR = 39		

Table 4: Higher monthly risk values in the CAR SAM FIR and one outside our region.

4.4 In the following graph, the green line represents the level of security (LoS) that must be achieved with a VR less than or equal to 20 and, as we have seen in the tables and graphs already presented, this value has sometimes been higher. In this study, we have only taken VR equal to or greater than 39 as an example.

4.5 In March, in FIR EZEIZA and BOGOTÁ the VR = 51 and in September in FIR AMAZÔNICA. In November, FIR LA PAZ had VR = 47 and with VR = 46, in March in FIR COMODORO RIVADAVIA, CURITIBA and PANAMA, in April in FIR GUAYAQUIL, in May in FIR COMODORO RIVADAVIA and LIMA and in June in FIR GUAYAQUIL.

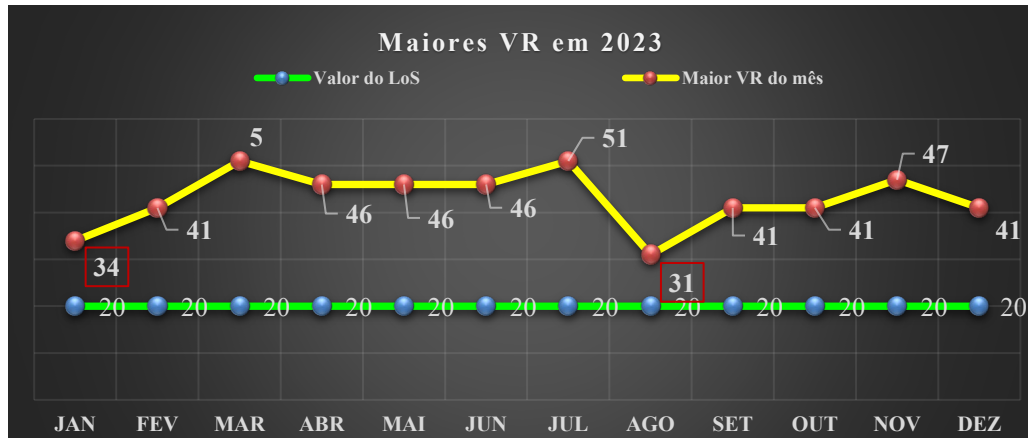


Chart 3: Highest individual LHD risk value by month in 2023

4.6 Graph 4 shows the number of LHD events contributing to each CAR/SAM FIR in terms of suffering and risk generation in 2023.

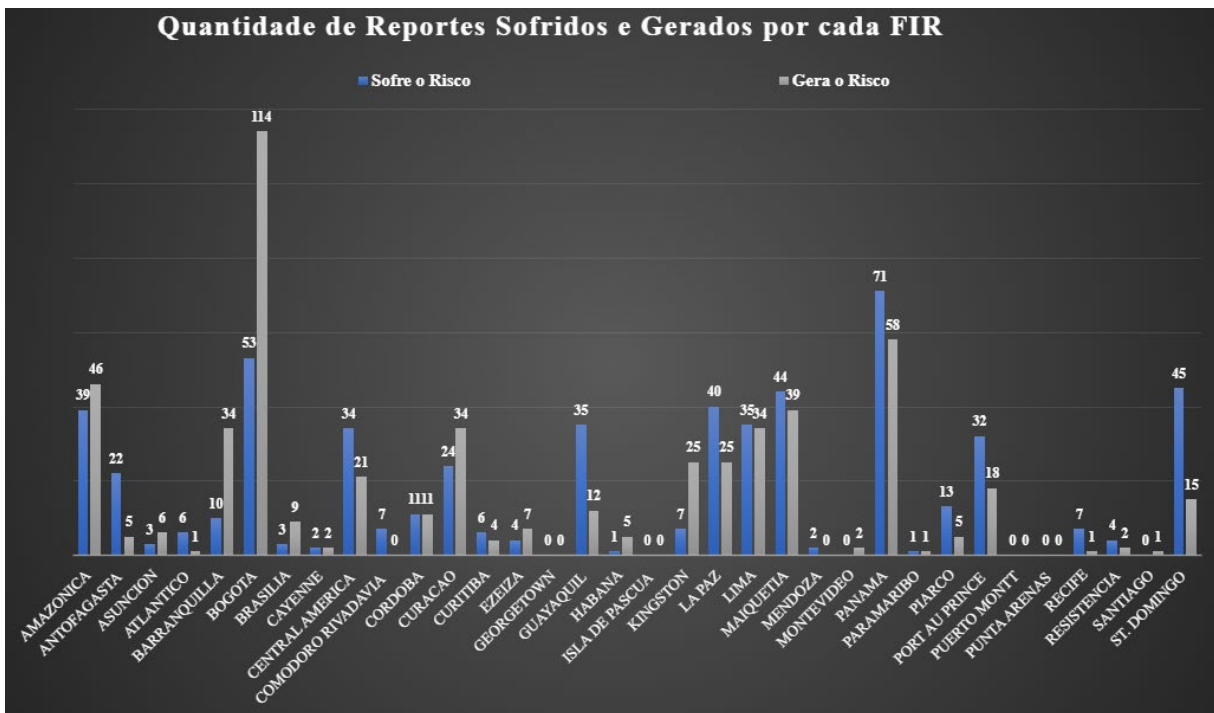


Chart 4: Contribution of LHD reports per FIR

## 5. Analysis of operational security (OSMS/SMS) of LHDs

5.1 Table 5 details the LHD operational errors received and evaluated by CARSAMMA in 2023 that had a risk value (VR) greater than LoS (> 20).



GUAYAQUIL (43)	BOGOTA	25	46	PULTU - 46 TEMOX - 46	ANRAX (3)	BOKAN (6)	ENSOL (2)	PULTU (3)	TEMOX (1)	UGUPI (9)	LIXAS (1)			
	CENTRAL AMERICA	11	39	OSELO - 39	LIXAS (7)	OSELO (2)	UGADI (2)							
	LIMA	7	26	ANPAL - 26	ANPAL (2)	ARNEL (2)	TOSES (2)	VAKUD (1)						
LA PAZ (47)	AMAZONICA	25	39	EROGI - 39 RCO - 39	AKVOR (4)	ARMUK (1)	EROGI (2)	GEDUS (1)	ILRES (2)	RCO (14)	UBKAB (1)			
	APP VIRU VIRU	1	23	LODAK - 23	LODAK (1)									
	ASSUNÇÃO	4	34	BUXOR - 34 SIDAK - 34	BUXOR (1)	MOMDI (1)	OROM (1)	SIDAK (1)						
	CÓRDOBA	9	39	PUBUM - 39	GESPA (3)	PUBUM (4)	UBSAS (2)							
	CURITIBA	3	39	SIDAK - 39	SIDAK (3)									
	LIMA	3	39	RAXUN - 39	ORALO (2)	RAXUN (1)								
	PILOTO	1	47	RCO - 47	RCO (1)									
	RESISTENCIA	1	31	PILCO - 31	PILCO (1)									
LIMA (38)	AMAZONICA	7	22	LET - 22 ISIDI - 22	ISIDI (5)	LET (2)								
	ANTOFAGASTA	5	31	ESDIN - 31	ALDAX (2)	ESDIN (1)	IREMI (2)							
	BOGOTA	12	46	PLG - 46	PLG (5)	ROLUS (7)								
	GUAYAQUIL	7	31	LOBOT - 31	ANPAL (1)	LOBOT (3)	MOXOM (1)	TERAS (1)	VAKUD (1)					
	LA PAZ	7	39	DOBNI - 39 VURUS - 39	DOBNI (4)	OBLIR (1)	ORALO (1)	VURUS (1)						
MAIQUETIA (53)	AMAZONICA	12	34	VAGAN - 34 VUMPI - 34	PAKON (1)	UGAGA (4)	VAGAN (3)	VUMPI (4)						
	BARRANQUILLA	5	31	KONSO - 31	DALEX (1)	KONSO (3)	REBIM (1)							
	BOGOTA	29	39	KIKAS - 39	ENPUT (12)	KIKAS (9)	OPRUS (5)	PAY (3)						
	CURACAO	4	22	ALCOT - 22	ALCOT (1)	ESIPO (1)	VODIN (2)							
	PIARCO	1	17	ILVAS - 17	ILVAS (1)									
	SAN JUAN	2	39	MILOK - 39	MILOK (2)									
PANAMA (79)	BARRANQUILLA	23	21	ISIMO - 21	AGUJA (7)	ALPON (1)	BITIX (1)	BOGAL (7)	ESEDA (5)	ISIMO (2)				
	BOGOTA	41	22	ARORO - 22 BUSMO - 22 BUXOS - 22	ARORO (8)	BUSMO (7)	BUXOS (10)	IRASO (3)	OGLUT (1)	SIGN (6)	TOKUT (6)			
	CENTRAL AMERICA	9	46	OGLUT - 46	AMUBI (2)	BUFO (3)	ISEBA (1)	LESIR (1)	OGLUT (1)	PELRA (1)				
	KINGSTON	6	18	ARNAL - 18	ARNAL (3)	DAGUD (3)								
PIARCO (16)	CAYENNE	1	26	0927N05300W - 26	0927N 05300 W (1)									
	DAKAR	3	44	1825N04433W - 44	1825N 04433 W (1)	GANK (2)								
	MAIQUETIA	5	22	ITEGO - 22	ANADA (1)	ITEGO (3)	KIKER (1)							



	NEW YORK	4	34	ELJEZ - 34	ELJEZ (4)													
	PARAMARIBO	1	13	TRAPP - 13	TRAPP (1)													
	SAN JUAN	2	22	ANADA - 22	ANADA (1)													
PORT AU PRINCE (42)	HAVANA	7	31	URLAM - 31	URLAM (7)													
	KINGSTON	18	39	NOSIS - 39	KEBET (4)	NOSIS (14)												
	MIAMI	6	31	ALBEE - 31 BODLO - 31 JOSES - 31	ALBEE (1)	BODLO (1)	JOSES (4)											
	SANTO DOMINGO	11	41	PIGBI - 41	ETBOD (4)	ONPAD (1)	PIGBI (5)	RETA K (1)										
SAN JUAN (12)	MAIQUETIA	9	41	ARMUR - 41 MILOK - 41	ARMUR (2)	MILOK (7)												
	PIARCO	2	21	MODUX - 21	GEECE (1)	MODUX (1)												
	SANTO DOMINGO	1	25	BQN - 25	BQN (1)													

Table 5: LHDs evaluated as those with the highest VR in 2023. (Cells in blue)

5.2 In figure 2 we can see all the points in which the VRs were between 39 and 51 points.



Figure 2: Points where VR occurred between 39 and 51 points

5.3 In Figure 3 below we can see all the points where LHD reports occurred in 2023.

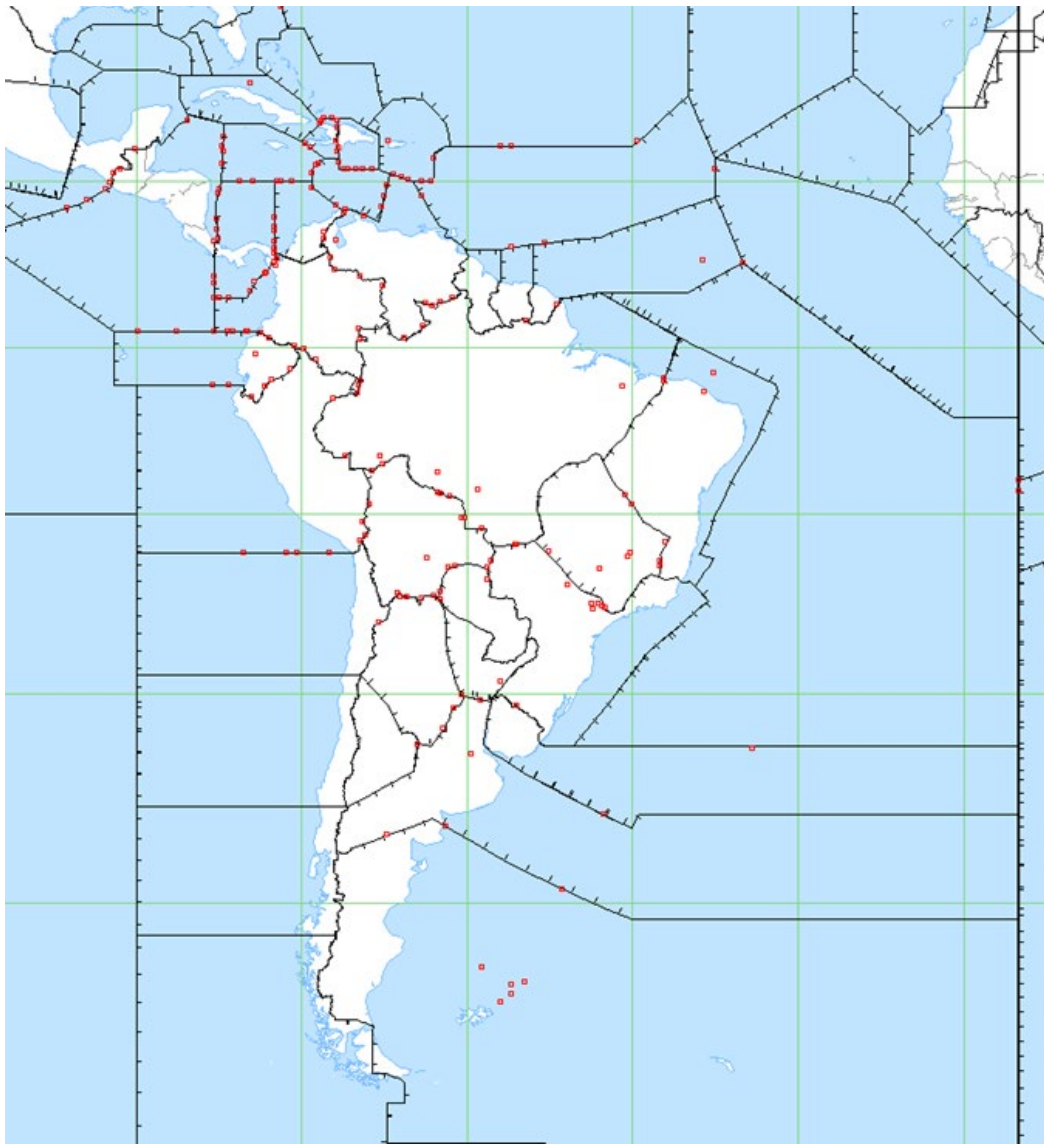
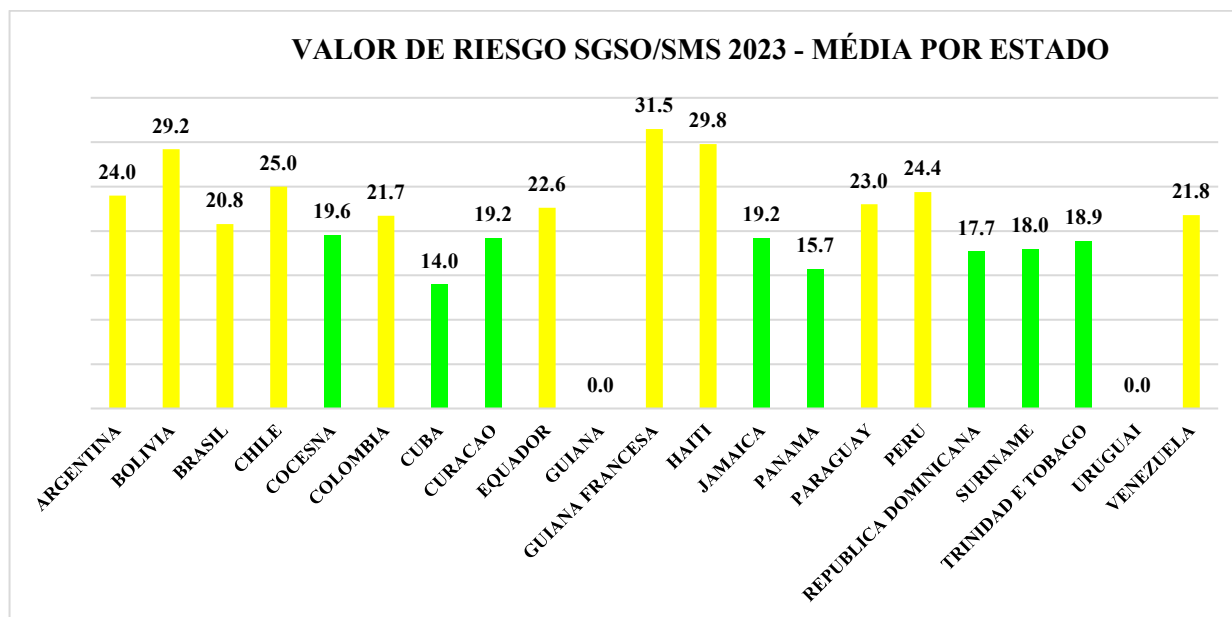
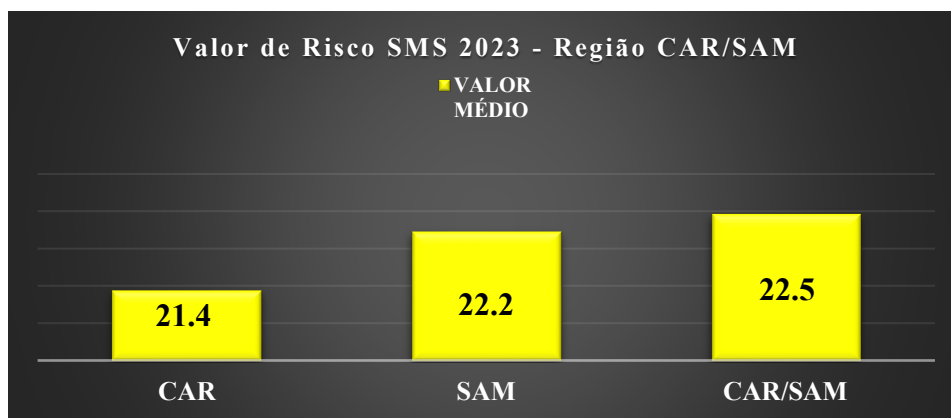


Figure 3: Points where LHD reports occurred in 2023

5.4 Graph 5 identifies the results of this analysis with an indication of the risk value assigned to the operational errors of the main altitude deviations by the State when analysing the 2023 data and Graph 6 shows the average risk value for the region CAR, SAM and CAR/SAM.



Graph 5: Contribution to the risk value by State



Graph 6: Contribution of the CAR, SAM and CAR/SAM regions to the risk value

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**APPENDIX**  
**DETAILS OF THE LHD REPORTS ANALYSED IN THIS WORKING PAPER**

1. Figures 1A and 1B show the summary of LHD occurrences validated by CARSAMMA and the duration (in minutes) associated with LHD per month.

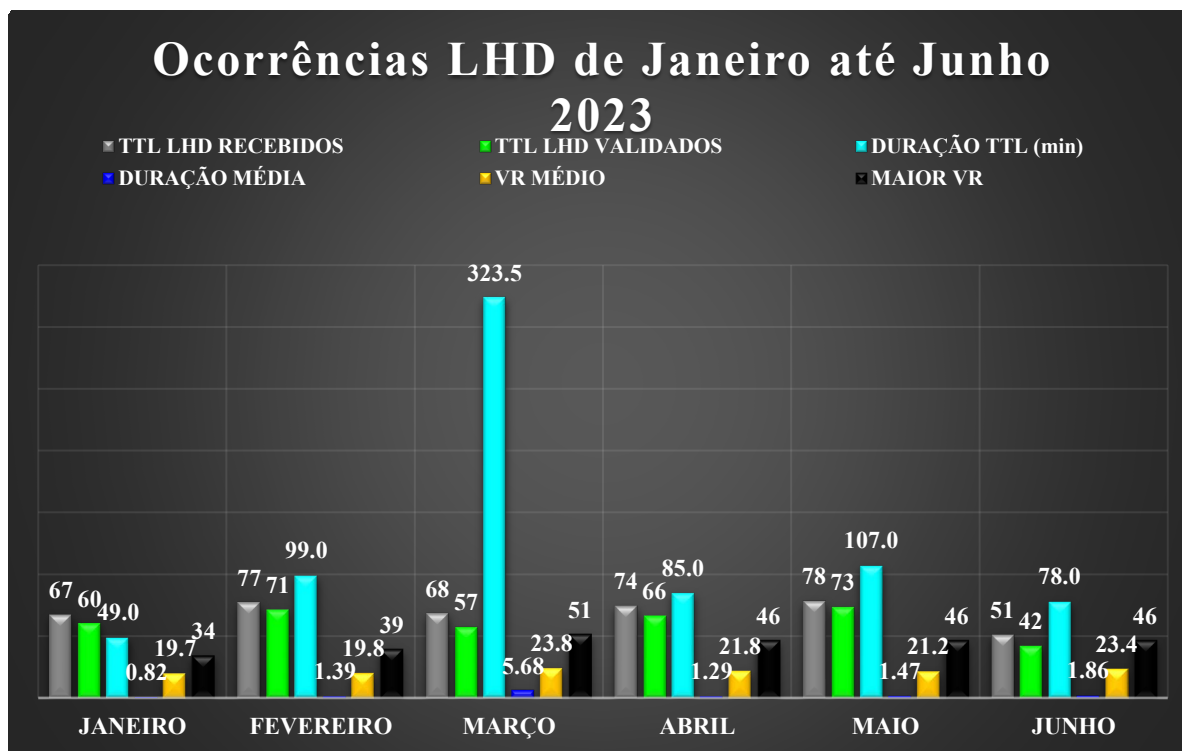


Figure 1A: Summary of CARSAMMA-validated LHD occurrences by month

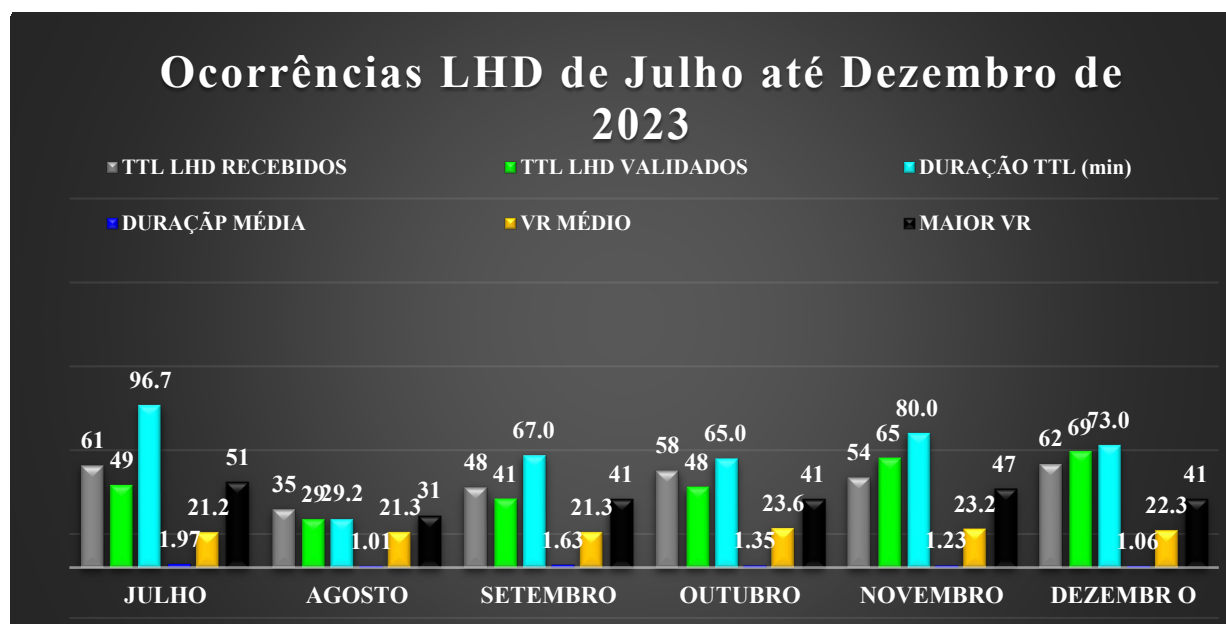


Figure 1B: Summary of CARSAMMA-validated LHD occurrences by month.

1.1 In February there was one (1) situation that lasted 90 seconds or 1.5 minutes. The total number of failures this month was 5,940 seconds or 99.0 minutes, so 1.5% of the month's duration was made with this report alone. #141 occurred between FIR LIMA and LA PAZ, DOBNI position, VR = 39.90 seconds, E2.

1.2 In March, six (6) situations occurred that, together, lasted 15,660 seconds or 261.0 minutes. The total number of failures this month was 19,410 seconds or 323.5 minutes, so 80.7% of the month's duration was made up of just these 6 reports. The first, #150, occurred between FIR EZEIZA and MONTEVIDEO, position 3905S04734W, VR = 51, 3,000 seconds E2 and for the code L aircraft. The second, #151, occurred between FIR COMODORO RIVADAVIA and EZEIZA, VR = 46, 3,900 seconds, E2 and for the code L aircraft. The third, #155, occurred between FIR CURITIBA and ASUNCION, VR = 46, 600 seconds, E2. The fourth, #159, between FIR PANAMA and CENTRAL AMERICA, OGLUT position, VR = 46, 720 seconds, E2. The fifth, #202, between FIR BOGOTÁ and PANAMÁ, OGLUT position, VR = 51, 300 seconds, E2. The sixth, #206, between FIR GUAYAQUIL and CENTRAL AMERICA, position OSELO, VR = 39 and for aircraft code L.

1.3 In April, four (4) situations occurred that, together, lasted 990 seconds or 16.5 minutes. The total number of failures this month was 5,100 seconds or 85.0 minutes, so 19.4% of the month's duration corresponded only to these 4 reports. The first, #217, occurred between FIR GUAYAQUIL and BOGOTÁ, PULTU position, VR = 46, 180 seconds, E2. The second, #237, between FIR LA PAZ and AMAZONICA, RCO position, VR = 39,540 seconds, E1. The third, #270, between FIR SAN JUAN and MAIQUETIA, MILOK position, VR = 41, 10 seconds, E2. The fourth, #286, between FIR PORT AU PRINCE and SANTO DOMINGO, PIGBI position, VR = 39, 90 seconds, E2.

1.4 In May, four (4) situations occurred that, together, lasted 2,200 seconds or 36.7 minutes. The total number of failures this month was 6,417 seconds or 106.9 minutes, so 34.3% of the month's duration corresponded to just these 4 reports. The first, #325, occurred between FIR LIMA and LA PAZ, position VURUS, VR = 39.90 seconds, E2. The second, #336, occurred between FIR COMODORO RIVADAVIA and APP MOUNT PLEASANT, position KABES, VR = 46, 1,300 seconds, E2. The third, #347, took place between FIR LIMA and BOGOTÁ, position PLG, VR = 46, 360 seconds, E2 and for aircraft code L. The fourth, #363, between FIR MAIQUETIA and SAN JUAN, position MILOK, VR = 39, 90 seconds, E2.

1.5 In June, three (3) situations occurred that, together, lasted 1,080 seconds or 18.0 minutes. The total number of failures this month was 4,680 seconds or 78.0 minutes, so 23.0% of the month's duration corresponded to just these 3 reports. The first, #384, occurred between the PIARCO and DAKAR FIRs, position 1825N 04433W, VR = 39.90 seconds, E2. The second, #397, occurred between FIR BOGOTÁ and PANAMÁ, position IRASO, VR = 39.90 seconds, E2. The third, #409, between FIR GUAYAQUIL and BOGOTÁ, TEMOX position, VR = 46,900 seconds, E2.

1.6 In July, one (1) situation occurred that lasted 2,640 seconds or 44 minutes. The total failures this month were 5,800 seconds or 96.7 minutes, so 45.5% of the month's duration was made with this report alone. #476 occurred between FIR AMAZÔNICA and BOGOTÁ, position BRACO, VR = 51, 1,320 seconds, E2 and for aircraft code L.

1.7 In October, seven (7) situations occurred that, together, lasted 1,260 seconds or 21.0 minutes. The total number of failures this month was 3,898 seconds or 65.0 minutes, so 32.3% of the month's duration corresponded to just these 7 reports. The first, #563, occurred between FIR LA PAZ and AMAZÔNICA, position RCO, VR = 39, 180 seconds, E1. The second, #564, occurred between FIR LA PAZ and CÓRDOBA, PUBUM position, VR = 39.90 seconds, E2. The third, #571, occurred between FIR SAN JUAN

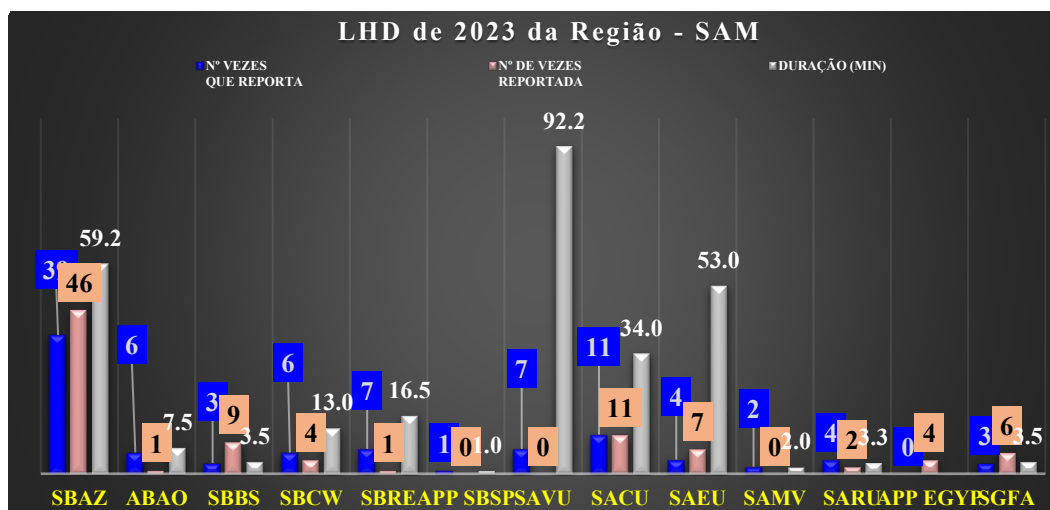
and MAIQUETIA, position MILOK, VR = 41, 480 seconds, E2 and for aircraft code L. The fourth, #572, occurred between FIR CÓRDOBA and LA PAZ, position PUBUM, VR = 39.90 seconds, E2. The fifth, #575, took place between FIR BOGOTÁ and PANAMÁ, position OGLUT, VR = 39.90 seconds, E2. The sixth, #588, took place between FIR SAN JUAN and MAIQUETIA, ARMUR position, VR = 41, 240 seconds, E2. The seventh, #607, took place between FIR ANTOFAGASTA and LIMA, SORTA position, VR = 39, 90 seconds, E2

1.8 Four (4) situations occurred in November that together lasted 360 seconds or 6.0 minutes. The total number of breakdowns this month was 4,800 seconds or 80.0 minutes, so 7.5% of the month's duration was due to these 4 reports alone. The first, #627, occurred between FIR PORT AU PRINCE and KIGSTON, NOSIS position, VR = 39.90 seconds, E2. The second, #636, took place between FIR LA PAZ and LIMA, RAXUN position, VR = 39.90 seconds, E2. The third, #650, took place between FIR LA PAZ and PILOT failure, RCO position, VR = 47.90 seconds, E2.

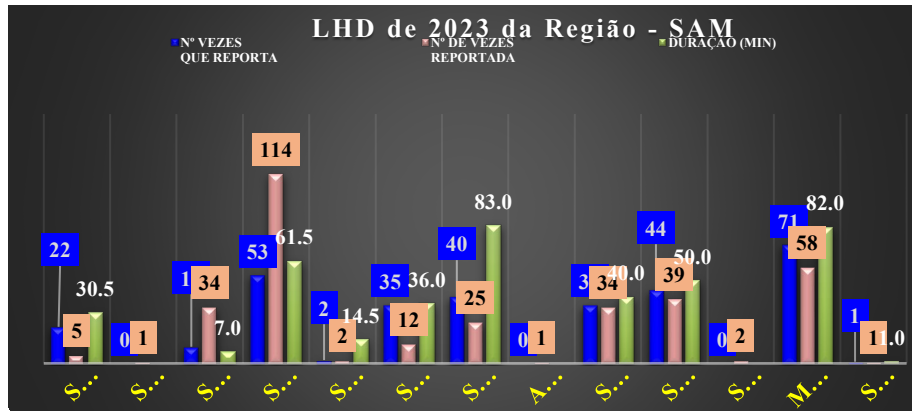
1.9 In December, six (6) situations occurred that together lasted 720 seconds or 12.0 minutes. The total absences for this month were 4,380 seconds or 73.0 minutes, so 16.4% of the month's duration corresponded to these 4 reports alone. The first, #675, occurred between FIR MAIQUETIA and BOGOTÁ, position KIKAS, VR = 39, 180 seconds, E2 and for aircraft code L. The second, #681, occurred between FIR BOGOTÁ and PANAMÁ, position OGLUT, VR = 39, 90 seconds, E2. The third, #693, occurred between FIR LA PAZ and CURITIBA, SIDAK position, VR = 39.90 seconds, E2. The fourth, #706, occurred between FIR AMAZÔNICA and BOGOTÁ, position ABIDE, VR = 39.90 seconds, E1. The fifth, #708, occurred between FIR LA PAZ and AMAZÔNICA, position EROGI, VR = 39, 90 seconds, E2 and for aircraft code L. The sixth, #712, occurred between FIR BOGOTÁ and AMAZÔNICA, position ASAPA, VR = 41, 90 seconds, E1.

1.10 As can be seen from points 1.1 to 1.9, in 2023, the FIRs that reported the most were: LA PAZ (7 times), BOGOTÁ (5 times), LIMA (4 times), GUAYAQUIL and SAN JUAN (3 times each) and the FIRs that committed the most failures and generated the most risks were: BOGOTÁ (6 times), PANAMÁ and AMAZÔNICA (4 times each), LA PAZ and MAIQUETIA (3 times each).

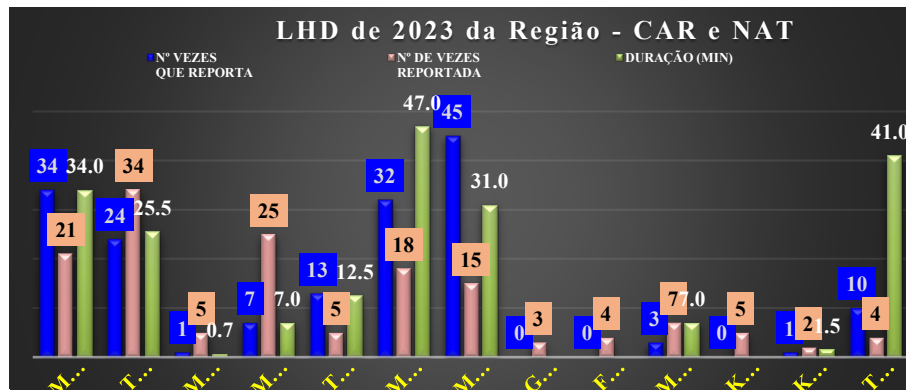
1.11 Charts 4A, 4B and 4C show the number of LHD reports that reached the RMA, the number validated and the duration in minutes, separated by the FIR that sent them.



Graph 4A: Summary of LHD incidents due to FIR in the SAM region



Graph 4B: Summary of LHD incidents due to FIR in the SAM region (continued)



Graph 4C: Summary of LHD incidents due to FIR in the CAR and NAT region

## 2 Assessment of Risk Value (VR)

2.1 Graph 5 shows the average VR values for the months of 2023.



Graph 5: Average value r of individual LHD risk per month in 2023

## 3 Analysis of operational security (OSMS/SMS) of LHDs

3.1 Some observations:

3.2 FIR COMODORO RIVADAVIA, on 2 March 2023, in position 4408S 05125W, #151, reports the highest absolute value for the duration of the event, 3,900 seconds, due to the failure of FIR EZEIZA, suffering VR = 46. The aircraft involved in this failure did not have RVSM approval on the day of the flight.

3.3 FIR EZEIZA, on 2 March 2023, at position 3905S 04734W, #150, reports the second highest absolute value for the duration of the event, 3,000 seconds due to the failure of FIR MONTEVIDEO, suffering the highest VR = 51. The aircraft involved in this failure did not have RVSM approval on the day of the flight.

3.4 FIR AMAZONICA, on 30 July 2023, in position BRACO, #476, reports the third highest absolute value for the duration of the event, 1,320 seconds, due to the failure of FIR BOGOTA, suffering the highest VR = 51. The aircraft involved in this failure did not have RVSM approval on the day of the flight.

3.5 The FIR COMODORO RIVADAVIA, on 19 May 2023, at position KABES, #336, reports the fourth highest absolute value for the duration of the event, 1,300 seconds, due to the failure of the APP MOUNT PLEASANT, suffering VR = 46.

3.6 FIR LA PAZ, on 9 February 2023, in position ORALO, #097, due to the failure of FIR LIMA suffers a VR = 34 and FIR CORDOBA, on June 5, 2023, in position UBSAS, #372, due to the failure of FIR LA PAZ, it suffers a VR = 29. Both report the fifth highest absolute value for the duration of the event, 1,200 seconds.

3.7 FIR GUAYAQUIL, on 29 June 2023, at position TEMOX, #409, reports the sixth highest absolute value for the duration of the event, 900 seconds due to the failure of FIR BOGOTA, suffering VR = 46.

3.8 FIR SAN JUAN, on 13 September 2023, at position ARMUR, #530, reports the seventh highest absolute value for the duration of the event, 780 seconds, due to the failure of FIR MAIQUETIA, suffering VR = 11.

3.9 FIR PANAMA, on 4 March 2023, at position OGLUT, #159, reports the eighth highest absolute value for the duration of the event, 720 seconds due to the failure of FIR CENTROAMERICA, suffering VR = 46.

3.10 FIR CURITIBA, on 3 March 2023, in position REMEK, #155, due to a failure of FIR ASSUNÇÃO, suffers a VR = 46 and FIR RECIFE, on September 22, 2023, in position 0217S 03738W, # 541, due to an AIR EQUIPMENT failure, suffers a VR = 13. Both report the ninth highest absolute value for the duration of the event, 600 seconds.

3.11 FIR LA PAZ, on 9 April 2023, at RCO position #237, reports the tenth highest absolute value for the duration of the event, 540 seconds due to the failure of FIR AMAZONICA, suffering VR = 39.