International Civil Aviation Organization

Twenty-Eighth Meeting of the Regional Airspace Safety Monitoring Advisory Group (RASMAG/28)

Bangkok, Thailand, 21 – 24 August 2023

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

ASIA/PACIFIC CONSOLIDATED SAFETY REPORT

(Presented by MAAR on behalf of Asia Pacific RMAs and EMAs)

SUMMARY

This paper presents a combined summary of the safety analysis results for the Asia Pacific Region to be considered by the RASMAG. It is a combined effort to present the risk estimates, geolocations of LHDs/LLDs/LLEs, hot spots analysis, and the reporting rates of operational errors during the calendar year 2022 as a consolidated manner.

1. INTRODUCTION

1.1 In an effort to present an overall picture of airspace safety risk in the Asia Pacific region as a consolidated safety report, the monitoring agencies agreed during the RASMAG MAWG/6 in 2019 to present the report in a presentation format to facilitate more effective communication of the analysis results.

2. DISCUSSION

2.1 Data presented in this paper and its attachment is from the analysis of airspace risk conducted by Australian Airspace Monitoring Agency (AAMA), Bay of Bengal Arabian Sea and Indian Ocean Safety Monitoring Agency (BOBASMA) China Regional Monitoring Agency (China RMA), Japan Airspace Safety Monitoring Agency (JASMA), the Monitoring Agency for Asia Region (MAAR), Pacific Approvals Registry and Monitoring Organization (PARMO) and South East Asia Safety Monitoring Agency (SEASMA). In this report, each monitoring agency bases their analysis on a December Traffic Sample Data (TSD), Large Height Deviations (LHDs) Large Longitudinal Errors (LLEs) and Large Lateral Deviations (LLDs) collected throughout 2022.

2.2 The 2022 Asia Pacific Consolidated Safety Report is presented in **Attachment A** of this paper.

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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2022 Asia Pacific
Consolidated Safety Report

RASMAG/28
21 - 24 Aug 2023

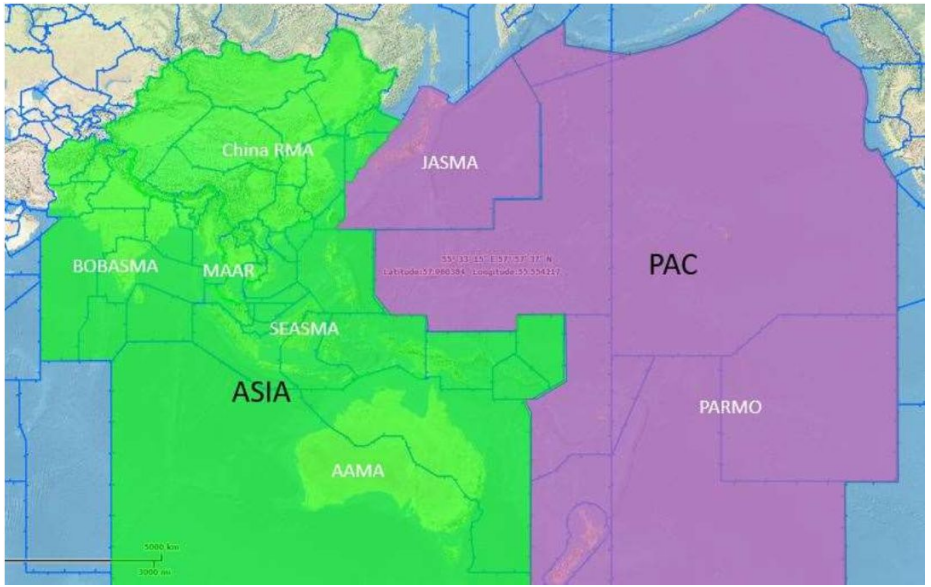
Outline

- Background
- PAC Area
  - Vertical Collision Risk Estimates and Summary of LHDs
  - Horizontal Collision Risk Estimates and Summary of LLDs and LLEs
  - Geolocations of LHDs/LLDs/LLEs
  - Hot Spots
- Asia Area
  - Vertical Collision Risk Estimates and Summary of LHDs
  - Horizontal Collision Risk Estimates and Summary of LLDs and LLEs
  - Geolocations of LHDs/LLDs/LLEs
  - Hot Spots
- Reporting Rate of LHDs/LLDs/LLEs
- Conclusion

Background

Background

In MAWG/5, APAC monitoring agencies agreed to consolidate key elements from their safety risk analysis into one report to give an overall picture of airspace safety risk in Asia Pacific.



The report is divided into:

- **Pacific (PAC) Area**
- **Asia Area**

For each area, there will be a summary of:

- vertical collision risk estimates, LHD summary, and their hot spots (if any);
- horizontal collision risk estimates, LLD & LLE summary, and their hot spots (if any); and
- reporting rates in 3 groups: Category A + B + C (related to the pilot/aircrew), D + E + F (related to ATC), and G + H + I + J + K + L + M (Other).

Pacific Area (PAC)

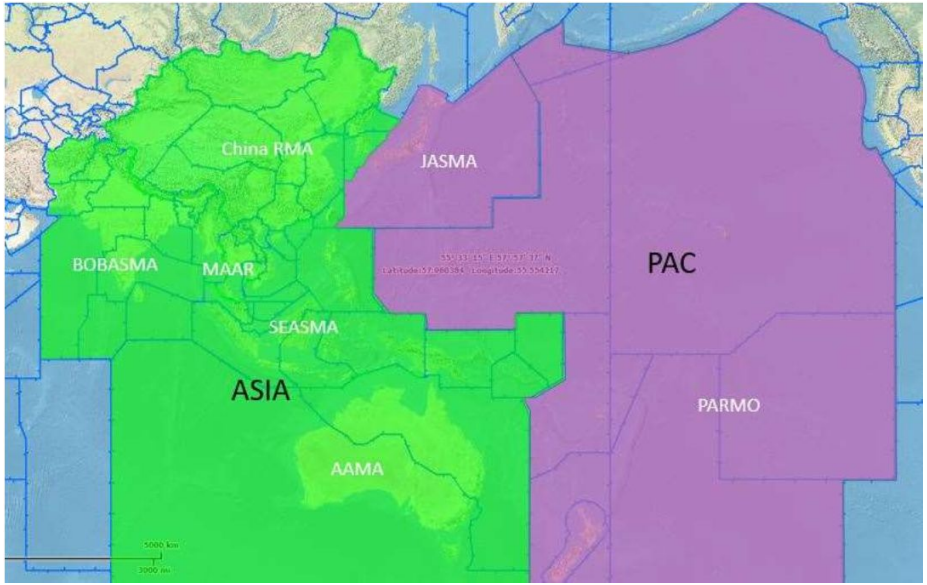
Traffic between North America and Asia, or North America and South Pacific States

FIRs : Anchorage, Auckland, Fukuoka, Nadi, Oakland, and Tahiti

Monitoring Agencies :

RMAs (Verical): JASMA, PARMO

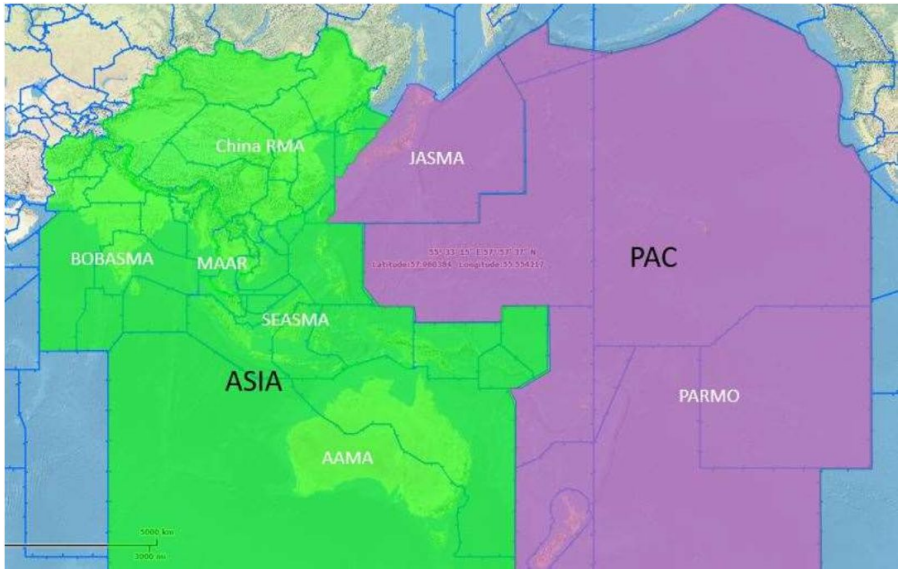
EMAs (Horizontal): JASMA, PARMO



Asia Area (Asia)

Traffic flows between between Asia and Middle East, Europe and South Pacific States.

FIRs : Bangkok, Beijing, Brisbane, Chennai,Colombo, Dhaka, Delhi, Guangzhou, Hanoi, Ho Chi Minh, Hong Kong, Honiara, Incheon, Jakarta, Karachi, Kathmandu, Kolkata, Kota Kinabalu, Kuala Lumpur, Kunming, Lahore, Lanzhou, Male, Manila, Melbourne, Mumbai, Nauru, Phnom Penh, Port Moresby, Pyongyang, Sanya, Shanghai, Shenyang, Singapore, Taibei, Ujung Pandang, Ulaanbaatar, Urumqi, Vientiane, Wuhan, and Yangon



Monitoring Agencies :

RMAs (Vertical): AAMA, China RMA, MAAR, PARMO
EMAs (Horizontal): AAMA, BOBASMA, PARMO, SEASMA

PAC Area

PAC : Vertical Collision Risk

PAC : Vertical Collision Risk Estimates

Number of annual flying hours: 2,758,126 hours/year

2022 PAC Area	Vertical Risk Estimate	Remark
Vertical Technical Risk	00.19 x 10^{-9} FAPFH	Below Technical TLS
Vertical Operational Risk	19.43 x 10^{-9} FAPFH	
Vertical Overall Risk	19.62 x 10^{-9} FAPFH	Above TLS

PAC : Vertical Collision Risk Estimates

2016 - 2022

Year	Vertical Overall Risk Estimate	Remark
2022	19.62×10^{-9} FAPFH	Above TLS
2021	19.74×10^{-9} FAPFH	Above TLS
2020	16.71×10^{-9} FAPFH	Above TLS
2019	30.21×10^{-9} FAPFH	Above TLS
2018	19.40×10^{-9} FAPFH	Above TLS
2017	7.30×10^{-9} FAPFH	Above TLS
2016	5.01×10^{-9} FAPFH	Above TLS

PAC : Summary of LHDs

Attributions	Category Code	Description	Number of Occurrences	Duration (minutes)	Number of Levels Crossed
Aircrew/ Pilot	A	Flight crew failing to climb/descend the aircraft as cleared	6	5	5
	B	Flight crew climbing/descending without ATC Clearance	22	13	45
	C	Incorrect operation or interpretation of airborne equipment	6	8	5
ATC	D	ATC system loop error	8	63	12
	E	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	48	197	0
	F	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of equipment outage or technical issues	3	8	1
Aircraft/ Avionics/ Contingencies	G	Aircraft contingency event leading to sudden inability to maintain assigned flight level	3	7	5
	H	Airborne equipment failure leading to unintentional or undetected change of flight level	3	2	0

PAC : Summary of LHDs

Attributions	Category Code	Description	Number of Occurrences	Duration (minutes)	Number of Levels Crossed
Weather/ Turbulence	I	Turbulence or other weather related causes leading to unintentional or undetected change of flight level	11	35	1
TCAS	J	TCAS resolution advisory, flight crew correctly climb or descend following the resolution advisory	5	7	0
	K	TCAS resolution advisory, flight crew incorrectly climb or descend following the resolution advisory	0	0	0
Other	L	An aircraft being provided with RVSM separation is not RVSM approved	0	0	0
	M	Other	3	104	0
		Total	**118**	**449**	**74**

PAC : Horizontal Collision Risk

PAC : Horizontal Collision Risk Estimates

Number of annual flying hours: 103,253 hours/year

2022 PAC Area	Horizontal Risk Estimate	Airspace	Remark
Lateral Risk	2.09×10^{-9} FAPFH	Pacific	Below TLS
50NM Lateral Risk	0.456×10^{-9} FAPFH	Japan	Below TLS
30NM Longitudinal Risk	0.008×10^{-9} FAPFH	Japan	Below TLS
10MIN Longitudinal Risk	1.754×10^{-9} FAPFH	Japan	Below TLS
2021 PAC Area	**Horizontal Risk Estimate**	**Airspace**	**Remark**
30NM Lateral Risk	1.74×10^{-9} FAPFH	Pacific	Below TLS
50NM Lateral Risk	0.71×10^{-9} FAPFH	Japan	Below TLS
30NM Longitudinal Risk	-	Pacific	Below TLS
30NM Longitudinal Risk	0.01×10^{-9} FAPFH	Japan	Below TLS
50NM Longitudinal Risk	2.22×10^{-9} FAPFH	Pacific	Below TLS
10MIN Longitudinal Risk	0.03×10^{-9} FAPFH	Japan	Below TLS

PAC : Summary of LLDs and LLEs

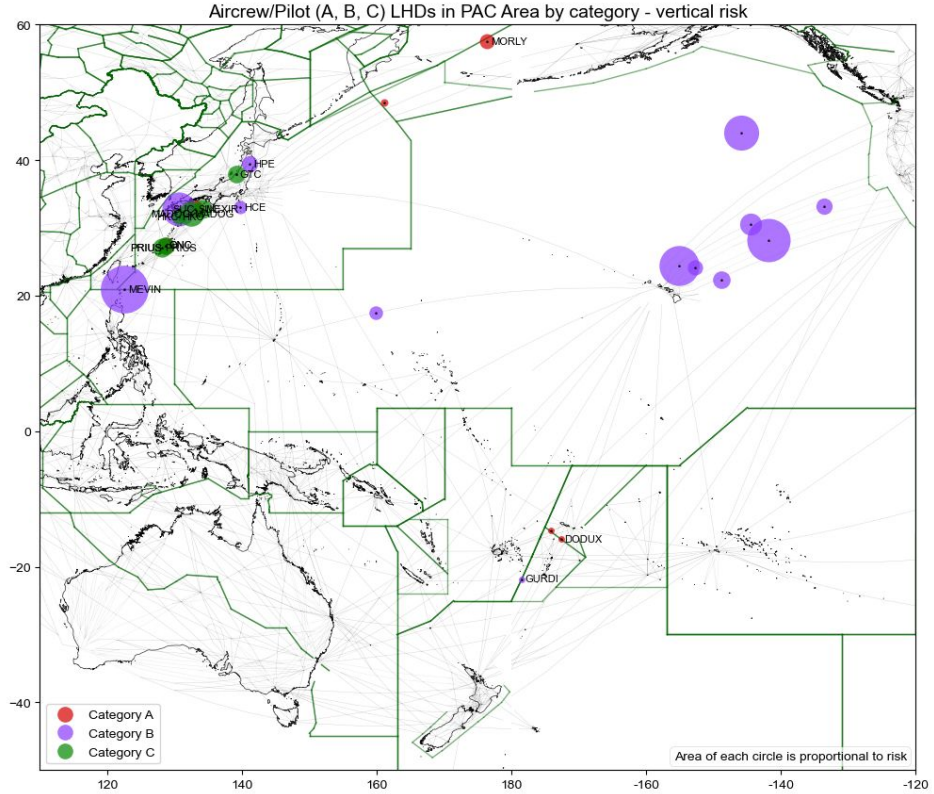
Attributions	Category Code	Description	Number of Occurrences	Duration (minutes)	Number of Tracks/Routes Crossed	Horizontal Deviation (NM)
Aircrew/ Pilot	A	Flight crew deviate without ATC Clearance	16	1.5	1	317
	B	Incorrect estimate or route provided due to incorrect operation or interpretation of airborne equipment	8	45	0	12
	C	Flight crew waypoint insertion error, due to correct entry of incorrect position or incorrect entry of correct position	4	66	0	80
ATC	D	ATC system loop error	4	57	0	10
	E	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	92	178.5	0	60
	F	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of equipment outage or technical issues	6	44	0	0

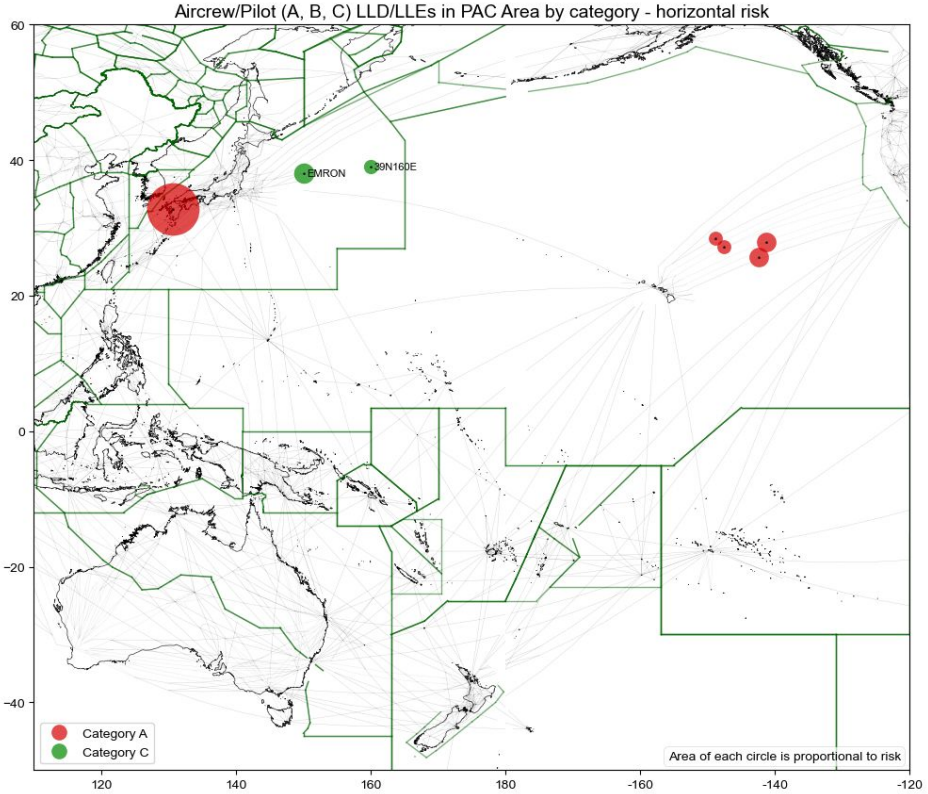
PAC : Summary of LLDs and LLEs

Attributions	Category Code	Description	Number of Occurrences	Duration (minutes)	Number of Tracks/Routes Crossed	Horizontal Deviation (NM)
Aircraft/ Avionics/ Contingencies	G	Navigation errors due to airborne equipment failure	2	18	0	46
Weather/ Turbulence	H	Turbulence or other weather related causes leading to a deviation in the horizontal dimension	12	42	0	190
Other	I	An aircraft was provided with reduced horizontal separation minima but did not meet the RNP/RSP/RCP specification;	0	0	0	0
	J	Other	2	26	0	0
		Total	**146**	**478**	**1**	**715**

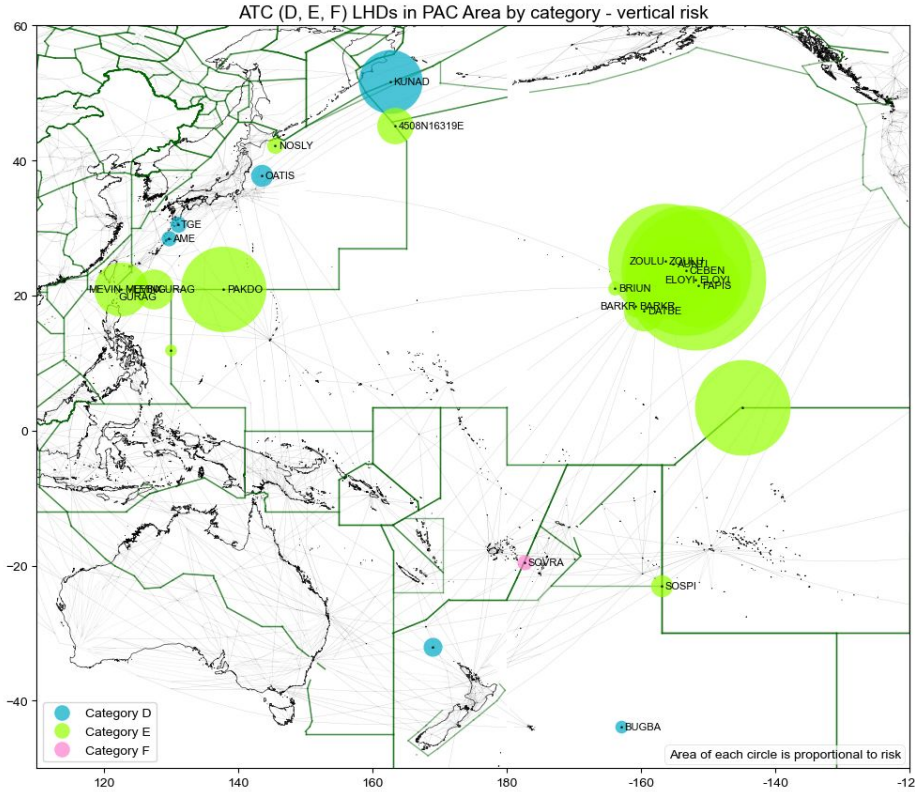
PAC : Geolocation of LHDs/LLDs/LLEs

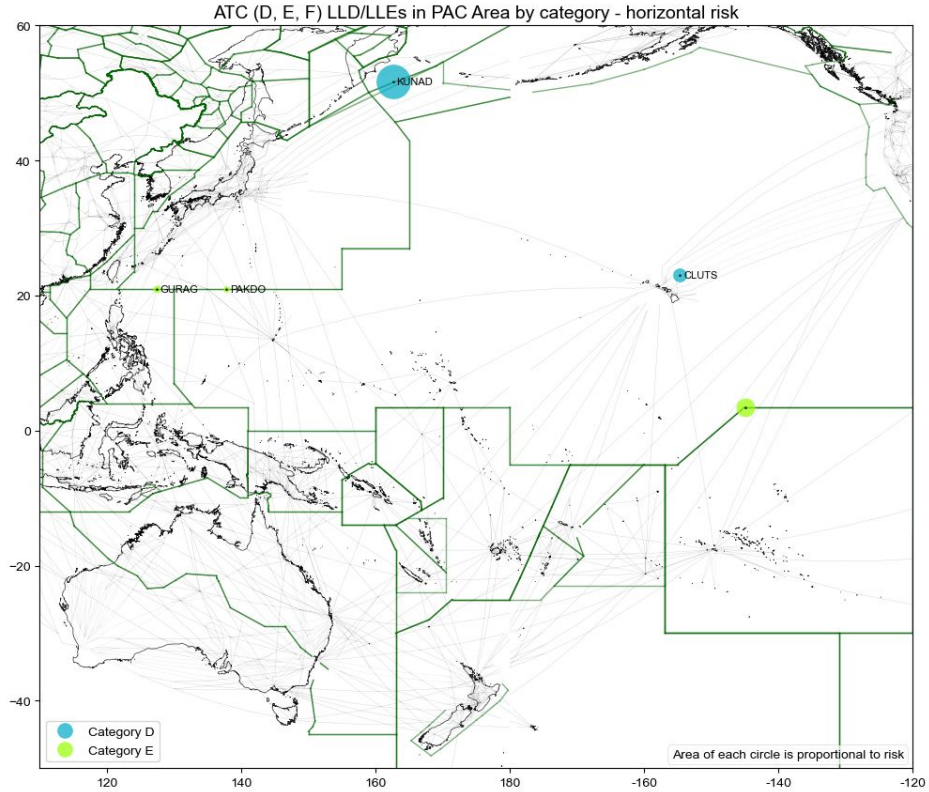
PAC : Aircrew/Pilot (A, B, C)



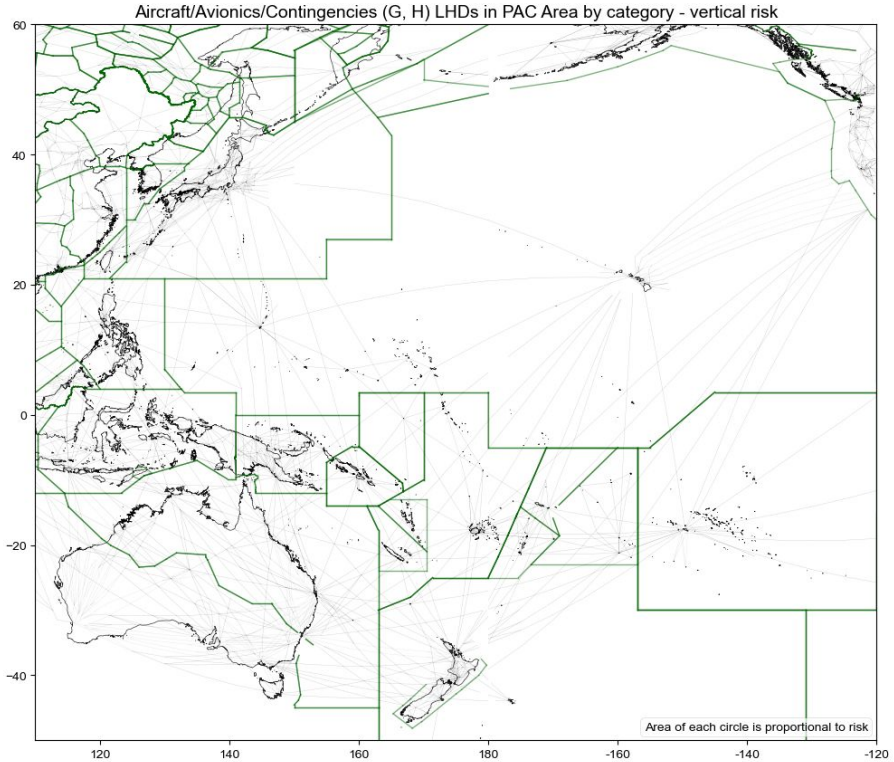


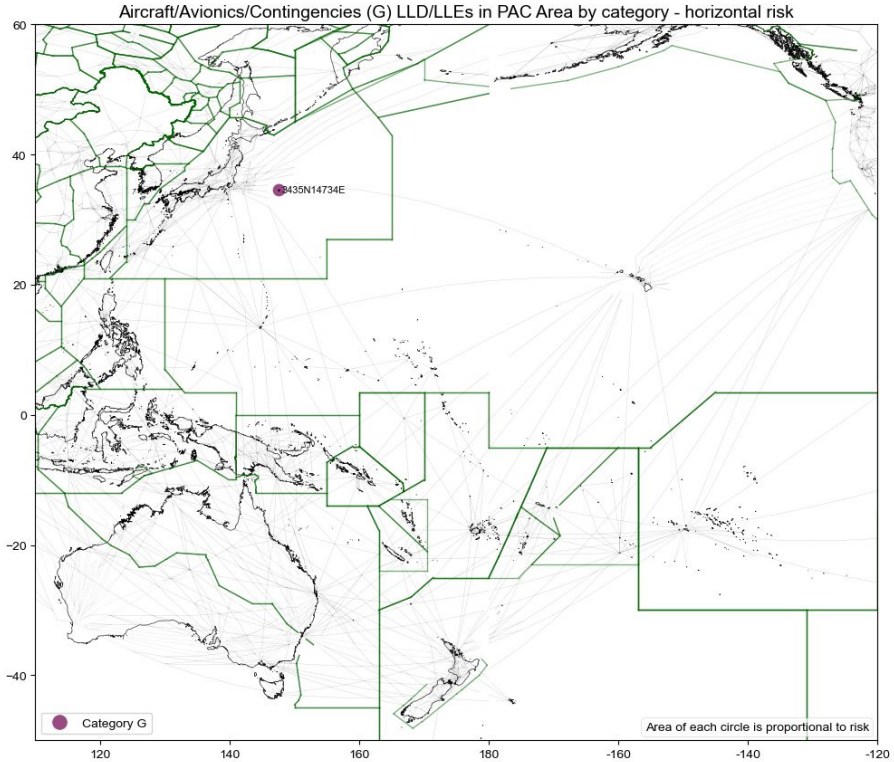
PAC : ATC (D, E, F)


ATC (D, E, F) LHDs in PAC Area by category - vertical risk
KUNAD
4508N16319E
NOSLY
OATIS
TGE
AME
MEVIN
GURAG
PAKDO
ZOULU
ZOULU
CEBEN
ELOYI
FLOYI
PAPIS
BRIUN
BARKR
BARKR
DATBE
SOVRA
SOSPI
BUGBA
Category D
Category E
Category F
Area of each circle is proportional to risk
60
40
20
0
−20
−40
120
140
160
180
-160
-140
-12


ATC (D, E, F) LLD/LLEs in PAC Area by category - horizontal risk
KUNAD
CLUTS
GURAG
PAKDO
Category D
Category E
Area of each circle is proportional to risk
60
40
20
0
−20
−40
120
140
160
180
-160
-140
-120

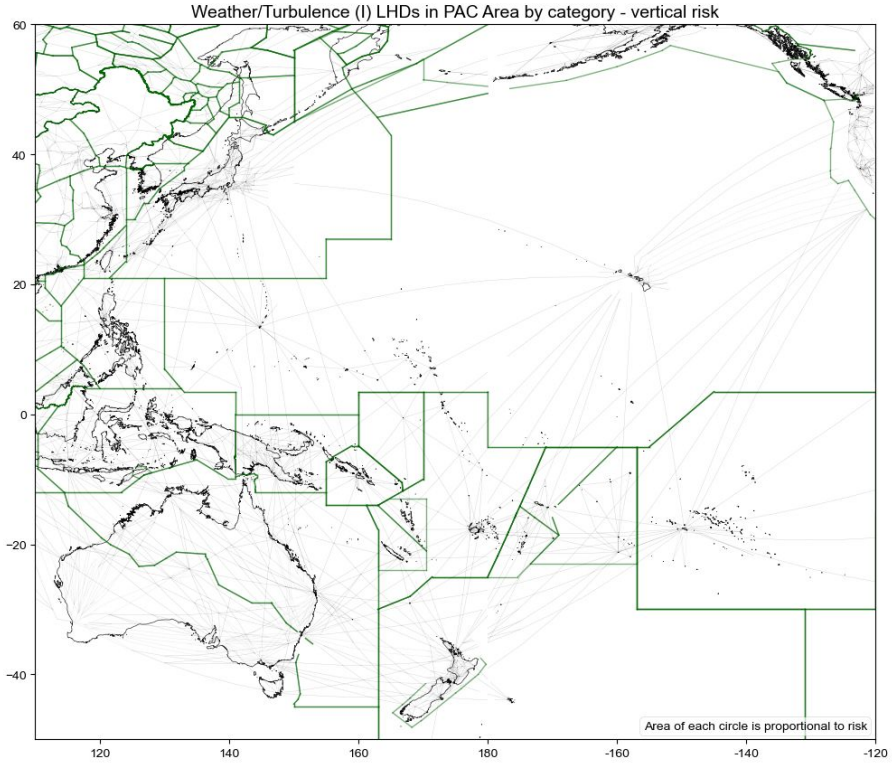
PAC : Aircraft Avionics/Contingencies (G, LHD:H)

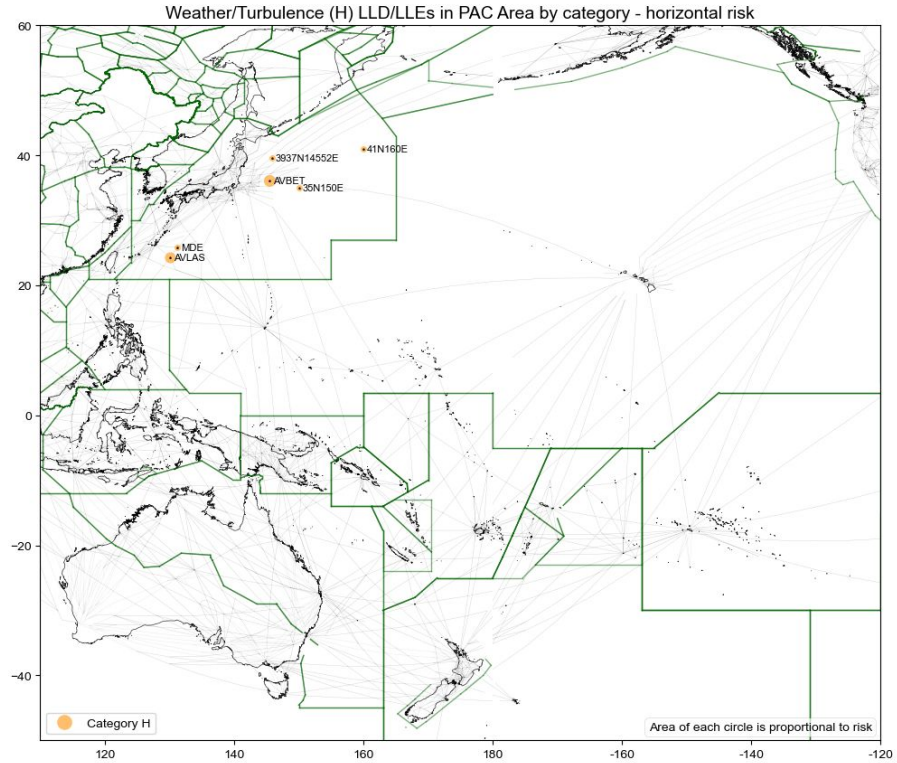




Note: No Category non-zero G and H LHD in 2022

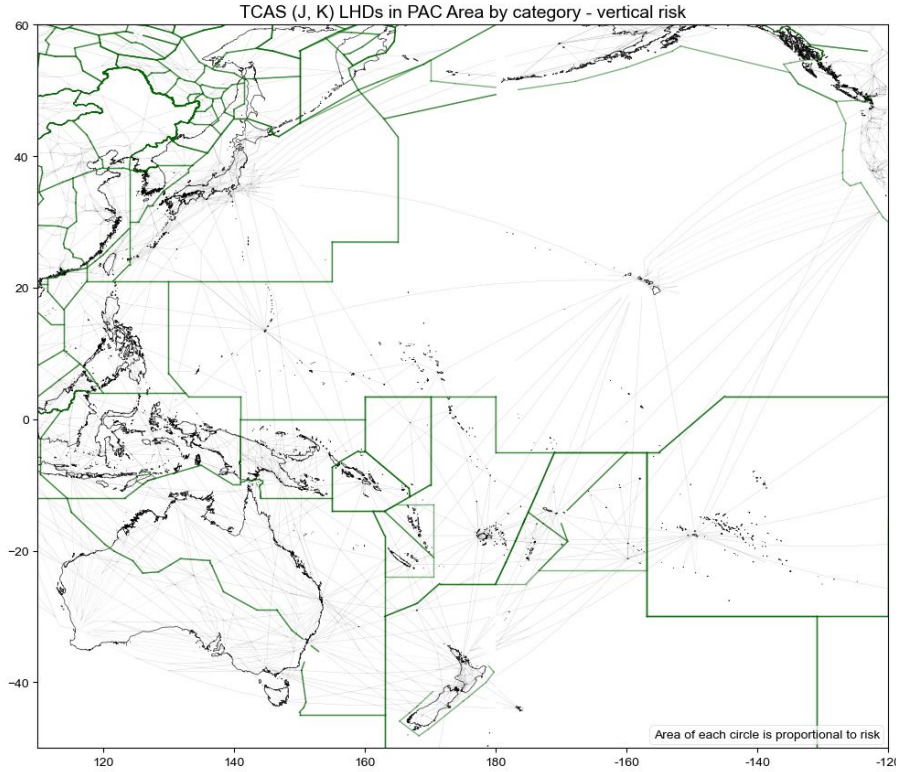
PAC : Weather/Turbulence (LHD:I, LLD/LLE:H)

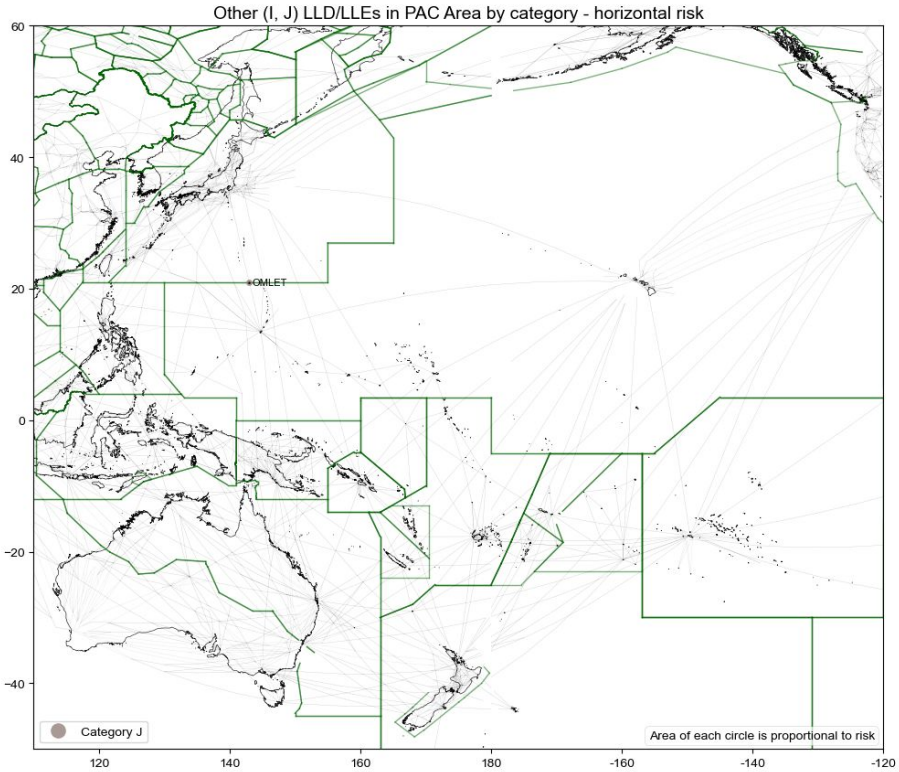




Note: No non-zero Category I LHD in 2022

PAC : TCAS (LHD:J, K)





Note: No non-zero Category J and K LHD in 2022

PAC : Hot Spots

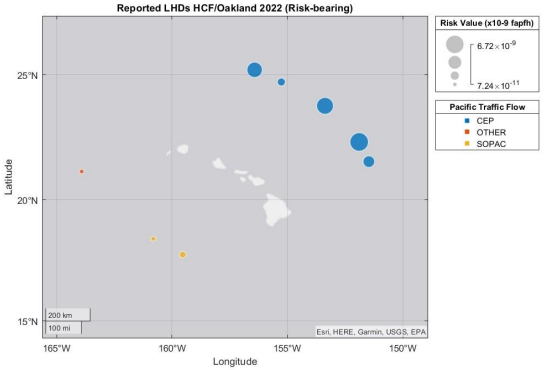
PAC : LHD Hot Spot N (North America - Hawaii CEP)

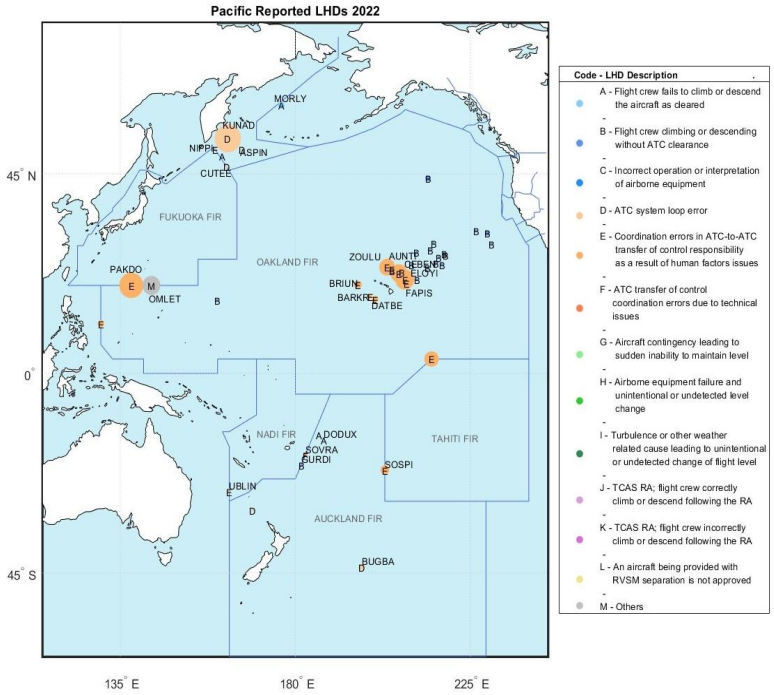
Nature of Occurrences : In 2021, several long duration LHDs were reported. Category E LHDs are the largest contribution to the vertical risk estimate in 2022 (this was also true for 2019, 2020, and 2021).

Contributing Factors : Central East Pacific (CEP) traffic flow has high traffic volume. The reported occurrences affect the user preferred routes that cross the CEP airways.

Trend : Increasing trend continued in reported category E LHDs between Honolulu Control Facility (HCF) and Oakland Center.

Mitigations : Implementation of new ATC system is planned for 2025. Both facilities developed mitigation procedures.





Asia Region

Asia : Vertical Collision Risk

ASIA : Vertical Collision Risk Estimates

Number of annual flying hours: 7,305,055 hours/year

2022 ASIA Area	Vertical Risk Estimate	Remark
Vertical Technical Risk	0.49 x 10^{-9} FAPFH	Below Technical TLS
Vertical Operational Risk	1.04 x 10^{-9} FAPFH	
Vertical Overall Risk	1.53 x 10^{-9} FAPFH	Below TLS

ASIA : Vertical Collision Risk Estimates

2016 - 2022

The vertical overall risk was improved to be below the TLS in 2021 and 2022.

Year	Vertical Overall Risk Estimate	Remark
2022	1.53 x 10^{-9} FAPFH	Below TLS
2021	4.03 x 10^{-9} FAPFH	Below TLS
2020	7.42 x 10^{-9} FAPFH	Above TLS
2019	12.88 x 10^{-9} FAPFH	Above TLS
2018	15.50 x 10^{-9} FAPFH	Above TLS
2017	27.30 x 10^{-9} FAPFH	Above TLS
2016	12.53 x 10^{-9} FAPFH	Above TLS

Asia : Summary of LHDs

Attributions	Category Code	Description	Number of Occurrences	Duration (minutes)	Number of Levels Crossed
Aircrew/ Pilot	A	Flight crew failing to climb/descend the aircraft as cleared	15	18.5	0
	B	Flight crew climbing/descending without ATC Clearance	17	14	0
	C	Incorrect operation or interpretation of airborne equipment	12	0	0
ATC	D	ATC system loop error	7	11	0
	E	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	390	144	0
	F	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of equipment outage or technical issues	10	1	0
Aircraft/ Avionics/ Contingencies	G	Aircraft contingency event leading to sudden inability to maintain assigned flight level	0	0	0
	H	Airborne equipment failure leading to unintentional or undetected change of flight level	2	0	0

Asia : Summary of LHDs

Attributions	Category Code	Description	Number of Occurrences	Duration (minutes)	Number of Levels Crossed
Weather/ Turbulence	I	Turbulence or other weather related causes leading to unintentional or undetected change of flight level	46	2.5	0
TCAS	J	TCAS resolution advisory, flight crew correctly climb or descend following the resolution advisory	2	1	0
	K	TCAS resolution advisory, flight crew incorrectly climb or descend following the resolution advisory	0	0	0
Other	L	An aircraft being provided with RVSM separation is not RVSM approved	0	0	0
	M	Other	17	0	0
		Total	**518**	**192**	**0**

Asia : Horizontal Collision Risk

Asia : Horizontal Collision Risk Estimates

Number of annual flying hours: 503,528 hours/year

2022 Asia Area	Horizontal Risk Estimate	Airspace	Remark
30NM Lateral Risk	0.068 x 10-9 FAPFH	SEA	Below TLS
50NM Lateral Risk	0.096 x 10-9 FAPFH	SEA	
30NM Longitudinal Risk	0.786 x 10-9 FAPFH	SEA	Below TLS
50NM Longitudinal Risk	0.475 x 10-9 FAPFH	SEA and SA/IO	Below TLS
2021 Asia Area	**Horizontal Risk Estimate**		**Remark**
30NM Lateral Risk	0.0015 x 10^{-9} FAPFH	SEA and SA/IO	Below TLS
50NM Longitudinal Risk	1.02 x 10^{-9} FAPFH	SEA and SA/IO	Below TLS

Asia : Summary of LLDs and LLEs

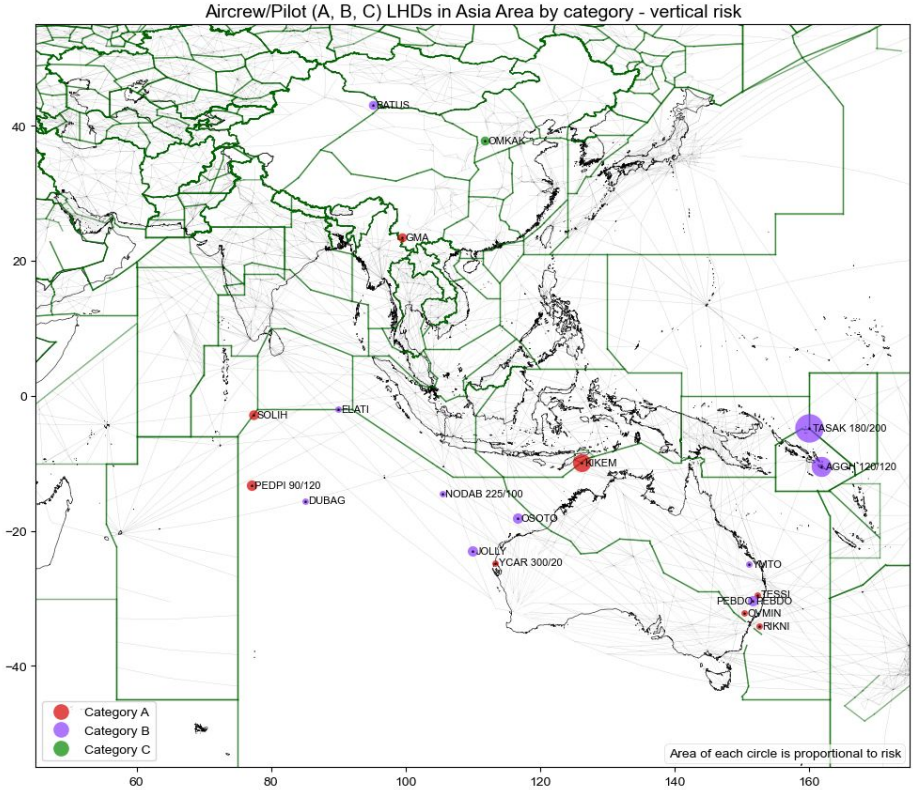
Attributions	Category Code	Description	Number of Occurrences	Duration (minutes)	Number of Tracks/Routes Crossed	Horizontal Deviation (NM)
Aircrew/ Pilot	A	Flight crew deviate without ATC Clearance	1	0	0	15
	B	Incorrect estimate or route provided due to incorrect operation or interpretation of airborne equipment	0	0	0	0
	C	Flight crew waypoint insertion error, due to correct entry of incorrect position or incorrect entry of correct position	0	0	0	0
ATC	D	ATC system loop error	0	0	0	0
	E	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	1	0	0	89
	F	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of equipment outage or technical issues	0	0	0	0

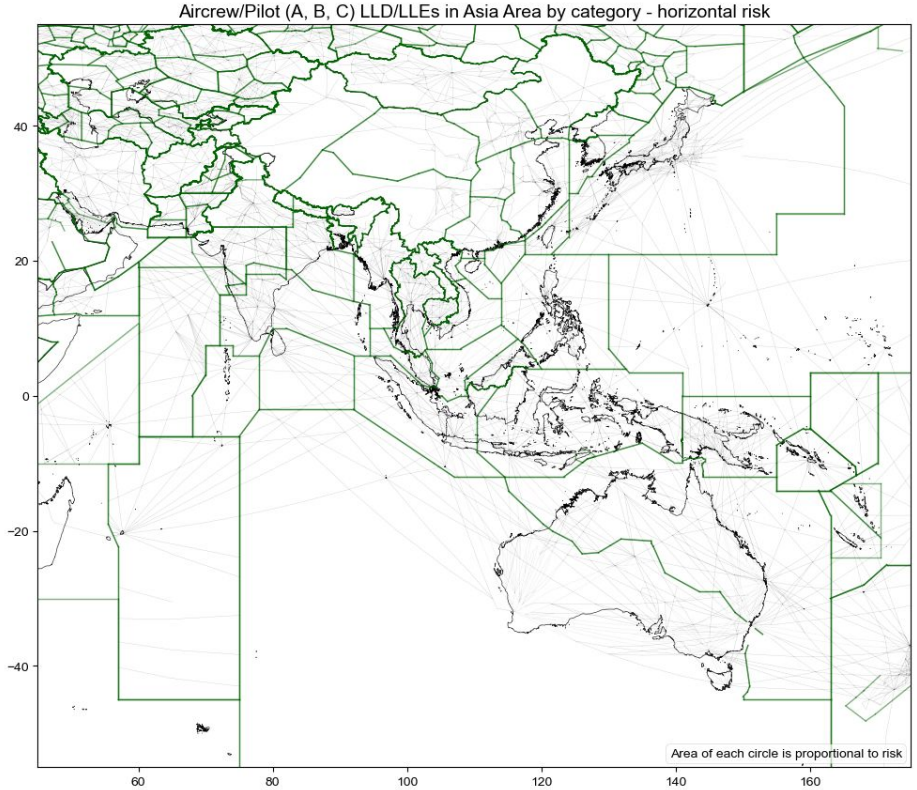
Asia : Summary of LLDs and LLEs

Attributions	Category Code	Description	Number of Occurrences	Duration (minutes)	Number of Tracks/Routes Crossed	Horizontal Deviation (NM)
Aircraft/ Avionics/ Contingencies	G	Navigation errors due to airborne equipment failure	0	0	0	0
Weather/ Turbulence	H	Turbulence or other weather related causes leading to a deviation in the horizontal dimension	0	0	0	0
Other	I	An aircraft was provided with reduced horizontal separation minima but did not meet the RNP/RSP/RCP specification;	0	0	0	0
	J	Other	0	0	0	0
		Total	2	0	0	104

Asia : Geolocation of LHDs/LLDs/LLEs

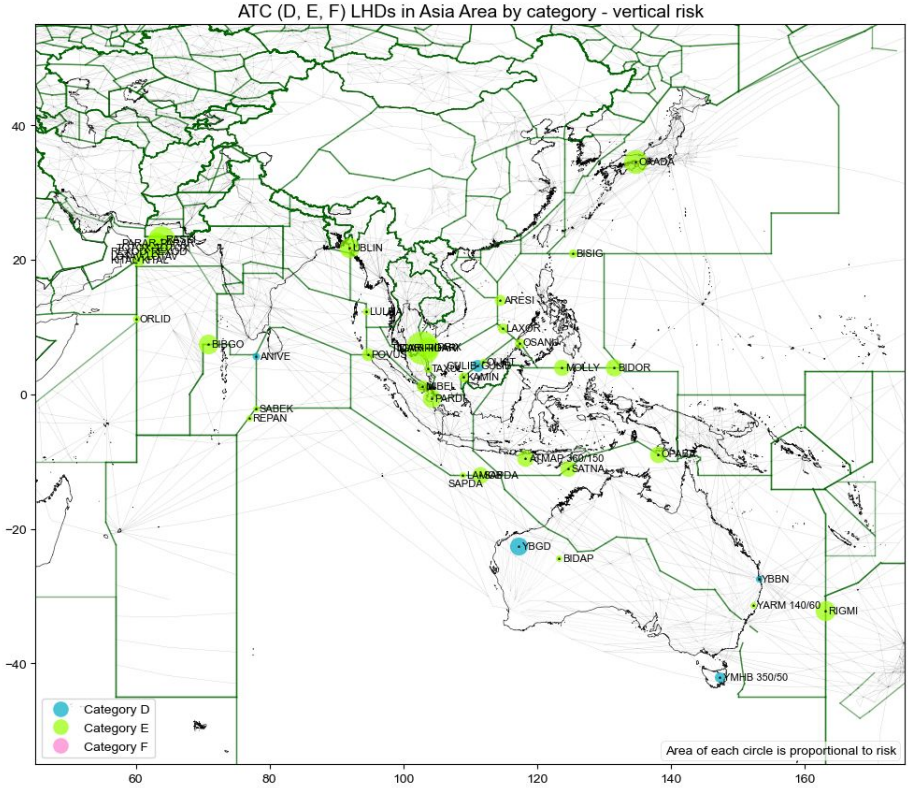
Asia : Aircrew/Pilot (A, B, C)

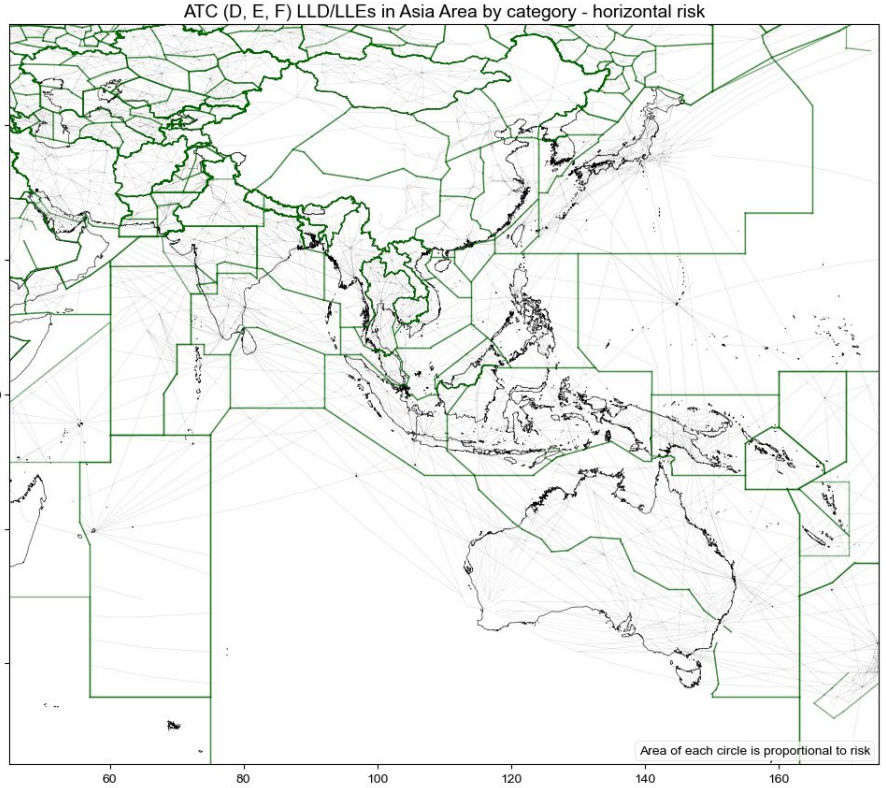




Note: No non-zero Category A, B and C LLD/LLE in 2022

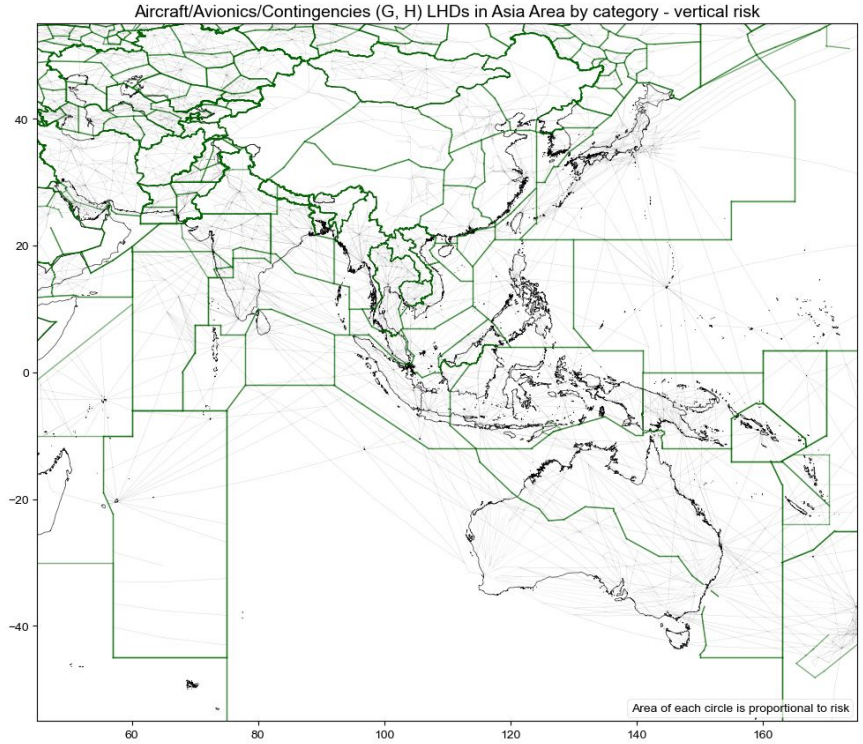
Asia : ATC (D, E, F)



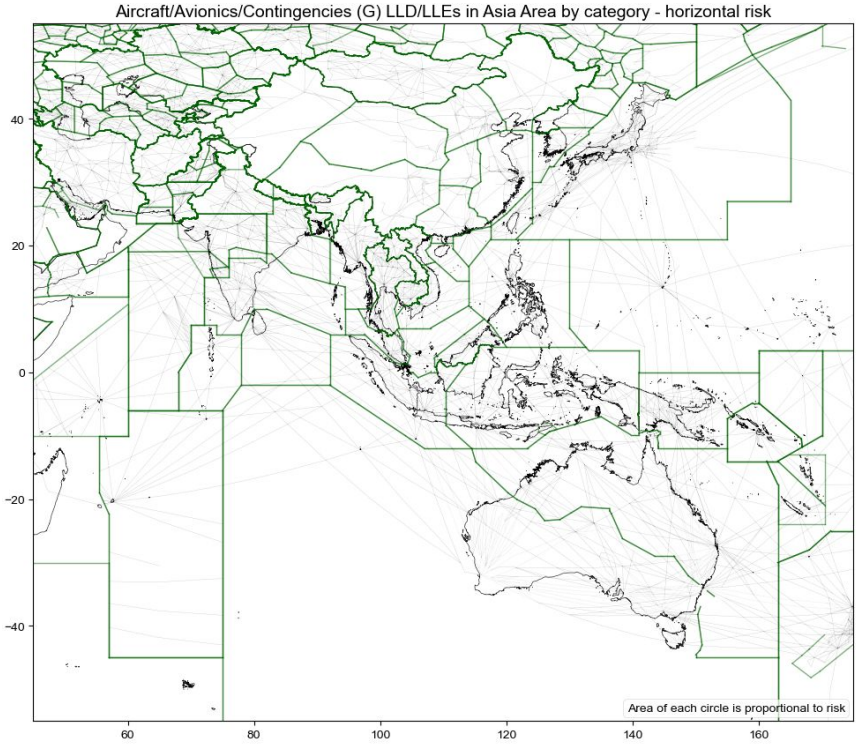


Note: No non-zero Category D, E and F LLD/LLE in 2022

Asia : Aircraft Avionics/Contingencies (G, LHD:H)

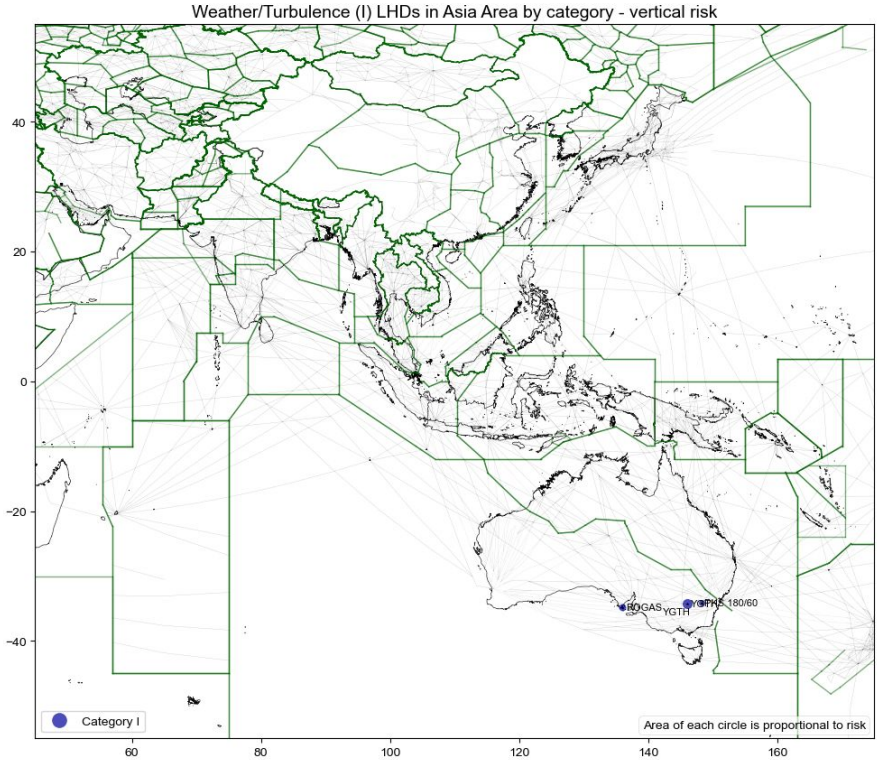


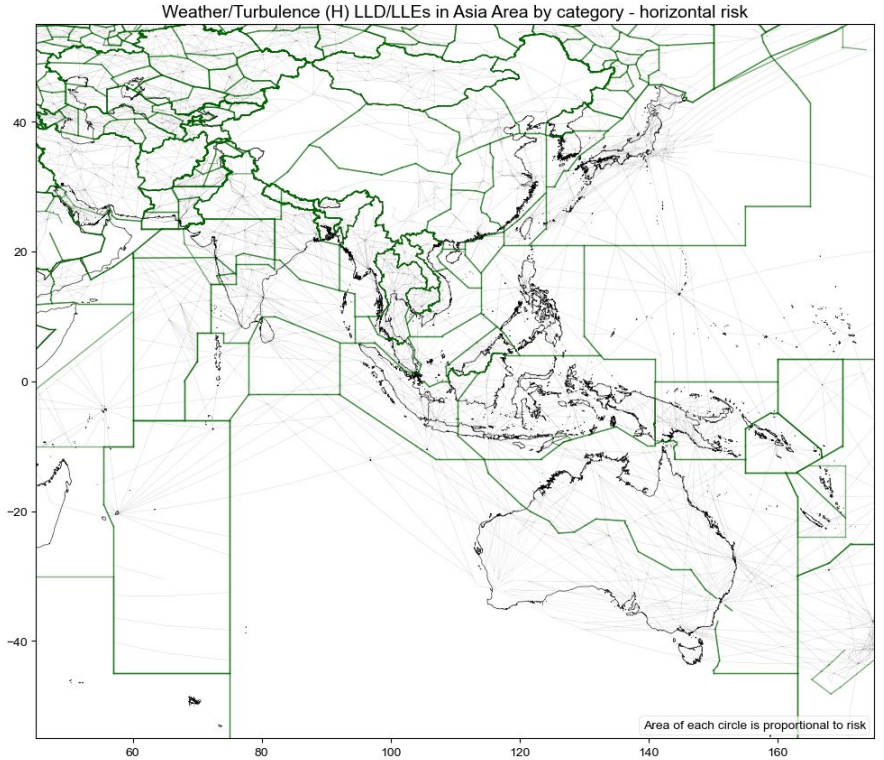
Note: No non-zero Category G and H LHD in 2022



Note: No non-zero Category G LLD/LLE in 2022

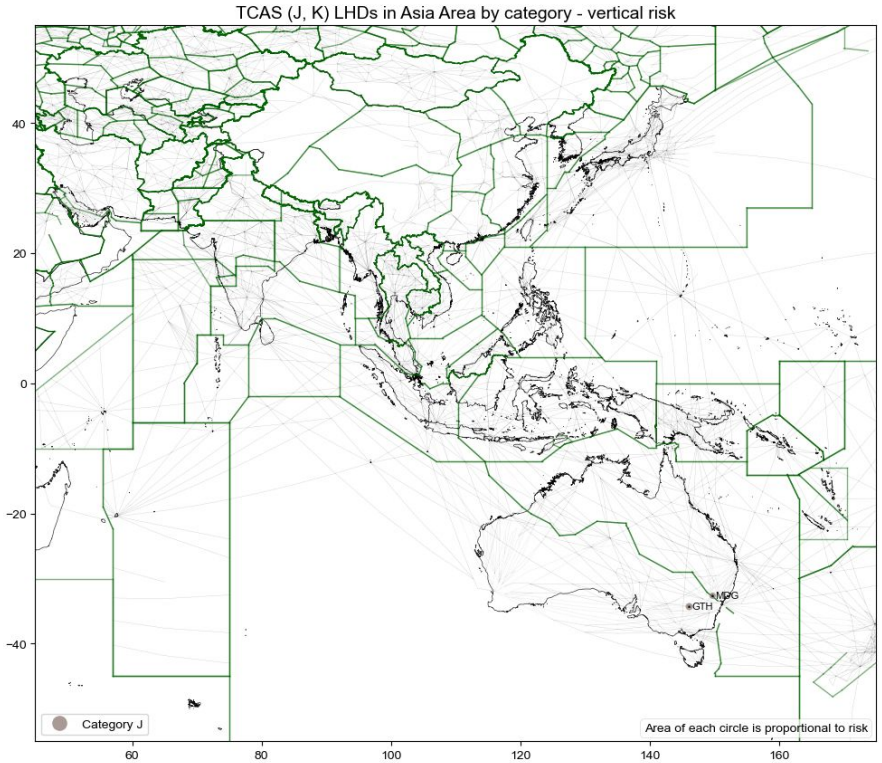
Asia : Weather/Turbulence (LHD:I, LLD/LLE:H)

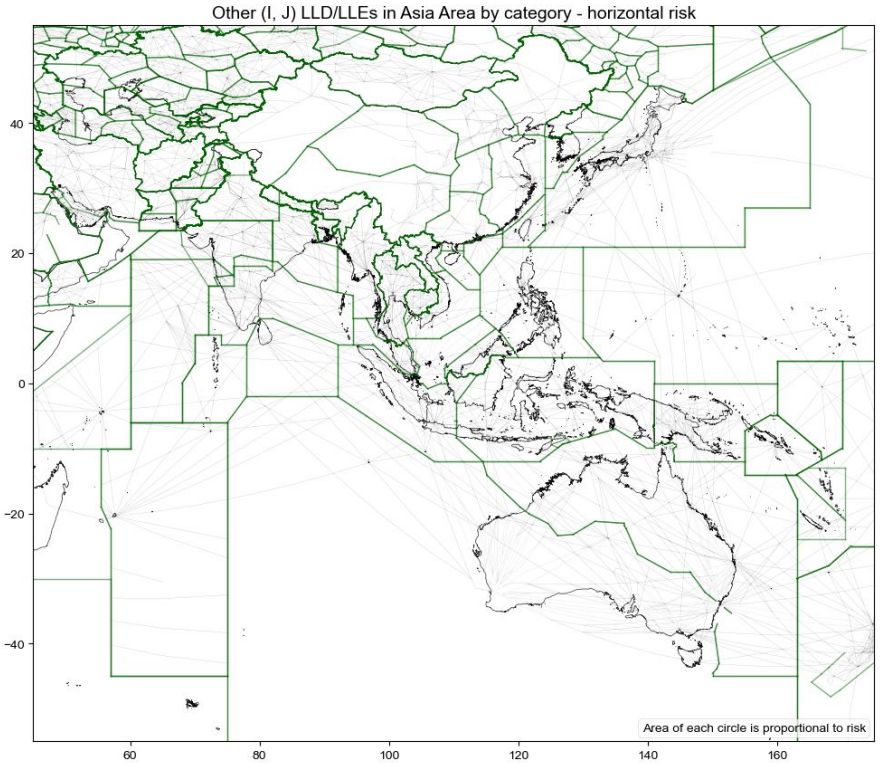




Note: No non-zero Category H LLD/LLE in 2022

Asia : TCAS (LHD:J, K)





Note: No non-zero Category I and J LLD/LLE in 2022

Asia : Hot Spots

Asia : LHD Hot Spot A1 (Kolkata/Dhaka/Chennai - Yangon)

Nature of Occurrences : Coordination errors as a result of human factors issues (Category E)

Contributing Factors :
- Some gaps in communication and surveillance coverage
- The recovery of traffic

Trend : The number of LHDs significantly increased in 2022. However, there was one non-zero-duration LHD, contributing to the operational risk of 0.02 x 10^{-9} FAPFH.

Mitigations :
- The surveillance was enhanced by Space-Based ADS-B of Indian FIRs and ADS-B data sharing among Kolkata ACC, Chennai ACC and Yangon ACC.
- The AIDC has been initiated between Kolkata ACC/Chennai ACC and Yangon ACC, but has not been successfully operated yet.

Boundary	The Number of LHDs		
	2020	2021	2022
Kolkata-Yangon	8	1	17
Chennai-Yangon	3	8	23
Boundary	**Operational Risk (FAPFH)**		
	2020	**2021**	**2022**
Kolkata-Yangon	0	0	0
Chennai-Yangon	0	0	0.02 x 10^{-9}

Result from the identifying hot spots process :
- Hot Spot A1 satisfies the hot spot criteria in terms of the number of LHD.
- **Hot Spot A1 remains on the hot spot list** and should be monitored until further safety improvement initiatives are implemented and successfully reduce the number of LHDs and the associated risks.

Asia : LHD Hot Spot A2 (Chennai - Yangon/Kuala Lumpur)

Nature of Occurrences : Coordination errors as a result of human factors issues (Category E)

Contributing Factors : Some gaps in communication and surveillance coverage.

Trend : The number of LHDs slightly increased. Nonetheless, there was no non-zero-duration LHD or operational risk in 2022.

Mitigations :
- The surveillance was enhanced by Space-Based ADS-B of Indian FIRs.
- The AIDC operation was successfully implemented between Chennai ACC and Kuala Lumpur ACC since January 2021

Result from the identifying hot spots process :
- Hot Spot A2 does not satisfy any hot spot criteria
- **Hot Spot A2 is labelled as the potential non-hot spot.** If this boundary does not satisfy the hot spot criteria again in 2023, Hot Spot A2 can be proposed for removal from the list of hot spots.

Boundary	The Number of LHDs		
	2020	2021	2022
Chennai-KL	13	21	22
Boundary	**Operational Risk (FAPFH)**		
	2020	2021	2022
Chennai-KL	0	0.05×10^{-9}	0

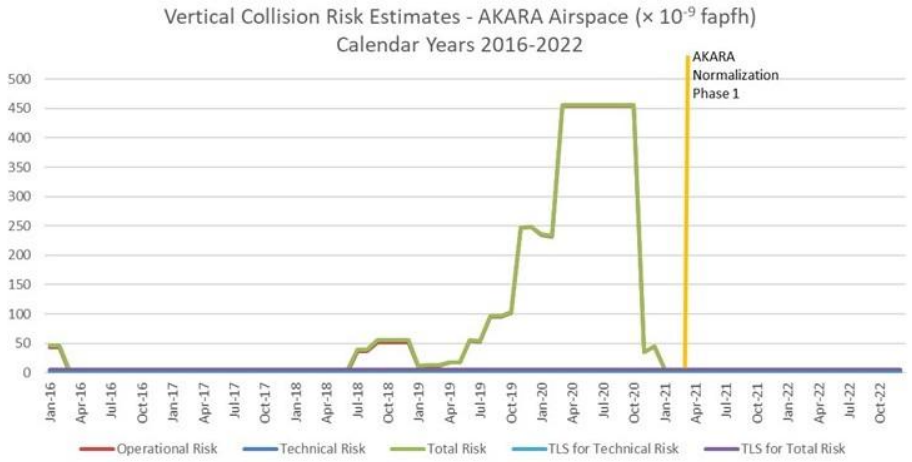
Asia : LHD Hot Spot B (AKARA Airspace)

Nature of Occurrences : Reported occurrences classified as category E are most common.

Contributing Factors : The Flight Level Orientation Scheme (FLOS) limits available flight levels for the high traffic volume in the area. Existing LOA for provision of ATS.

Trend : Identified as a hot spot in 2015. All reported category E occurrences were mitigated in 2022 (also true for 2021), and there has been no reported LHD at the interface between Fukuoka and Incheon FIRs for over two years. As a result the vertical operational risk estimate was zero in 2021 and 2022.

Mitigations :
- Significant route structure change was implemented in March 2021. The Phase I implementation included a parallel airway (Y590/Y591) to A593.
- Mitigations provided by the available surveillance and direct speech circuit.



Asia : LHD Hot Spot D (Manila - adjacent FIRs)

Nature of Occurrences :
- Coordination errors as a result of human factors issues (Category E)
- Several coordination errors as a result of equipment outage or technical issues (Category F) emerging from AIDC failures.

Contributing Factors :
- Communication and surveillance coverage gaps along the boundaries of Manila FIR
- Verbal exchange of transfer information
- Sectors configuration of Manila ACC
- New ATM system and new infrastructure implementation such as AIDC

Trend : In 2021 and 2022, the total number of LHDs and the operational risk at this hot spot decreased from 2020. In 2022, the LHDs and the associated risk frequently occurred at **Manila-Kobe/Fukuoka boundary**.

Boundary	Number of LHDs			Operational Risk (x 10^{-9} FAPFH)		
	2020	2021	2022	2020	2021	2022
Manila-Kobe/Fukuoka*	8	11	8	4.34	6.40	1.73
Manila-Ho Chi Minh	4	7	3	0	0.77	0.05
Manila-Hong Kong	5	2	1	0.19	0	0
Manila-Kota Kinabalu	2	2	3	0.37	0	0.04
Manila-Sanya	2	0	0	0	0	0
Manila-Singapore	3	2	2	0	0	0.04
Manila-Taibei	3	4	3	0	0.07	0
Manila-Ujung Pandang	0	7	2	0	0.36	0.11
Manila-Oakland	0	2	0	0	0	0

Note: *The number of LHDs and operational risk at Manila-Kobe/Fukuoka Boundary are combined from MAAR's and JASMA's analysis. Hence, the same occurrence is counted only once.

Asia : LHD Hot Spot D (Manila - Fukuoka FIR)

Mitigations :
- Several safety improvement activities such as the new ATM system, ACC sector re-sectorization, enhanced surveillance, ADS-C/CPDLC have been implemented.

- Manila ACC and Fukuoka ACC have bilateral meetings regularly and agreed to implement a mitigation measure that would contribute to a reduction of transfer error due to human factor.

Result from the identifying hot spots process in SEA (MAAR):
The Manila-Fukuoka FIR boundary did not satisfied the hot spot criteria in 2022.

Result from the identifying hot spots process in Japan Airspace (JASMA):
The Manila-Fukuoka FIR boundary satisfied the hot spot criteria in terms of the operational risk. Thus, JASMA proposes that the FIR boundary between Fukuoka and Manila FIRs remains as a hot spot.

Hot Spot D remains on the hot spot list due to the result from the hot spot identification process from JASMA. Hot Spot D should be monitored until further safety improvement initiatives are implemented and successfully reduce the number of LHDs and the associated risk.

Asia : LHD Hot Spot F (Mogadishu – Mumbai)

Nature of Occurrences : Coordination errors as a result of human factors issues (Category E)

Contributing Factors : The Mogadishu-Mumbai interface (Waypoint: ORLID, Route: G450) is in the oceanic airspace with poor communication and surveillance coverage.

Trend : Even thought, the number of LHDs increased in 2022, the operational risk conversely decreased.

Mitigations :
- The Space-Based ADS-B enhances surveillance capability of Indian FIRs.
- AIDC implementation between Mumbai ACC and Mogadishu ACC remains in the testing phase.

Result from the identifying hot spots process :
- Even though it does not satisfy any hot spot criteria, **Hot Spot F remains on the hot spot list** until further safety improvement initiatives or prevention measures such as AIDC are completed and demonstrate their effectiveness.

Boundary	The Number of LHDs		
	2020	2021	2022
Mogadishu-Mumbai	8	5	9
Boundary	**The Operational Risk (FAPFH)**		
	2020	2021	2022
Mogadishu-Mumbai	4.8×10^{-9}	0.12×10^{-9}	0.02×10^{-9}

Asia : LHD Hot Spot G (Sanaa/Muscat – Mumbai)

Nature of Occurrences : Coordination errors as a result of human factors issues (Category E)

Contributing Factors : Sanaa-Mumbai and Muscat-Mumbai boundaries are oceanic airspace with poor communication and surveillance coverage.

Trend : The number of LHDs and the operational risk at both boundaries decreased in 2022.

Mitigations :
- The Space-Based ADS-B enhances surveillance capability of Indian FIRs.
- AIDC implementation between Mumbai ACC and Muscat ACC remains in the testing phase.

Result from the identifying hot spots process :
- Hot Spot G meet the criteria in terms of both the number of LHDs and the operational risk. **Hot Spot G remains on the hot spot list** until further safety improvement initiatives or prevention measures such as AIDC are completed and demonstrate their effectiveness.

Boundary	The Number of LHDs		
	2020	2021	2022
Muscat-Mumbai	48	44	43
Sanaa-Mumbai	1	4	2
Boundary	**The Operational Risk (FAPFH)**		
	2020	**2021**	**2022**
Muscat-Mumbai	6.37×10^{-9}	1.35×10^{-9}	0.79×10^{-9}
Sanaa-Mumbai	0	0.07	0

Asia : LHD Hot Spot J (Jakarta – Singapore/Kota Kinabalu)

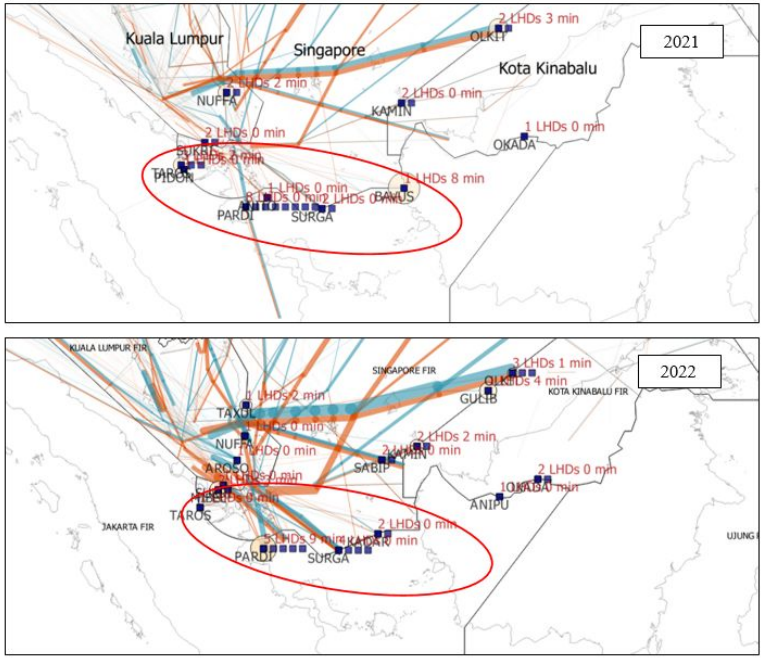
Nature of Occurrences : Coordination errors as a result of human factors issues (Category E)

Contributing Factors : To be analysed

Trend : In SEA airspace, the number of LHDs and operational risk at Singapore-Jakarta boundary slightly decreased in 2022.

Mitigations : AAMA is working with CAAS to share and confirm the information about LHDs on the Jakarta–Singapore FIR interface. AirNav Indonesia is working towards implementation of AIDC, which could mitigate coordination errors due to human factors issues.

Result from the identifying hot spots process :
This boundary satisfied the hot spot criteria in terms of the number of LHDs for 2 consecutive years (2021 and 2022). Therefore, **Hot Spot J remains on the hot spot list**.



Asia : LHD Hot Spot M (Colombo – Melbourne)

Nature of Occurrences : Category A, B, and E LHDs.

Contributing Factors : A large number were pilot errors involving the Indian Navy.

Trend : Since 2019, the number of LHDs at Hot Spot M has been decreasing, so RASMAG/26 proposed to re-classify as a non-Hot Spot. However, AAMA and MAAR still do not have a suitable contact for the Indian Navy.

Mitigations : In 2020, the sectorisation was implemented at Colombo oceanic airspace. Furthermore, awareness and training were promoted to Colombo's ATS.

ICAO had also issued the State Letter to DGCA India (dated 08 Feb 2023) to provide the relevant Point/s of Contact for the India Navy as a mitigation to the LHD Hotspot (M). However, ICAO, AAMA and MAAR have not received any response from DGCA India. For this reason, **Hot Spot M remains on the hot spot list**.

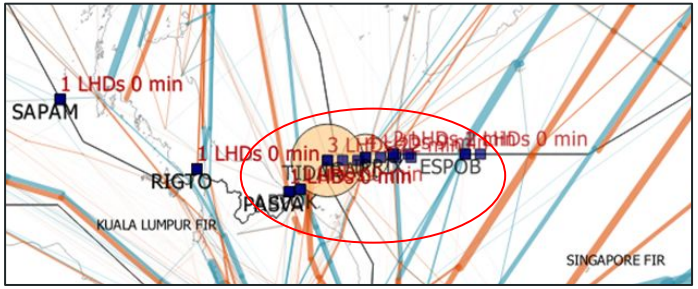
Asia : New LHD Hot Spot O
(Singapore-Bangkok/Ho Chi Minh/Kuala Lumpur)

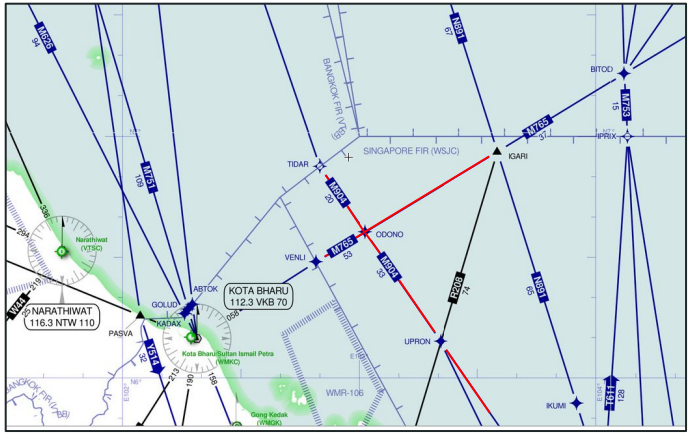
Nature of Occurrences : Coordination errors as a result of human factors issues (Category E).

Contributing Factors : The route structure and ATC procedures of handling crossing traffic over this area can be complex between Singapore ACC and the other three adjacent ATS units.

Trend : The operational risk increased to reach 51% of the total operational risk in SEA airspace.

Result from the identifying hot spots process : The boundary between Singapore FIR and Bangkok/Ho Chi Minh/Kuala Lumpur FIR satisfied the hot spot criteria in terms of the operational risk in 2022. **Thus, this is included on the hot spot list as a <u>new Hot Spot</u>.**





Reporting Rate
of LHDs/LLDs/LLEs

Reporting Rate of LHDs/LLDs/LLEs

Airspace	# Reports							1 Report : Flying Hrs						
	2016	2017	2018	2019	2020	2021	2022	2016	2017	2018	2019	2020	2021	2022
DPRK	0	0	0	0	0	0	0	-	-	-	-	-	-	-
Mongolia	0	4	1	2	0	1	0	-	1: 37,771	1: 158,891	1: 82,138	-	1: 121,621	-
SEA	426	474	205	152	42	70	62	1: 5,884	1: 6,548	1: 17,757	1: 22,275	1: 25,106	1: 15,456	1:32,620
SA/IO	778	935	681	439	152	135	143	1: 3,689	1: 3,166	1: 3,783	1: 7,955	1: 7,907	1: 11,167	1:21,018
Japan	43	71	76	77	66	80	75	1: 33,834	1: 21,510	1: 20,632	1: 20,762	1: 14,737	1: 13,528	1:18,751
China	117	134	110	79	85	105	72	1: 20,413	1: 18,248	1: 22,229	1: 31,119	1: 26,867	1: 15,477	1:18,003
Pacific	33	42	43	173	134	176	179	1: 63,500	1: 54,191	1: 45,064	1: 10,139	1: 6,404	1: 6,638	1:8,280
Indonesia	32	34	23	37	18	41	54	1: 11,520	1: 10,842	1: 53,603	1: 33,321	1: 17,346	1: 7,402	1:8,060
SW Pacific	52	51	53	101	46	47	81	1: 16,639	1: 17,572	1: 17,817	1: 9,335	1: 6,954	1: 11,975	1:5,352
ROK and AKARA	6	5	12	34	5	24	108	1: 93,291	1: 117,090	1: 28,365	1: 18,959	1: 25,965	1: 6,285	1:1,056
Total	**1,487**	**1,750**	**1,204**	**1,094**	**548**	**679**	**774**	**1: 8,905**	**1: 8,180**	**1: 12,332**	**1: 14,330**	**1: 13,202**	**1: 11,200**	**1:13,230**

Notes:

- The flying hours for Indonesian airspace in 2021 was calculated based on the 2020 TSD.
- The flying hours for SW Pacific and Indonesian airspace in 2022 were calculated based on the 2021 TSD.

2022 Reporting Rate of LHDs/LLDs/LLEs

Airspace	Flying Hours	Aircrew/Pilot		ATC		Other		Total	
		# Reports	1 Report : Flying Hrs	# Reports	1 Report : Flying Hrs	# Reports	1 Report : Flying Hrs	# Reports	1 Report : Flying Hrs
DPRK	10	0	-	0	-	0	-	0	-
Mongolia	44,732	0	-	0	-	0	-	0	-
SEA	2,022,449	3	1:674,150	57	1:35,482	2	1:1,011,225	62	1:32,620
SA/IO	3,005,641	2	1:1,502,821	139	1:21,623	2	1:1,502,821	143	1:21,018
Japan	1,406,330	18	1:78,129	26	1:54,090	31	1:45,365	75	1:18,751
China	1,296,204	4	1:32,4051	11	1:117,837	57	1:22,740	72	1:18,003
Pacific	1,482,049	40	1:37,051	136	1:10,897	3	1:494,016	179	1:8,280
Indonesia	435,220	6	1:72,537	48	1:9,067	0	-	54	1:8,060
SW Pacific	433,496	30	1:14,450	45	1:9,633	6	1:72,249	81	1:5,352
ROK and AKARA	114,006	0	-	108	1:1,056	0	-	108	1:1,056
Total	10,240,138	103	1:99,419	570	1:17,965	101	1:101,388	774	1:13,230

Notes:

- The flying hours for SW Pacific and Indonesian airspace in 2022 were calculated based on the 2021 TSD.

Conclusion

RVSM TLS Compliance - Vertical

- **The 2022 PAC vertical overall risk** was 19.62 x 10^{-9} FAPFH. The vertical overall risk slightly decreased from 2021 and was **higher than the target level of safety (TLS)**.
- **The 2022 ASIA vertical overall risk** was 1.53 x 10^{-9} FAPFH. The vertical overall risk decreased from 2021 and remained **below the TLS**. In addition, there is no individual airspace, where has the risk greater than the TLS.

RVSM TLS Compliance - Horizontal

- **All horizontal risk estimates in 2022** were **below the TLS**.

RASMAG's Hot Spot List

Hot Spot	Involved FIRs	Identified	Remarks
A1	Kolkata/Chennai/Dhaka - Yangon	2015	Cat. E LHDs. Risk reduced.
A2	Chennai - Kuala Lumpur	2015	Cat. E LHDs reduced. Risk reduced. Potential non-hotspot 2023 (RASMAG/28)
B	Incheon (AKARA Airspace)	2015	Cat. E LHDs reduced. Risk reduced.
D	Manila - all adjacent FIRs	2015	Cat. E & F LHDs reduced. Risk reduced. Except Manila-Kobe/Fukuoka boundary.
F	Mogadishu - Mumbai	2015	Cat. E LHDs reducing. Risk reducing.
G	Sanaa/Muscat - Mumbai	2015	Cat. E LHDs. Risk reducing.
J	Jakarta - Singapore/Kota Kinabalu	2018	Cat. E LHD.
M	Colombo - Melbourne	2019	LHDs and risk reducing. Awaiting response to establish a POC before removing from the hot spot list.
N	Oakland USA - Hawaii CEP	2019	Cat. E LHDs increasing. Risk increasing.
O	Singapore-Bangkok/ Ho Chi Minh/Kuala Lumpur	2023	Cat. E LHDs.

Reporting Rate of LHDs/LLDs/LLEs

- The flying hours **increased** from 7,234,881 hours in 2020, 7,604,927 in 2021 to **10,240,138 hours in 2022**.
- The overall reporting rate of LHDs/LLDs/LLEs decreased in 2022:
    - 1 report : 13,202 hours in 2020
    - 1 report : 11,200 hours in 2021
    - 1 report : 13,230 hours in 2022
- The reporting rate in ROK and SW Pacific significantly improved the in 2022.
- The reporting rate in SEA and SA/IO dramatically decreased in 2022, because the number of reports in 2022 were similar to the number in 2021, while the flying hours significantly increased.
- Mongolia and DPRK had no report in 2022, while DPRK had no LHD/LLD/LLE report since 2016.

Thank You