International Civil Aviation Organization

Thirtieth Meeting of the Regional Airspace Safety Monitoring Advisory Group (RASMAG/30)

Bangkok, Thailand, 14 – 17 July 2025

Agenda Item 3: Reports from Asia/Pacific RMAs and EMAs

JASMA VERTICAL SAFETY REPORT

(Presented by JASMA)

SUMMARY

This paper presents the results of the vertical safety assessment of the Reduced Vertical Separation Minimum (RVSM) airspace in the Fukuoka Flight Information Region (FIR) by the Japan Airspace Safety Monitoring Agency (JASMA) for the period from January to December 2024.

1. INTRODUCTION

1.1 This paper provides the executive summary of the airspace safety oversight assessment undertaken by the Japan Airspace Safety Monitoring Agency (JASMA) for the Reduced Vertical Separation Minimum (RVSM) implementations in the Fukuoka Flight Information Region (FIR), which is a part of the Pacific Ocean Airspace and North-East Asia Airspace. The report is detailed in **Attachment A**.

2. DISCUSSION

2.1 The report shows the estimated risk of RVSM airspace in Fukuoka FIR for the reporting period from 1 January 2024 to 31 December 2024 was 4.91 x 10^{-9}, which was below the Target Level of Safety (TLS) 5.0 x 10^{-9}.

Executive Summary

2.2 **Table 1** summarizes Japanese airspace RVSM technical, operational, and total risks. **Figure 1** presents collision risk estimate trends during the period from January 2024 to December 2024.

Table 1: Japanese Airspace RVSM Risk Estimates

Japanese Airspace – estimated annual flying hours = 1,794,073 hours *(note: estimated hours based on Dec 2024 traffic sample data)*			
Source of Risk	**Risk Estimation**	**TLS**	**Remarks**
RASMAG 29 Total Risk	*2.36 x 10^{-9}*	*5.0 x 10^{-9}*	*Below TLS*
Technical Risk	0.32 x 10^{-9}	2.5 x 10^{-9}	Below Technical TLS
Operational Risk	4.58 x 10^{-9}	-	-
Total Risk	**4.91 x 10^{-9}**	5.0 x 10^{-9}	**Below TLS**

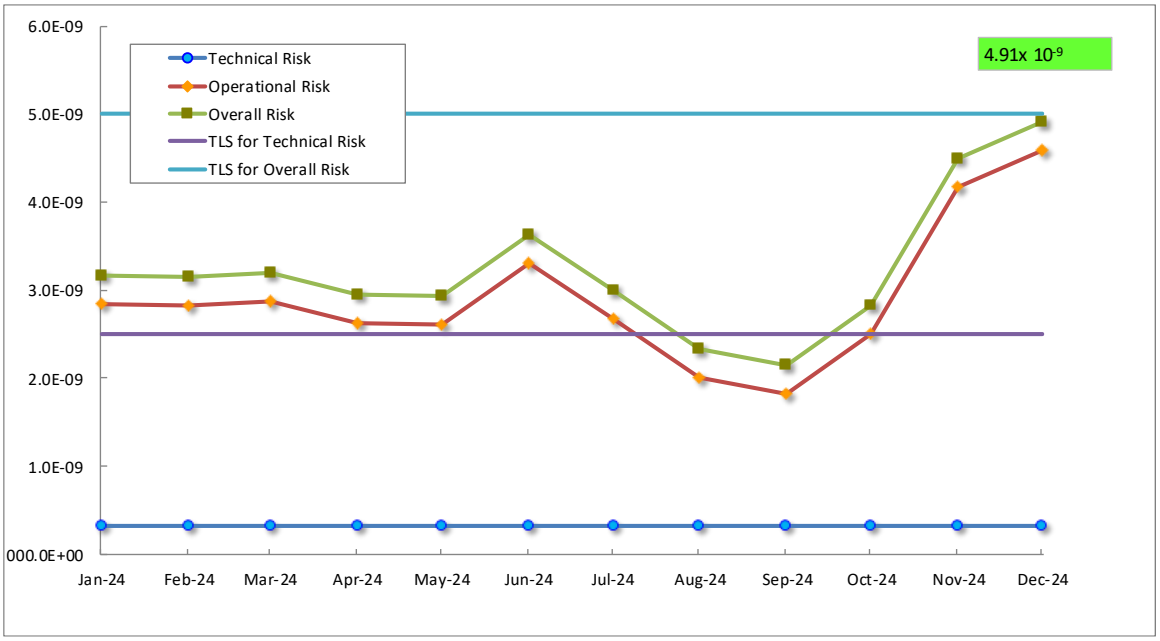


Figure 1: Japanese Airspace RVSM Risk Estimate Trends

2.3 **Table 2** presents a summary of the LHD causes within Japanese airspace from January 2024 until December 2024.

Table 2: Summary of LHD Causes within Japanese Airspace

Code	LHD Category Description	No.
A	Flight crew fails to climb or descend the aircraft as cleared	5
B	Flight crew climbing or descending without ATC clearance	3
C	Incorrect operation or interpretation of airborne equipment	1
D	ATC system loop error	3
E	Coordination errors in the ATC -to-ATC transfer of control responsibility as a result of human factors issues	2
F	ATC transfer of control coordination errors due to technical issues	0
G	Aircraft contingency leading to sudden inability to maintain level	1
H	Airborne equipment failure and unintentional or undetected level change	1
I	Turbulence or other weather related cause leading to unintentional or undetected change of flight level	15
J	TCAS resolution advisory; flight crew correctly climb or descend following the resolution advisory	17
K	TCAS resolution advisory; flight crew incorrectly climb or descend following the resolution advisory	0
L	An aircraft being provided with RVSM separation is not RVSM approved	0
M	Others	0
Total		48

2.4 **Figure 2** provides the geographic location of risk bearing LHD reports within Japanese airspace, Fukuoka FIR during the assessment period. The filled blue square symbols represent LHD location in the RVSM stratum of Fukuoka FIR. The circle size means that the duration of LHD is 50 seconds or more, and the size of circle is proportionally large according to the deviation time.

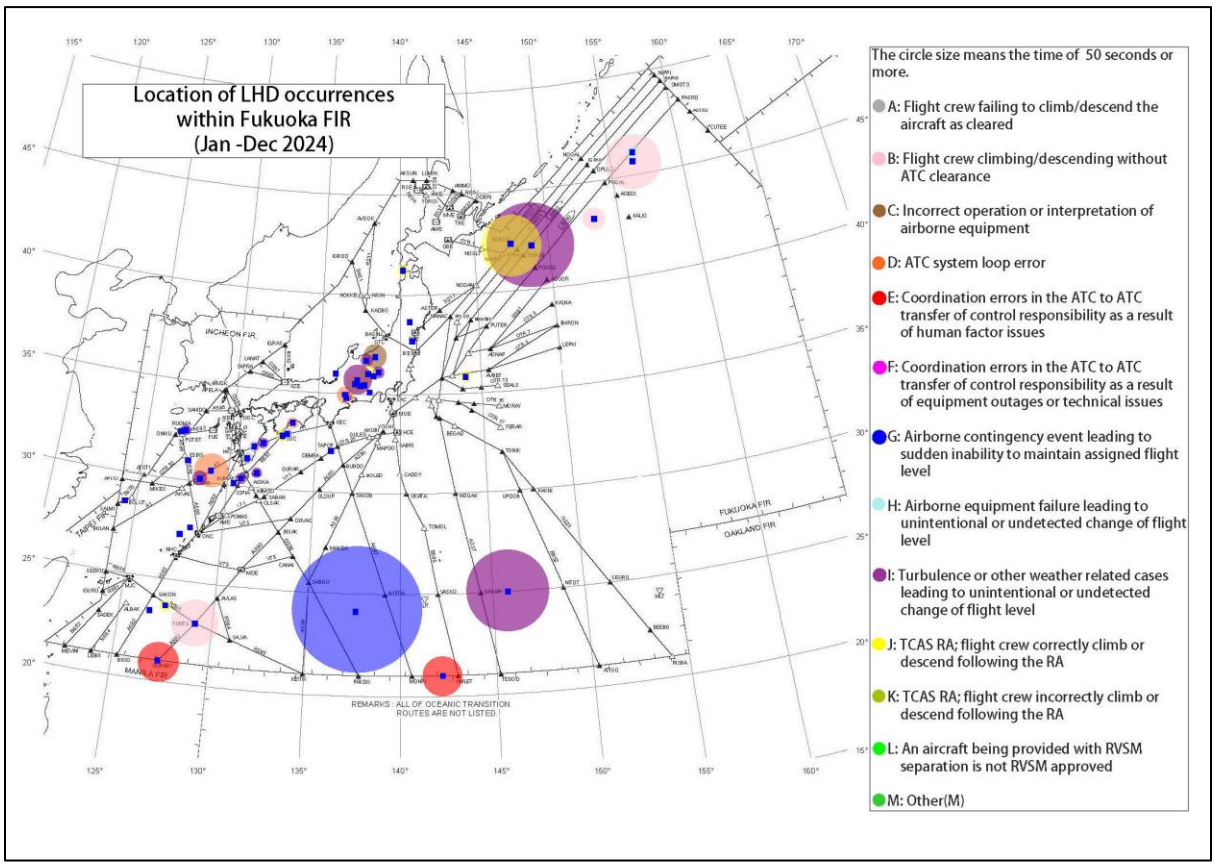
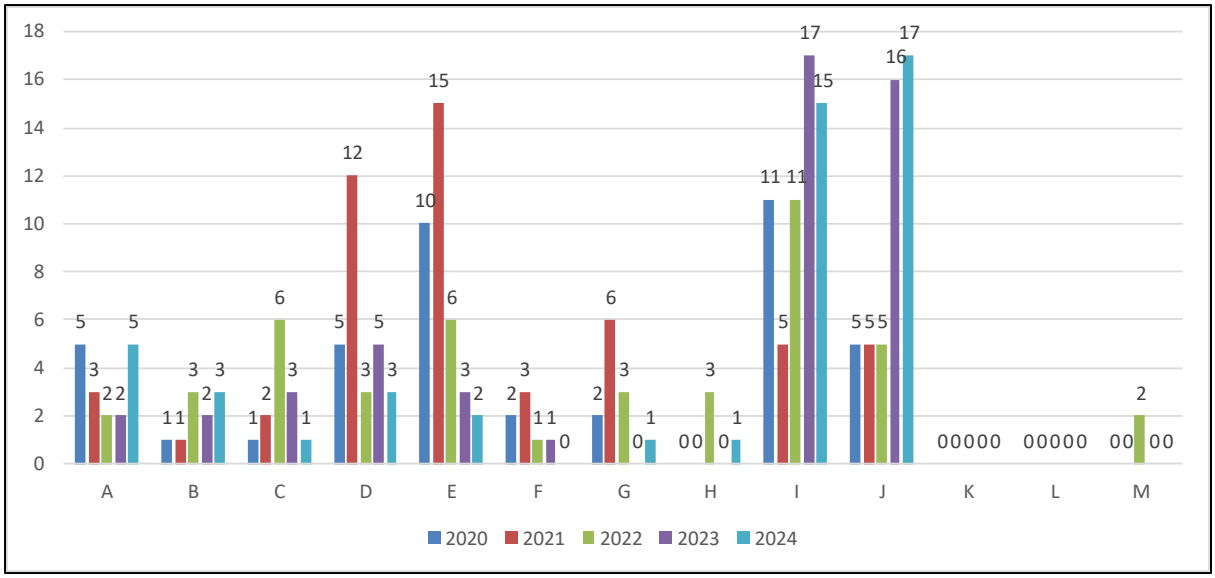


Figure 2: Geographical Location of LHDs within Fukuoka FIR

2.5 Figure 3 shows the comparing the number of LHDs by category from the calendar year 2020 to 2024. In general, the number of LHDs in 2024 decrease from 2023, however, the total duration time of LHDs in 2024 was longer than in 2023.

Figure 3: Comparing LHDs by category from 2020 to 2024



2.6 JASMA has analyzed the trends and changes of LHDs as follows.

a) In Category A LHDs, “Flight crew failing to climb/descend the aircraft as cleared,” there were 5 occurrences in 2024, increased from 2 in 2023.

b) The number of Category B LHDs, “Flight crew climbing/descending without ATC clearance,” was 3, increased from 2 in 2023.

c) It was shown in the number of Category C LHDs, “Incorrect flight level provided due to incorrect operation or interpretation of airborne equipment,” decreased from 3 in 2023 to 1 in 2024.

d) The number of Category D LHDs, “ATC system loop error,” decreased from 5 in 2023 to 3 in 2024.

e) The number of Category E LHDs, “ATC transfer error due to human factors,” plummeted from 15 in 2021 to 3 in 2023, and further declined to 2 in 2024, recorded the smallest number in the last five years.

f) The number of Category G LHDs, “Aircraft contingency leading to sudden inability to maintain level,” occurred one case in 2024. The deviation time was 28 minutes. The cause of LHD was the aircraft's pressurization system trouble, which requested to descent from FL360 to FL100, however ATC clearance could not be issued for maintaining separation with other aircraft. Therefore, the aircraft declared emergency to have descended to FL100.

g) In Category I LHDs, “Turbulence or bad weather,” slightly decreased from 17 in 2023 to 15 in 2024. Approximately half of Category I LHD occurrences were reported in the Pacific Ocean airspace in Fukuoka FIR, and the duration times are longer than those in the continental airspace where covered with en-route surveillance system. The reason of the different of duration time is thought to be that Pacific Ocean airspace is not covered by the en-route surveillance system, therefore ATC has longer time to response aircraft requests.

h) The number of Category J LHDs, “TCAS resolution advisory and flight crew correctly following the resolution advisory,” slightly increased from 16 in 2023 to 17 in 2024.

2.7 According to the ICAO’s proposal and the RASMAG Chair’s suggestion, “RMAs/EMAs consider the percentage value of traffic volume recovery since 2019 and include traffic trend evaluation in their safety reports in order to assist RASMAG in the re-examination of current LHD Hot Spots,” at the Tenth Meeting of the RASMAG Monitoring Agencies Working Group (RASMAG/MAWG/10), **Figure 4** shows the trend of traffic volume in Fukuoka FIR from 2008 to 2024.

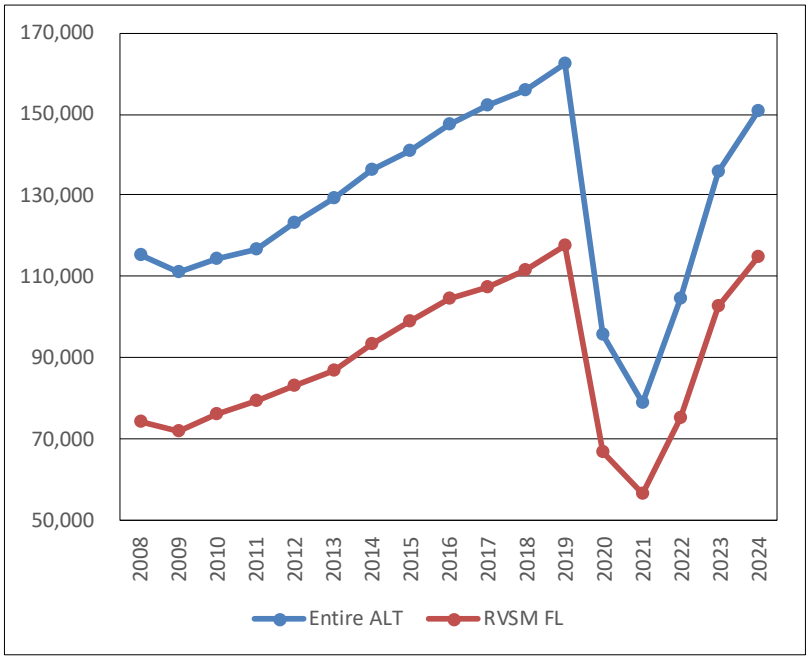


Figure 4: Traffic volume in Fukuoka FIR from 2008 to 2024

2.8 The total traffic volume of Fukuoka FIR shows a solid recovery from 2021, in 2024 it was approximately 93% of it in 2019, which was a peak traffic volume before the COVID-19 pandemic. On the other hand, the traffic volumes of the RVSM altitude stratum in 2025 will be expected to exceed the volume in 2019.

Hot Spot D1 (FIR Boundary between Fukuoka and Manila FIRs)

2.9 **Figure 5** presents the number of LHD occurrences at the FIR boundary between Fukuoka FIR and Manila FIR, where designated a Hot Spot D1.

2.10 One LHD of category E occurred while transferring from Manila ACC to Fukuoka ACC in 2024.

2.11 In order to mitigate transfer error caused by human factors at Hot Spot D1, the bilateral meetings between Fukuoka and Manila ACC have regularly been held since December 2022, encouraging mutual understanding of both ACCs. The number of LHDs at Hot spot D1 is steadily decreasing (*Appendix D). The bilateral meetings were held totally 4 times, and the next meeting will be held in the fall of 2025.

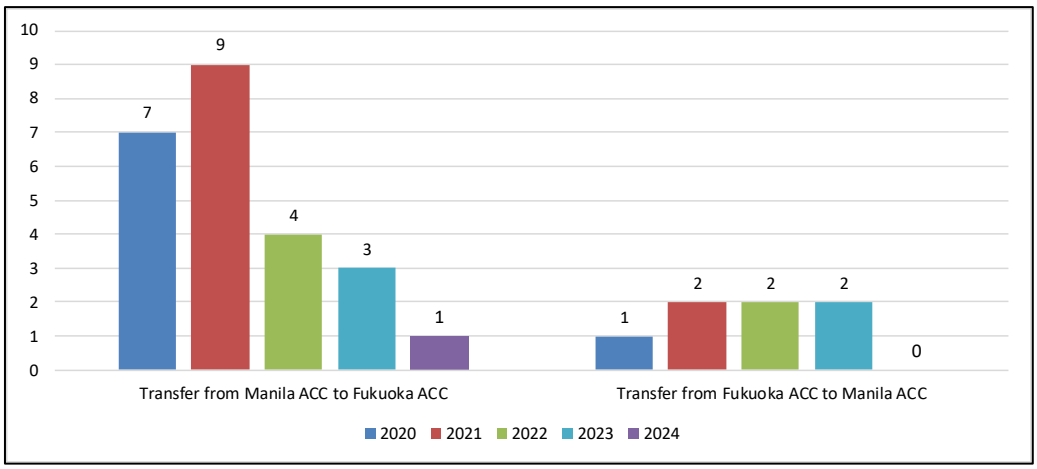


Figure 5: Number of LHDs at Hot spot D1 between Fukuoka and Manila FIR

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.

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Attachment A

AIRSPACE SAFETY REVIEW FOR THE RVSM IMPLEMENTATION IN FUKUOKA FLIGHT INFORMATION REGION

January 2024 to December 2024

(Presented by JASMA)

SUMMARY

The purpose of this report is to compare actual performance to safety goals related to the continued use of reduced vertical separation minimum (RVSM) in the Fukuoka Flight Information Region (FIR). This report contains a summary of large height deviation reports received by the Japan Airspace Safety Monitoring Agency (JASMA) and an update on the vertical collision risk for the period from January 2024 to December 2024. There are a total of 48 reported large height deviations that occurred during this period in Fukuoka FIR. The vertical collision risk estimate for the RVSM airspace in Fukuoka FIR was 4.91 x $10^{-9,}$ which was below the target level of safety (TLS).

1. INTRODUCTION

1.1 This attachment presents a summary of the Large Height Deviation (LHD) reports received by the JASMA and an update on the vertical collision risk for the period of 1 January 2024 to 31 December 2024.

2. DISCUSSION

2.1 Traffic Sample Data (TSD)

2.1.1 Traffic Sample data for December 2024 of aircraft operating in the Fukuoka FIR were used to assess the safety of RVSM airspace.

2.2 Large Height Deviation (LHD)

2.2.1 A series of cumulative 12-month LHD reports were used in this safety assessment starting from January 2024 to December 2024.

2.2.2 **Table 1** summarizes the number of LHD occurrences and associated LHD duration (in minutes) by month in the RVSM airspace of the Fukuoka FIR.

Month-Year	No. of LHD Occurrences	LHD Duration (Minutes)
January 2024	3	4.4
February 2024	1	1,0
March 2024	9	41.7
April 2024	3	6.5
May 2024	2	0.5
June 2024	4	10.0
July 2024	6	20.0

August 2024	3	19.0
September 2024	3	3.7
October 2024	6	13.3
November 2024	4	18.0
December 2024	4	9.5
Total	**48**	**146.6**

Table 1: Summary of LHD Occurrences and Duration per Month in the Fukuoka FIR

2.2.3 The LHD reports are separated by categories based on the details provided for each deviation. **Table 2** presents a summary of the LHD causes within Fukuoka FIR in 2023 and 2024. The number of LHDs reported in 2024 is slightly decreased from 2023.

Code	LHD Category Description	2023	2024
A	Flight crew fails to climb or descend the aircraft as cleared	2	5
B	Flight crew climbing or descending without ATC clearance	2	3
C	Incorrect operation or interpretation of airborne equipment	3	1
D	ATC system loop error	5	3
E	ATC transfer of control coordination errors due to human factors	3	2
F	ATC transfer of control coordination errors due to technical issues	1	0
G	Aircraft contingency leading to sudden inability to maintain level	0	1
H	Airborne equipment failure and unintentional or undetected level change	0	1
I	Turbulence or other weather related cause	17	15
J	TCAS resolution advisory and flight crew correctly responds	16	17
K	TCAS resolution advisory and flight crew incorrectly responds	0	0
L	Non-approved aircraft is provided with RVSM separation	0	0
M	Other	0	0
Total		**49**	**48**

Table 2: Summary of LHD Causes within Fukuoka FIR.

2.2.4 **Appendix A** contains the details of the 14 LHDs that contributed to the operational risk, which was reported to the JASMA during the assessment period.

2.2.5 **Appendix B** contains the details of the 34 LHDs that were not involved in the operational risk and were reported to the JASMA during the assessment period.

2.2.6 **Appendix C** contains the details of the 2 LHDs that occurred outside of Fukuoka FIR and were not involved in the operational risk during the assessment period.

2.2.7 **Appendix D** provides the geographic location of all LHD reports in Fukuoka FIR during the assessment period. The filled blue square symbols represent the LHD location in the RVSM stratum inside of Fukuoka FIR, and the hollow blue square symbols represent the LHD location in the RVSM stratum outside of Fukuoka FIR. The circle size means that the duration of LHD is 50 seconds or more, and the size of circle is proportionally large according to the deviation time.

2.2.8 The number of LHD occurrences between Fukuoka FIR and Manila FIR in 2024 is less than the number in 2023.

3. Risk Assessment and Safety Oversight

3.1 This section updates the results of safety oversight for the RVSM implementation in the Fukuoka FIR. Accordingly, the internationally accepted collision risk methodology is applied in assessing the safety of the airspace.

3.1.1 Estimate of the Collision Risk Model (CRM) Parameters shown in **Table 3**. The average sizes of aircraft based on the TSD of December 2024 are slightly smaller than that of aircraft based on the TSD of December 2023.

Parameter Symbol	Parameter Definition	Parameter Value	Source for Value
Pz(1000)	Probability that two aircraft nominally separated by the vertical separation minimum 1000 feet are in vertical overlap	1.7×10^{-8}	Value specified in ICAO Doc. 9574
Pz(0)	Probability that two aircraft at the same nominal level are in vertical overlap	0.54	Value often used (shown in RVSM/TF-9-IP/2)
Py(0)	Probability that two aircraft on the same track are in lateral overlap	0.0711	Using the data of secondary surveillance radar obtained by the Hachinohe Air Route Surveillance Radar (domestic RNAV route, 2001-2002) and FDPS data (December 2012).
λx	Average aircraft length	0.0274 nm	JASMA (TSD of RVSM flights in Dec 2024)
λy	Average aircraft width	0.0248 nm	
λz	Average aircraft height	0.0078 nm	
$\overline{\lvert\Delta V\rvert}$	Average along track speed of aircraft pairs	28.9 kt	Kushiro Air Route Surveillance Radar data (R220 route, NOPAC, Apr. 1994)
$\overline{\lvert V\rvert}$	Individual-aircraft along track speed	480 kt	Value often used
$\overline{\lvert\dot{y}\rvert}$	Average cross track speed of aircraft pairs	11.6 kt	Kushiro Air Route Surveillance Radar data (R220 route, NOPAC, Apr. 1994)
$\overline{\lvert\dot{z}\rvert}$	Average vertical speed of aircraft pairs	1.5 kt	Value often used
Nx(same)	The passing frequency of aircraft pair assigned to the adjacent flight levels under the same direction traffic	3.24×10^{-2}	CCAW data (Dec 2024)
Nx(opp)	The passing frequency of aircraft pair assigned to the adjacent flight levels under the opposite direction traffic	9.45×10^{-2}	CCAW data (Dec 2024)
$Naz^{technical}$ (cross)	The collision risk for crossing routes (technical dimension)	1.44×10^{-10} [accidents/flight hour]	FO flight data (Dec 2024) is utilized for the calculation of $E_z(\theta)$.
$Naz^{operational}$ (cross)	The collision risk for crossing routes (operational dimension)	2.04×10^{-9} [accidents/flight hour]	By eq. (12).
H	Total flight hours of aircraft flying on the route segments within airspace under consideration	1,794,073 flight hours	Estimated flight hours from Jan 2024 to Dec 2024 *12 times the flight hours in Dec 2024
T(0)	LHD duration in hours	0.80	Total duration hours of 20 operational LHD reports received from Jan 2024 to Dec 2024

Table 3: Summarizes the value of the parameters used for the vertical risk calculation.

3.2 Risk Calculation

3.2.1 Based on the TSD for one month of December 2024 extracted from the JCAB's Flight Object Administration Center System (FACE), the numbers of passing events, n_p(same) and n_p(opp), were calculated for each route segment consisting of two fixes.

3.2.2 Using the CRM parameters, such as the average size of the aircraft and average relative speed of the aircraft pair, contained in **Table 3**, kinematical coefficients of passing frequencies for the same and opposite direction traffic can be calculated by

$$K(same) = 1 + \frac{\lambda x}{Vrx(same)}\left(\frac{Vry}{\lambda y} + \frac{Vrz}{\lambda z}\right) \quad (1)$$

$$K(opp) = 1 + \frac{\lambda x}{Vrx(opp)}\left(\frac{Vry}{\lambda y} + \frac{Vrz}{\lambda z}\right) \quad (2)$$

Same-direction passing frequency N_x(same), opposite-direction passing frequency N_x(opp), and equivalent opposite-direction passing frequency $N_x{}^z$(e) are defined by

$$N_x^z(same) = \frac{2n_p(same)}{H} \quad (3)$$

$$N_x^z(opp) = \frac{2n_p(opp)}{H} \quad (4)$$

$$N_x^z(e) = N_x^z(opp) + \frac{K(same)}{K(opp)} N_x^z(same) \quad (5)$$

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respectively.

Technical Risk is estimated by

$$N_{az}{}^{technical} = N_{az}{}^{technical}(o+s) + N_{az}{}^{technical}(cross) \quad (6)$$

$$N_{az}(o+s)^{technical} = P_z(1000)P_y(0)N_x{}^z(e)K(o) \quad (7)$$

$$N_{az}{}^{technical}(cross) = P_z(1000)\sum_\theta P_h(\theta)E_z{}^{cross}(\theta)\left[\frac{2\left|\overline{\dot{h}(\theta)}\right|}{\pi\lambda_{xy}} + \frac{\left|\overline{\dot{z}}\right|}{2\lambda_z}\right] \quad (8)$$

$P_h(\theta)$ was calculated assuming that the distributions of along-track positions and cross-track deviations follow normal distributions whose standard deviations are $5/\sqrt{6}$ NM and 0.132, respectively. Remark that 5NM is the radar separation standard and $5/\sqrt{6}$ NM is the standard deviation of the uniform distribution with the domain width = 5NM. The value 0.132 is calculated from the Hachinohe radar data collected from August 2001 till July 2002. $P_h(\theta)$, $E_z{}^{cross}(\theta)$ and $\left|\overline{\dot{h}(\theta)}\right|$ were calculated every ten degrees.

Operational Risk is given by

$$N_{az}{}^{operational} = N_{az}{}^{operational}(o+s) + N_{az}{}^{operational}(cross) \quad (9)$$

where,

$$N_{az}{}^{operational}(o+s) = \frac{\sum P_z(z)T(z)}{H} P_y(0)N_x{}^z(e)K(o) \quad (10)$$

$$N_{az}{}^{operational}(cross) = \frac{\Sigma P_z(z)T(z)}{H}\sum_\theta P_h(\theta)E_z{}^{cross}(\theta)\left[\frac{2\left|\overline{\dot{h}(\theta)}\right|}{\pi\lambda_{xy}} + \frac{\left|\overline{\dot{z}}\right|}{2\lambda_z}\right] \quad (11)$$

$$N_{az}{}^{operational}(cross) = \frac{\Sigma P_z(z)T(z)}{H} \cdot \frac{N_{az}{}^{technical}(cross)}{P_z(1000)} \quad (12)$$

Executive Summary

3.3 Safety Oversight for the RVSM implementation in the Fukuoka FIR

3.3.1 **Table 4** presents the estimates of vertical collision risk for the RVSM airspace of the Fukuoka FIR. The technical risk is estimated to be 0.32 x 10^{-9} fatal accidents per flight hour. The operational risk estimate is 4.58 x 10^{-9} fatal accidents per flight hour. The estimate of the overall vertical collision risk is 4.91 x 10^{-9} fatal accidents per flight hour, which is below the globally agreed TLS value of 5.0 x 10^{-9} fatal accidents per flight hour.

Japanese Airspace – estimated annual flying hours = 1,688,572 hours *(note: estimated hours based on Dec 2023 traffic sample data)*			
Source of Risk	**Risk Estimation**	**TLS**	**Remarks**
RASMAG 29 Total Risk	*2.36 x 10^{-9}*	*5.0 x 10^{-9}*	*Below TLS*
Technical Risk	0.32 x 10^{-9}	2.5 x 10^{-9}	Below Technical TLS
Operational Risk	4.58 x 10^{-9}	-	-
Total Risk	**4.91 x 10^{-9}**	5.0 x 10^{-9}	**Below TLS**

Table 4: Fukuoka FIR RVSM Risk Estimates

3.3.2 **Figure 2** presents collision risk estimate trends by type (technical, operational, and total) for each month using the appropriate cumulative during the period from January 2024 to December 2024.

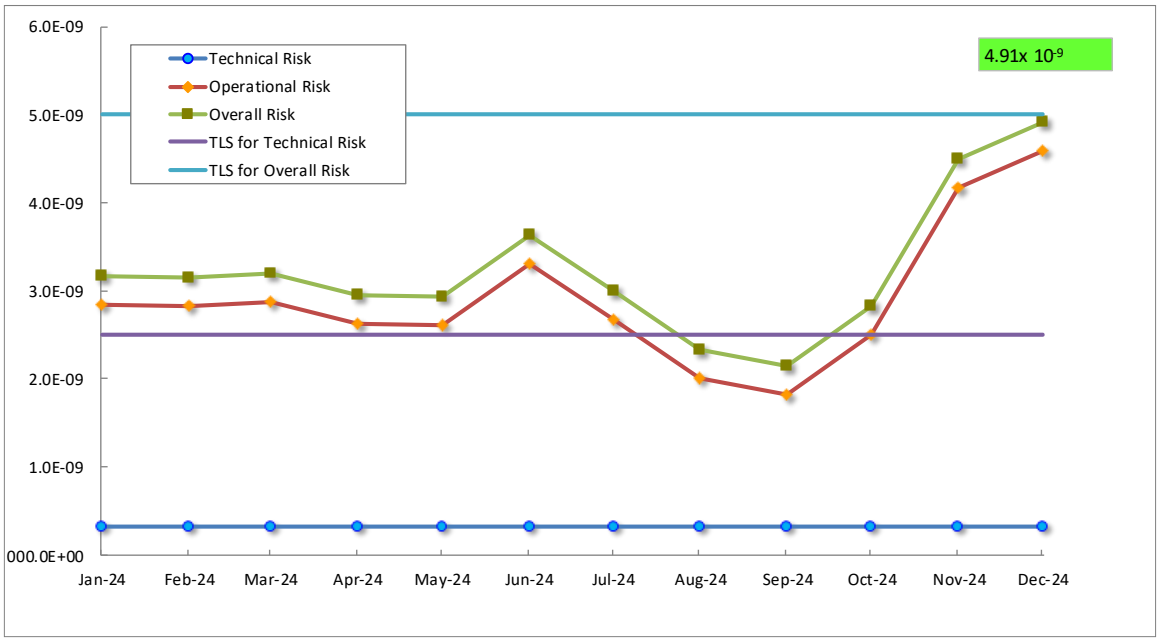


Figure 2: Fukuoka FIR RVSM Risk Estimate Trends

3.3.3 The estimated overall risk was below the TLS. The risk value is upper than the previous year.

Appendix A

LHDs contributed to Operational Risk within the RVSM airspace in Fukuoka FIR reported to the JASMA during the assessment period

	Occurrence Date	Reporter	Location	ACFT Type	Assigned FL	Observed/ Reported ALT (ft)	Duration of LHD (min.)	Cause	CAT code	Hot Spot
1	1-Jan-2024	Fukuoka ACC	KCC	A359	390	37,500	2.52	ATC system loop error	D	
2	24-Jan-2024	Fukuoka ACC	HKC	A320	350	32,800	1.35	Flight crew fails to climb or descend the aircraft as cleared	A	
3	20-Mar-2024	Tokyo ACC	CBE	B738	350	33,500	0.57	Flight crew fails to climb or descend the aircraft as cleared	A	
4	21-Apr-2024	Fukuoka ACC	HKC	A359	390	35,000	5.63	ATC system loop error	D	
5	7-Jun-2024	Fukuoka ACC	FUE	B763	300	31,000	0.13	Flight crew fails to climb or descend the aircraft as cleared	A	
6	20-Jun-2024	Fukuoka ACC	MLT	K35R	330	39,000	7.00	Flight crew climbing or descending without ATC clearance	B	
7	3-Sep-2024	Kobe ACC	KRE	A20N	310	31,700	0.93	ATC system loop error	D	
8	1-Oct-2024	Fukuoka ACC	2100N 14233E	A333	370	38,000	6.00	ATC transfer of control coordination errors due to human factors	E	
9	25-Oct-2024	Fukuoka ACC	HKC	A320	350	33,600	1.23	Flight crew fails to climb or descend the aircraft as cleared	A	
10	1-Nov-2024	Fukuoka ACC	TUNTO	A321	350	37,000	8.00	Flight crew climbing or descending without ATC clearance	B	
11	8-Nov-2024	Fukuoka ACC	GURAG	B77W	350	35,000	7.00	ATC transfer of control coordination errors due to human factors	E (E-OT)	D1

	Occurrence Date	Reporter	Location	ACFT Type	Assigned FL	Observed/ Reported ALT (ft)	Duration of LHD (min.)	Cause	CAT code	Hot Spot
12	18-Nov-2024	Fukuoka ACC	4250N 15303E	GLF6	390	41,000	3.00	Flight crew climbing or descending without ATC clearance	B	
13	7-Dec-2024	Fukuoka ACC	HAKKA	B788	350	41,000	3.00	Incorrect operation or interpretation of airborne equipment	C	
14	15-Dec-2024	Fukuoka ACC	MEXIR	A359	350	31,200	1.52	Flight crew fails to climb or descend the aircraft as cleared	A	

Appendix B

LHDs not contributed to Operational Risk in the Fukuoka FIR reported to the JASMA during the assessment period

	Occurrence Date	Reporter	Location	ACFT Type	Assigned FL	Observed/ Reported ALT (ft)	Duration of LHD (min.)	Cause	CAT code	Hot Spot
1	9-Jan-2024	Fukuoka ACC	TGE	B78X	350	34,700	0.52	Turbulence or other weather related cause	I	
2	19-Feb-2024	Kobe ACC	TGE	A21N	320	29,400	1.00	Turbulence or other weather related cause	I	
3	12-Mar-2024	ATMC	NUBDA	A35K	400	41,000	4.00	TCAS resolution advisory and flight crew correctly responds	J	
4	28-Mar-2024	Kobe ACC	SUC	B738	320	32,800	1.00	TCAS resolution advisory and flight crew correctly responds	J	
5	23-Mar-2024	Fukuoka ACC	MBE	B738	380	37,400	1.07	Turbulence or other weather related cause	I	
6	23-Mar-2024	Fukuoka ACC	FUE	A320	330	32,600	0.43	Turbulence or other weather related cause	I	
7	28-Mar-2024	ATMC	PAKDO	B762	360	10,000	28.00	Aircraft contingency leading to sudden inability to maintain level	G	
8	29-Mar-2024	Sapporo ACC	TAPPI	A320	340	35,000	1.00	TCAS resolution advisory and flight crew correctly responds	J	
9	30-Mar-2024	ATMC	NUBDA	B77W	320	32,500	5.00	TCAS resolution advisory and flight crew correctly responds	J	
10	30-Mar-2024	Fukuoka ACC	NHC	A321	330	32,500	0.63	Turbulence or other weather related cause	I	
11	14-Apr-2024	Tokyo ACC	PIGAP	A20N	290	29,400	0.23	TCAS resolution advisory and flight crew correctly responds	J	
12	23-Apr-2024	Kobe ACC	ONC	C25C	310	30,300	0.67	TCAS resolution advisory and flight crew correctly responds	J	

	Occurrence Date	Reporter	Location	ACFT Type	Assigned FL	Observed/ Reported ALT (ft)	Duration of LHD (min.)	Cause	CAT code	Hot Spot
13	2-May-2024	-	ONC	A21N	330	33,300	0.17	Turbulence or other weather related cause	I	
14	27-May-2024	Fukuoka ACC	KEC	GLF6	430	44,000	0.18	Turbulence or other weather related cause	I	
15	16-Jun-2024	Fukuoka ACC	KAD	K35R	310	30,000	1.62	TCAS resolution advisory and flight crew correctly responds	J	
16	29-Jun-2024	Fukuoka ACC	HKC	A320	340	33,500	1.25	Turbulence or other weather related cause	I	
17	1-Jul-2024	Fukuoka ACC	FUE	A21N	300	29,600	0.83	Turbulence or other weather related cause	I	
18	2-Jul-2024	Fukuoka ACC	KMC	B737	310	30,400	0.25	TCAS resolution advisory and flight crew correctly responds	J	
19	9-Jul-2024	Tokyo ACC	KIDAX	A21N	320	31,500	1.12	TCAS resolution advisory and flight crew correctly responds	J	
20	9-Jul-2024	Tokyo ACC	KIDAX	E190	330	33,300	1.08	TCAS resolution advisory and flight crew correctly responds	J	
21	21-Jul-2024	Tokyo ACC	YTE	B738	290	29,400	0.75	TCAS resolution advisory and flight crew correctly responds	J	
22	30-Jul-2024	Fukuoka ACC	ONEMU	B748	320	31,700	16.00	Turbulence or other weather related cause	I	
23	7-Aug-2024	Fukuoka ACC	2501N 14554E	K35R	400	40,424	16.00	Turbulence or other weather related cause	I	
24	19-Aug-2024	Fukuoka ACC	HKC	A321	340	33,500	1.63	Turbulence or other weather related cause	I	
25	19-Aug-2024	Tokyo ACC	OLTAX	B744	310	32,500	1.37	Turbulence or other weather related cause	I	

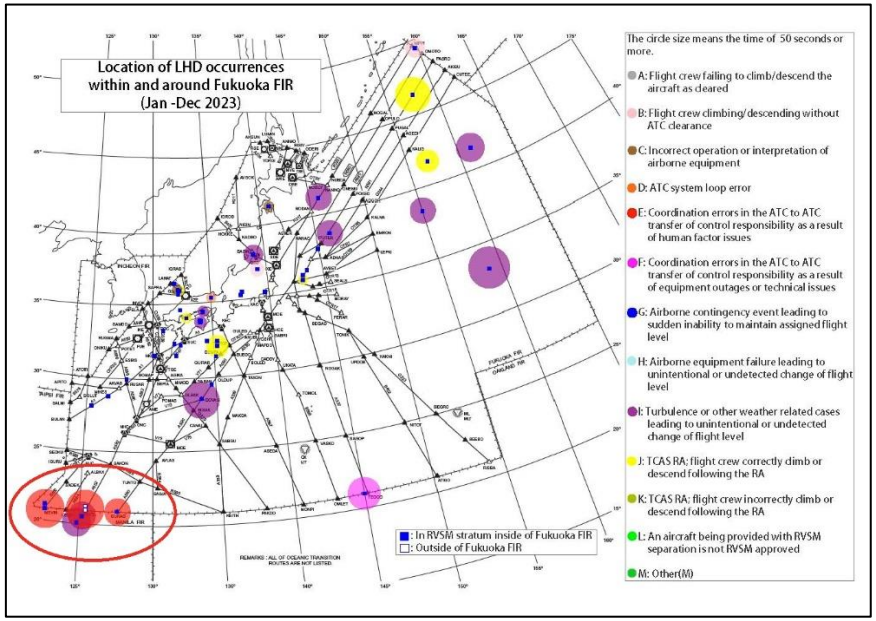
	Occurrence Date	Reporter	Location	ACFT Type	Assigned FL	Observed/ Reported ALT (ft)	Duration of LHD (min.)	Cause	CAT code	Hot Spot
26	11-Sep-2024	Tokyo ACC	PIGAP	E190	300	31,000	2.30	TCAS resolution advisory and flight crew correctly responds	J	
27	15-Sep-2024	Tokyo ACC	RUBIS	B773	360	36,400	0.50	TCAS resolution advisory and flight crew correctly responds	J	
28	11-Oct-2024	Tokyo ACC	IGARA	B78X	330	33,500	1.28	TCAS resolution advisory and flight crew correctly responds	J	
29	15-Oct-2024	Fukuoka ACC	HKC	P8	310	33,600	2.40	Turbulence or other weather related cause	I	
30	23-Oct-2024	Tokyo ACC	BOPNO	B738	330	33,500	0.50	TCAS resolution advisory and flight crew correctly responds	J	
31	26-Oct-2024	Fukuoka ACC	KCC	B738	370	36,400	1.83	TCAS resolution advisory and flight crew correctly responds	J	
32	20-Nov-2024	Fukuoka ACC	MJC	A320	340	34,300	0.00	TCAS resolution advisory and flight crew correctly responds	J	
33	7-Dec-2024	Fukuoka ACC	TEKEL	C25C	400	37,700	4.00	Turbulence or other weather related cause	I	
34	13-Dec-2024	Fukuoka ACC	4605N 15629E	B744	320	31,600	1.00	Airborne equipment failure and unintentional or undetected level change	H	

Appendix C

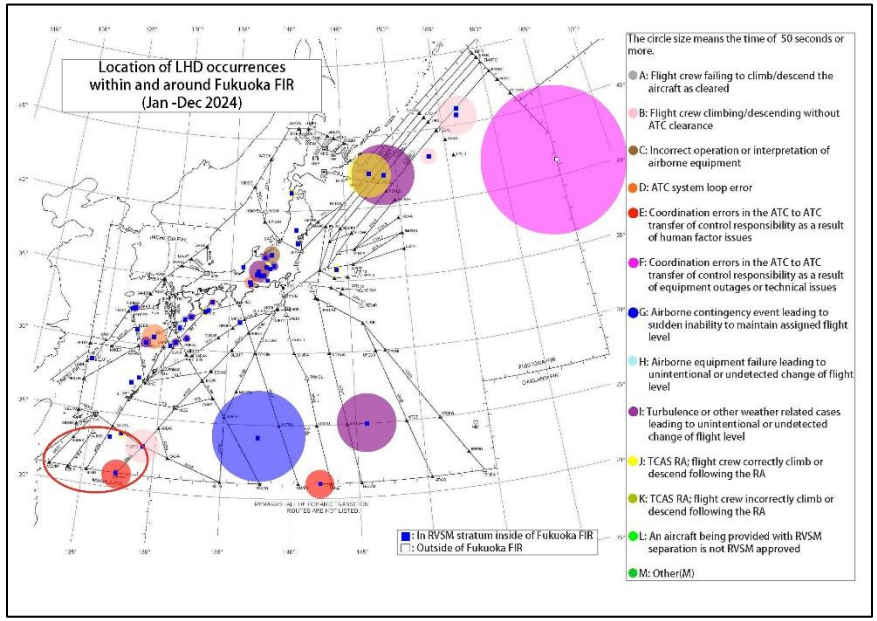
LHDs occurred outside of Fukuoka FIR

	Occurrence Date	Relevant ATC Unit	Location	ACFT Type	Assigned FL	Observed/ Reported ALT (ft)	Duration of LHD (min.)	Cause	CAT code	Hot Spot
1	29-Jun-2024	Fukuoka ACC	4100N 16500E	B77L	350	35,000	90.00	Turbulence or other weather related cause	I	
2	8-Jul-2024	Fukuoka ACC	OPULO	B350	300	32,000	70.00	Flight crew climbing or descending without ATC clearance	B	

Appendix D



Geographical Location of all LHDs in Fukuoka FIR (2023)



Geographical Location of all LHDs in Fukuoka FIR (2024)

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