International Civil Aviation Organization

Twenty-Seventh Meeting of the Regional Airspace Safety Monitoring Advisory Group (RASMAG/27)

Video Teleconference, 22 – 25 August 2022

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 2021 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 better communicate 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 2021

2.2 The 2021 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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2021 Asia Pacific
Consolidated Safety Report

Asia Pacific EMAs/RMAs

For RASMAG/27

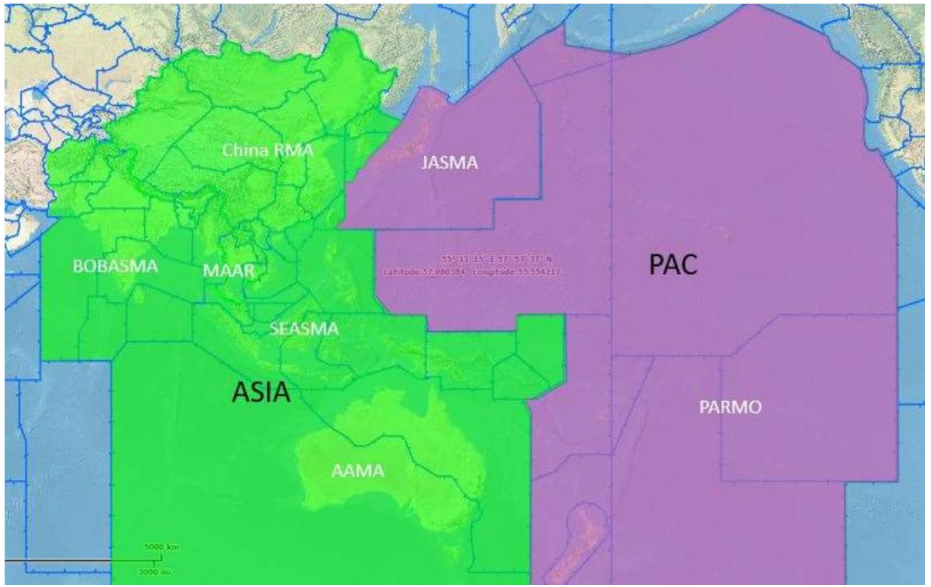
Outline

- 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
- Hot Spot identification process
- 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)

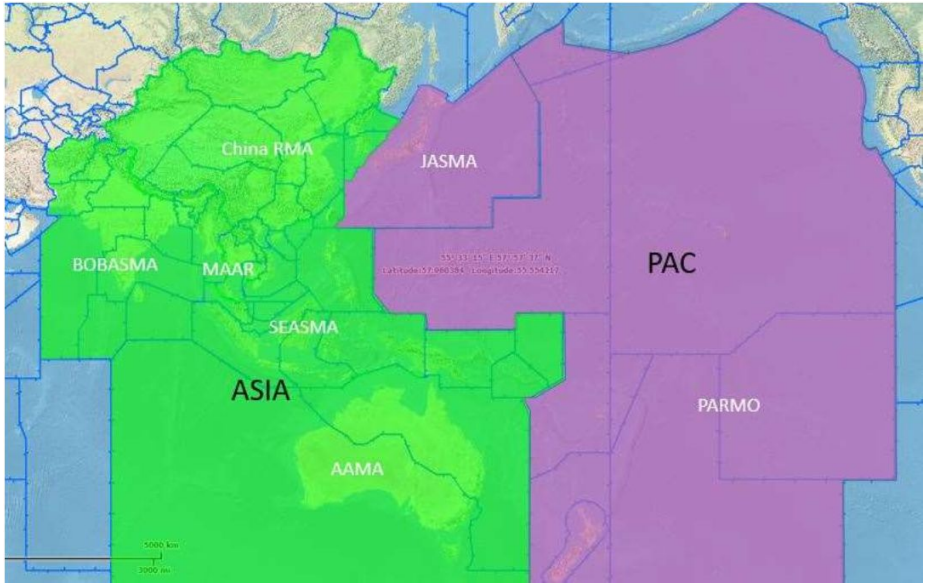
Traffic between North America and Asia, or North America and South Pacific States

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

Monitoring Agencies :

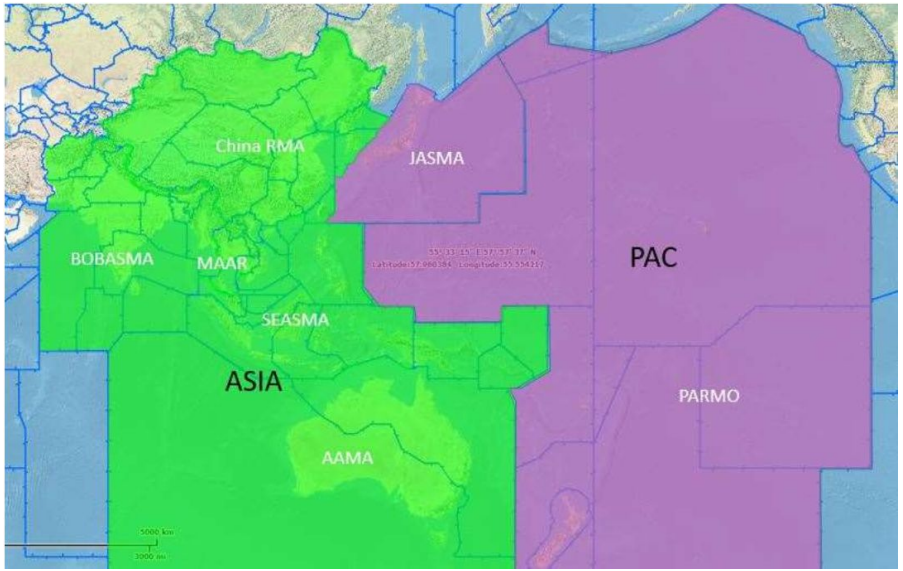
RMAs : JASMA, PARMO

EMAs : 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 : AAMA, China RMA, MAAR, PARMO

EMAs : AAMA, BOBASMA, PARMO, SEASMA

PAC Area

PAC : Vertical Collision Risk

PAC : Vertical Collision Risk Estimates

Number of annual flying hours: 2,159,665 hours/year

2021 PAC Area	Vertical Risk Estimate ($\times 10^{-9}$ FAPFH)	Remark
Vertical Technical Risk	0.14	Below Technical TLS
Vertical Operational Risk	19.61	
Vertical Overall Risk	**19.74**	**Above TLS**

PAC : Vertical Collision Risk Estimates

2016 - 2021

Year	Vertical Overall Risk Estimate (x 10^{-9} FAPFH)	Remark
2021	19.74	Above TLS
2020	16.71	Above TLS
2019	30.21	Above TLS
2018	19.40	Above TLS
2017	7.30	Above TLS
2016	5.01	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	6.80	6
	B	Flight crew climbing/descending without ATC Clearance	8	26.00	22
	C	Incorrect operation or interpretation of airborne equipment	2	4.02	1
ATC	D	ATC system loop error	15	89.12	17
	E	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	62	284.19	2
	F	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of equipment outage or technical issues	3	64	0
Aircraft/ Avionics/ Contingencies	G	Aircraft contingency event leading to sudden inability to maintain assigned flight level	6	19.92	8
	H	Airborne equipment failure leading to unintentional or undetected change of flight level	0	0	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	3.93	3
TCAS	J	TCAS resolution advisory, flight crew correctly climb or descend following the resolution advisory	9	10.42	2
	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	1	0	4
		Total	**123**	**508.40**	**65**

PAC : Horizontal Collision Risk

PAC : Horizontal Collision Risk Estimates

Number of annual flying hours: 1,259,048 hours/year

2021 PAC Area	Horizontal Risk Estimate (x 10^{-9} FAPFH)	Airspace	Remark
30NM Lateral Risk	1.74	Pacific	Below TLS
50NM Lateral Risk	0.71	Japan	Below TLS
30NM Longitudinal Risk	-	Pacific	Below TLS
30NM Longitudinal Risk	0.01	Japan	Below TLS
50NM Longitudinal Risk	2.22	Pacific	Below TLS
10MIN Longitudinal Risk	0.03	Japan	Below TLS
2020 PAC Area	**Horizontal Risk Estimate (x 10^{-9} FAPFH)**	**Airspace**	**Remark**
30NM Lateral Risk	0.09	Pacific	Below TLS
50NM Lateral Risk	0.65	Japan	Below TLS
30NM Longitudinal Risk	3.73	Pacific and Japan	Below TLS
50NM Longitudinal Risk	2.22	Pacific	Below TLS
10MIN Longitudinal Risk	0.25	Japan	Below TLS

PAC : Summary of LLDs and LLEs

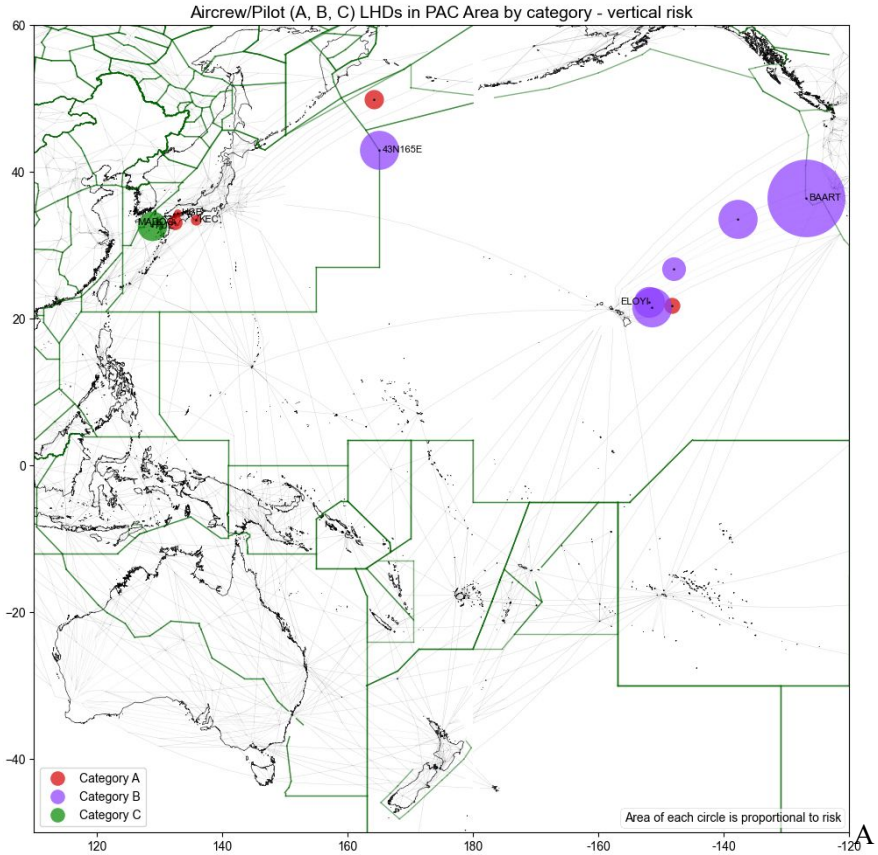
Attributions	Category Code	Description	Number of Occurrences	Duration (minutes)	Number of Tracks/Routes Crossed	Horizontal Deviation (NM)
Aircrew/ Pilot	A	Flight crew deviate without ATC Clearance	10	52	1	175
	B	Incorrect estimate or route provided due to incorrect operation or interpretation of airborne equipment	1	0	0	10
	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	4	75	1	45
	E	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	105	418	0	226
	F	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of equipment outage or technical issues	10	73	0	0

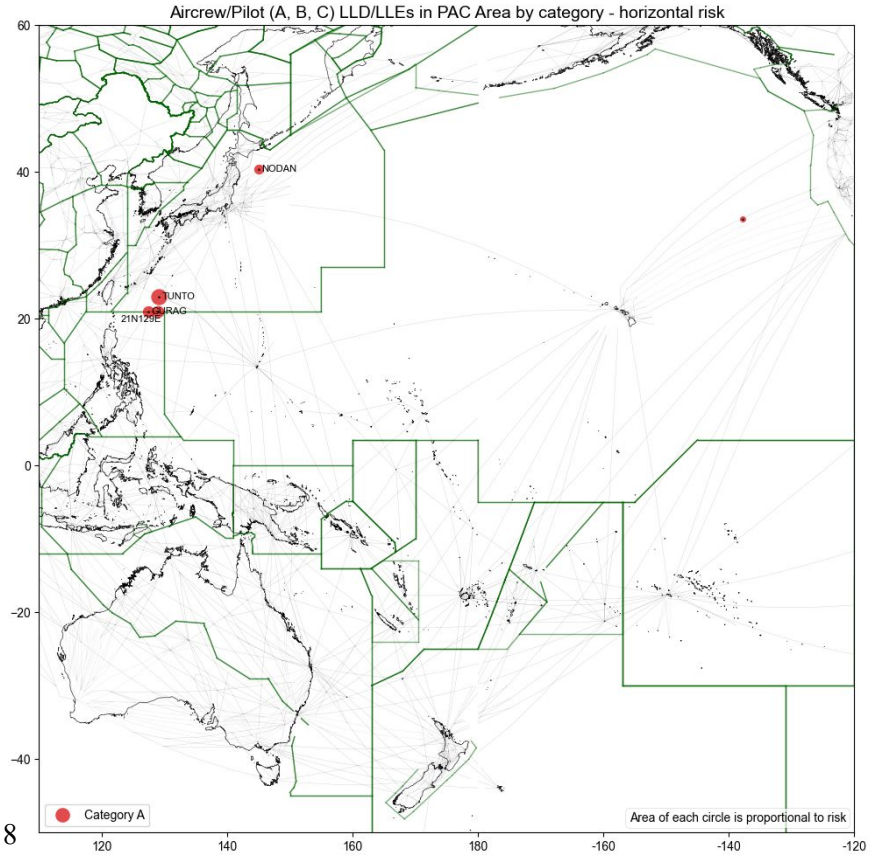
PAC : Summary of LLDs and LLEs

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	1	16	0	11
Weather/ Turbulence	H	Turbulence or other weather related causes leading to a deviation in the horizontal dimension	5	30	0	130
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	1	0	0	0
		Total	**137**	**664**	**2**	**597**

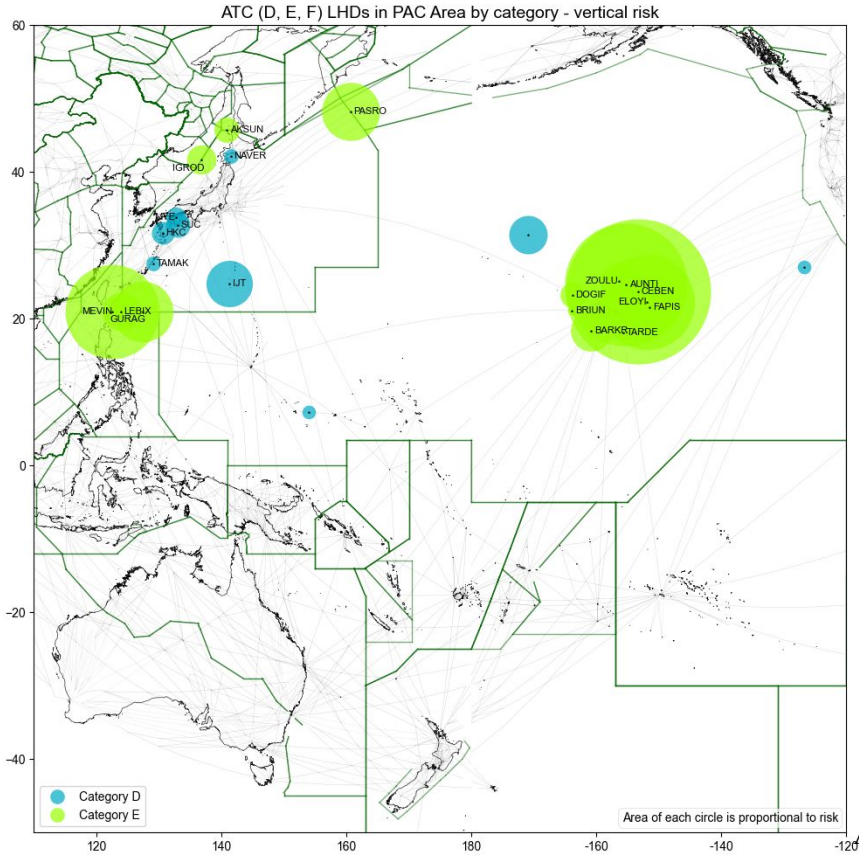
PAC : Geolocation of LHDs/LLDs/LLEs

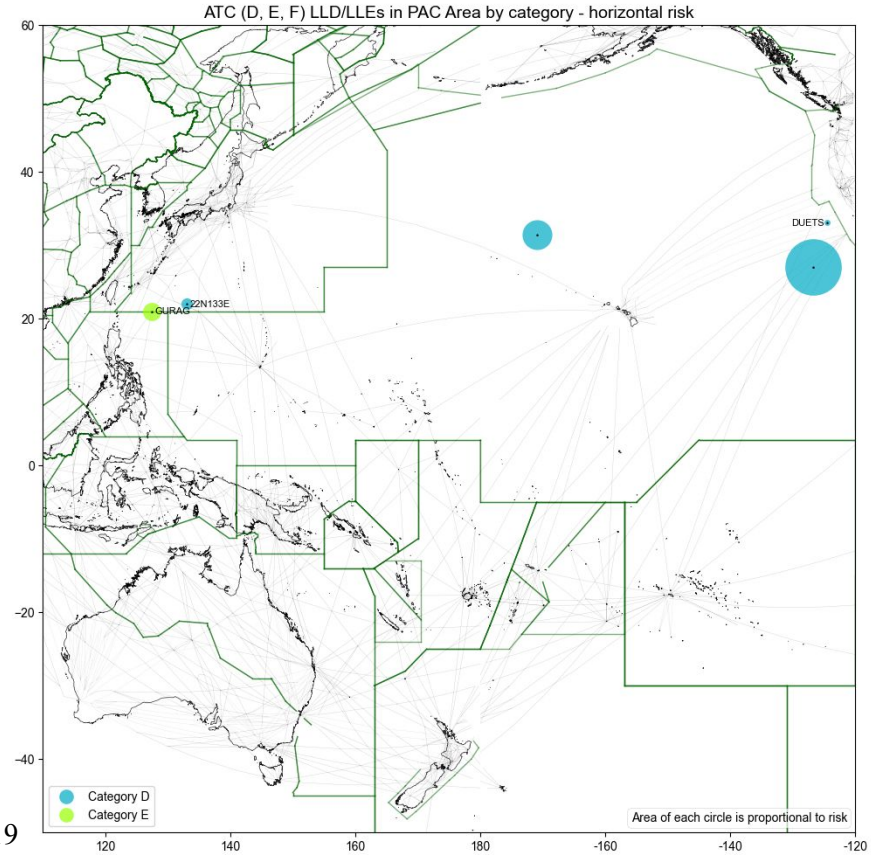
PAC : Aircrew/Pilot (A, B, C)



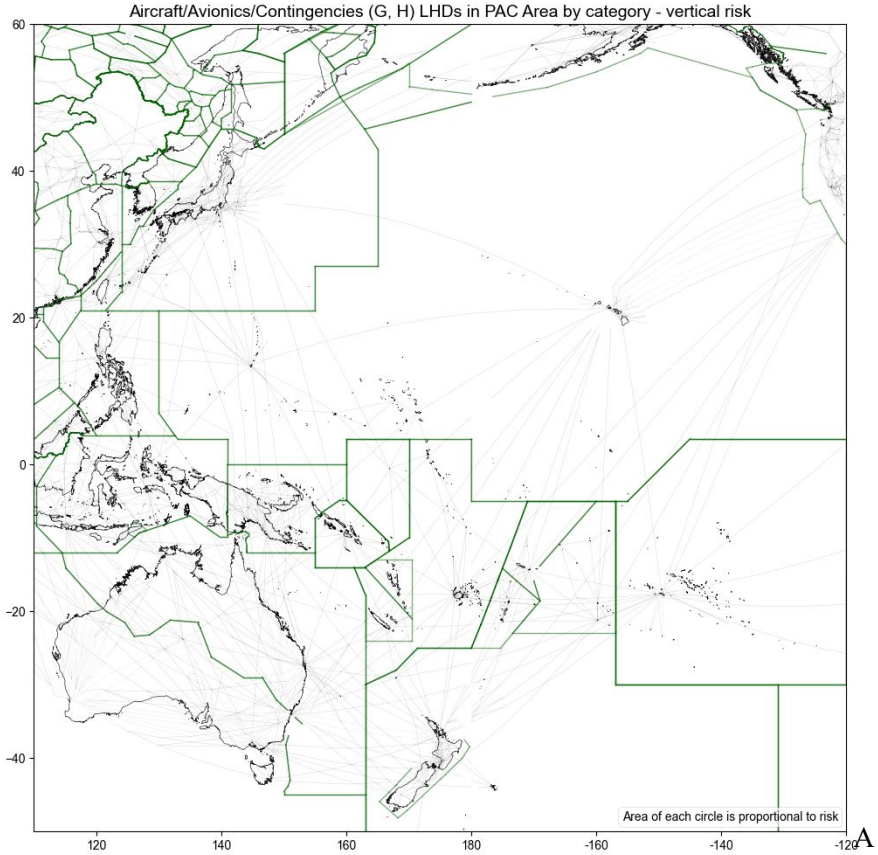


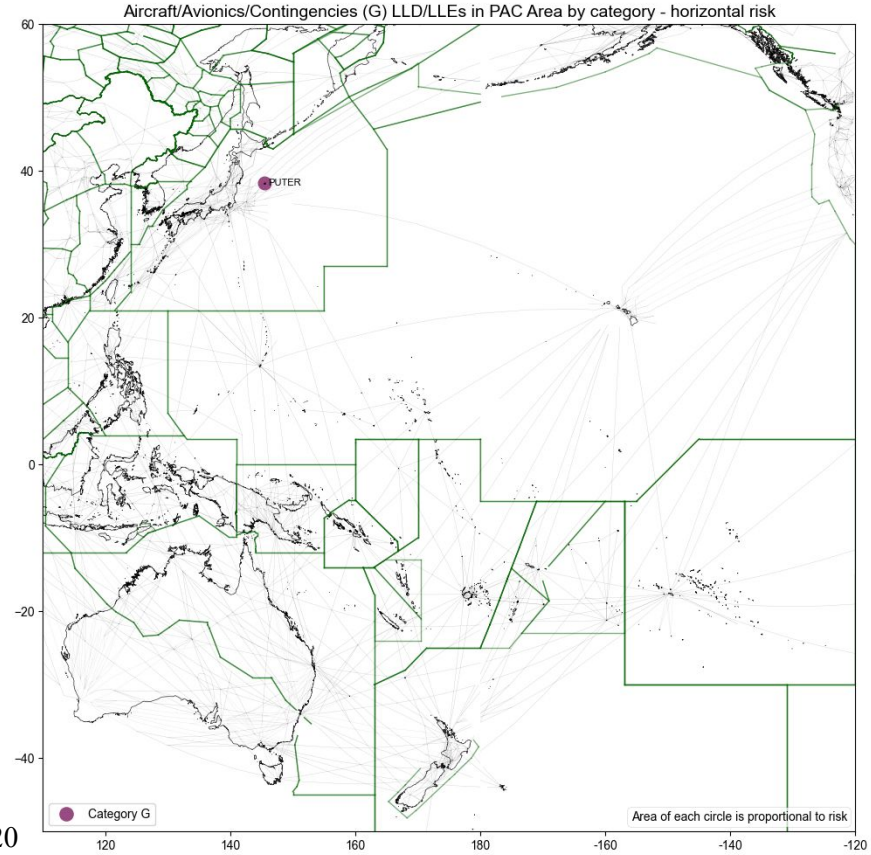
PAC : ATC (D, E, F)


ATC (D, E, F) LHDs in PAC Area by category - vertical risk
PASRO
AKSUN
NAVER
IGROD
TAMAK
IJT
MEVIN
LERIX
GURAG
ZOULU
DOGIF
BRIUN
AUNTI
CEBEN
ELOYL
FAPIS
BARKS
TARDE
Category D
Category E
Area of each circle is proportional to risk

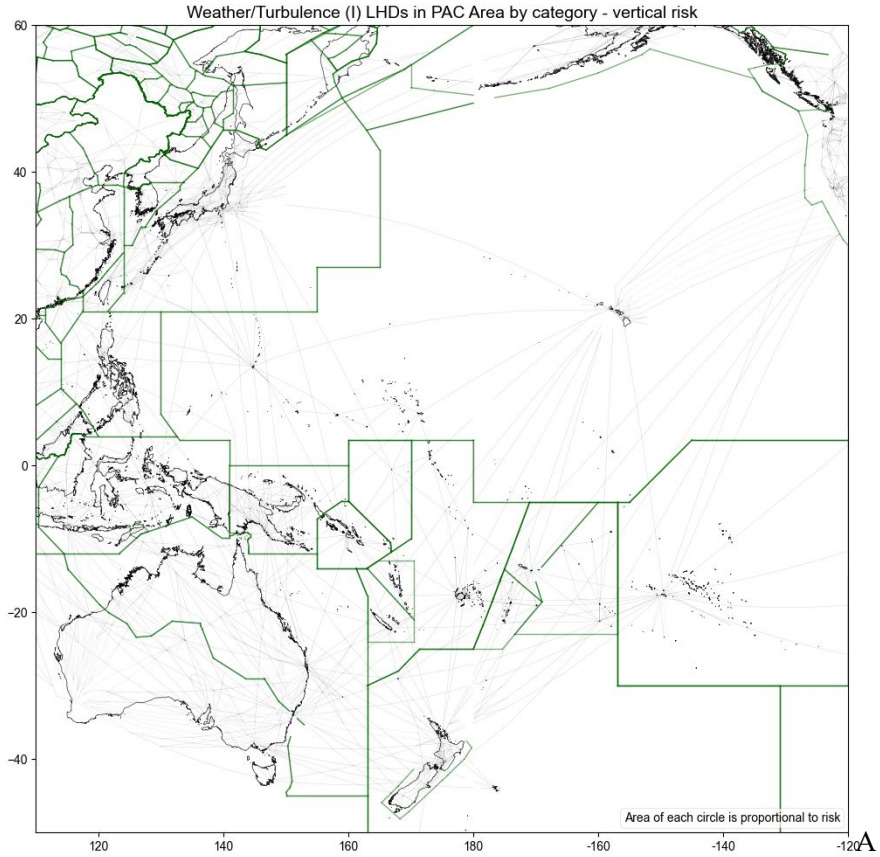

ATC (D, E, F) LLD/LLEs in PAC Area by category - horizontal risk
DUETS
22N133E
GURAG
Category D
Category E
Area of each circle is proportional to risk

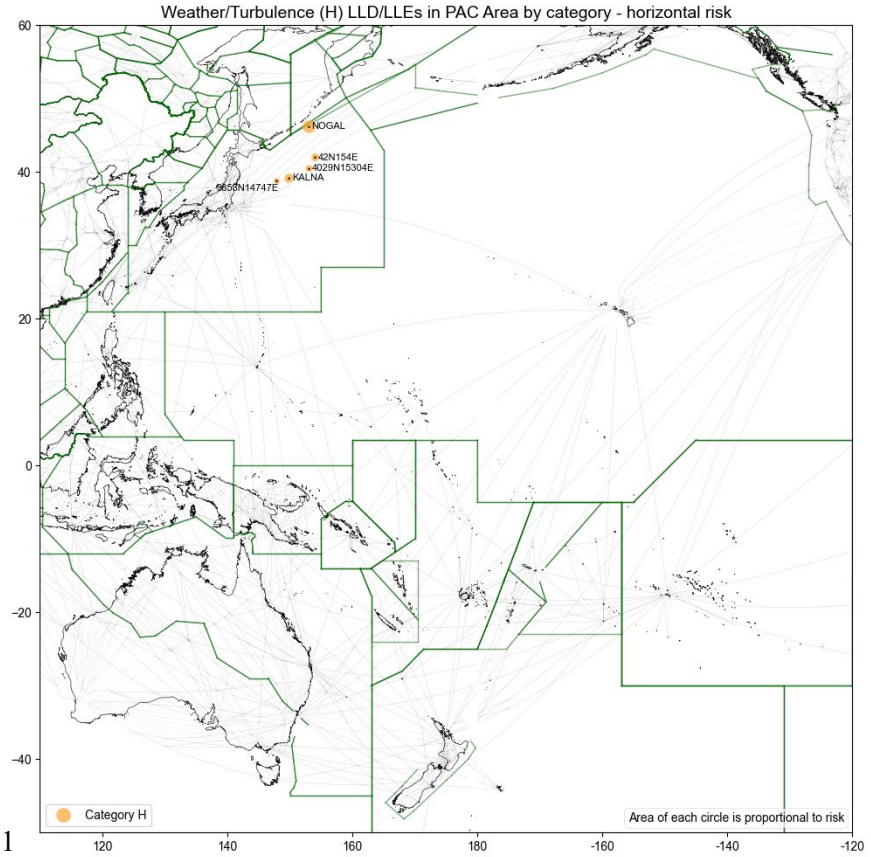
PAC : Aircraft Avionics/Contingencies (G, LHD:H)



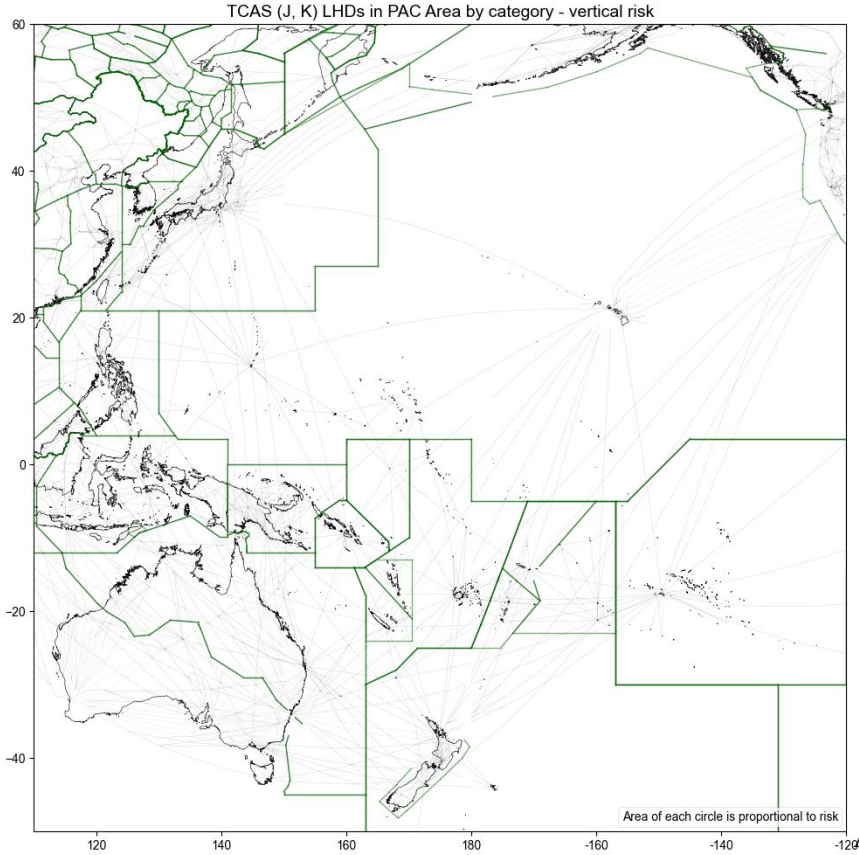


PAC : Weather/Turbulence (LHD:I, LLD/LLE:H)





PAC : TCAS (LHD:J, K)



PAC : Hot Spots

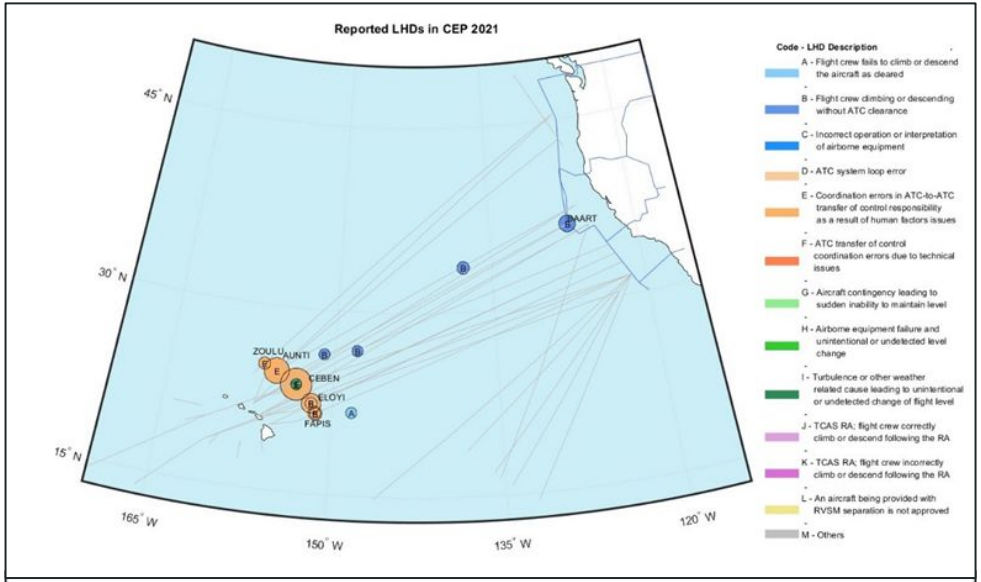
PAC : LHD Hot Spot N (North America - Hawaii CEP)

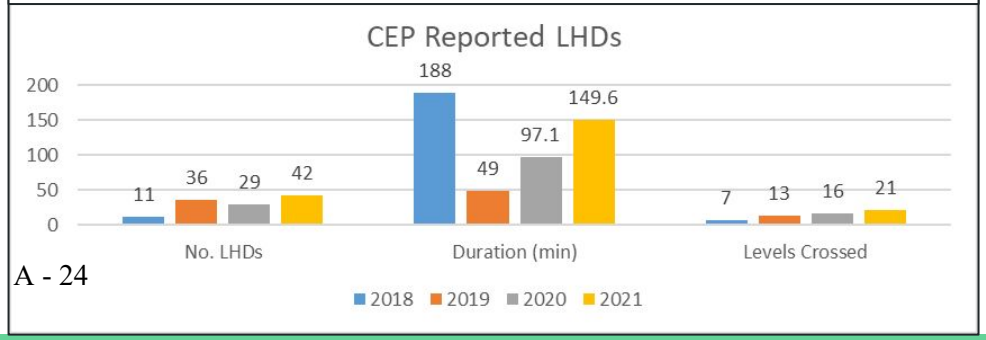
Nature of Occurrences : In 2018, several long duration LHDs were reported. Category E LHDs are the largest contribution to the estimate of risk in 2019, 2020 and 2021.

Contributing Factors : Central East Pacific (CEP) has high traffic volume. These 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 : A task force was established and has developed a long-term plan to prevent these occurrences. The short-term strategies include a procedure for ATC to manually transfer the ETA to the next facility and ATC refresher training to update the aircraft profile in the automation system.





Asia Region

Asia : Vertical Collision Risk

ASIA : Vertical Collision Risk Estimates

Number of annual flying hours: 5,021,298 hours/year

2021 ASIA Area	Vertical Risk Estimate (x 10^{-9} FAPFH)	Remark
Vertical Technical Risk	0.32	Below Technical TLS
Vertical Operational Risk	3.71	
Vertical Overall Risk	4.03	**Below TLS**

Note:

The flying hours, technical risk and operational risk for Indonesian airspace were calculated based on the 2020 TSD.

ASIA : Vertical Collision Risk Estimates

2016 - 2021

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

Year	Vertical Overall Risk Estimate (x 10^{-9} FAPFH)	Remark
2021	**4.03**	**Below TLS**
2020	7.42	Above TLS
2019	12.88	Above TLS
2018	15.50	Above TLS
2017	27.30	Above TLS
2016	12.53	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	17	5	20
	B	Flight crew climbing/descending without ATC Clearance	12	0	12
	C	Incorrect operation or interpretation of airborne equipment	11	21.5	0
ATC	D	ATC system loop error	11	1.5	26
	E	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	211	237	12
	F	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of equipment outage or technical issues	8	0	0
Aircraft/ Avionics/ Contingencies	G	Aircraft contingency event leading to sudden inability to maintain assigned flight level	2	0	0
	H	Airborne equipment failure leading to unintentional or undetected change of flight level	6	0	8

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	51	0	37
TCAS	J	TCAS resolution advisory, flight crew correctly climb or descend following the resolution advisory	5	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	2	60	0
	M	Other	30	13	0
		Total	**379**	**339**	**115**

Asia : Horizontal Collision Risk

Asia : Horizontal Collision Risk Estimates

Number of annual flying hours: 333,153 hours/year

2021 Asia Area	**Horizontal Risk Estimate** (x 10^{-9} FAPFH)	**Remark**
30NM Lateral Risk	0.0015	Below TLS
50NM Longitudinal Risk	1.02	Below TLS
2020 Asia Area	**Horizontal Risk Estimate** (x 10^{-9} FAPFH)	**Remark**
30NM Lateral Risk	0.0004	Below TLS
50NM Longitudinal Risk	0.85	Below TLS
2019 Asia Area	**Horizontal Risk Estimate** (x 10^{-9} FAPFH)	**Remark**
30NM Lateral Risk	0.0001	Below TLS
50NM Longitudinal Risk	0.25	Below TLS

Asia : Summary of LLDs and LLEs

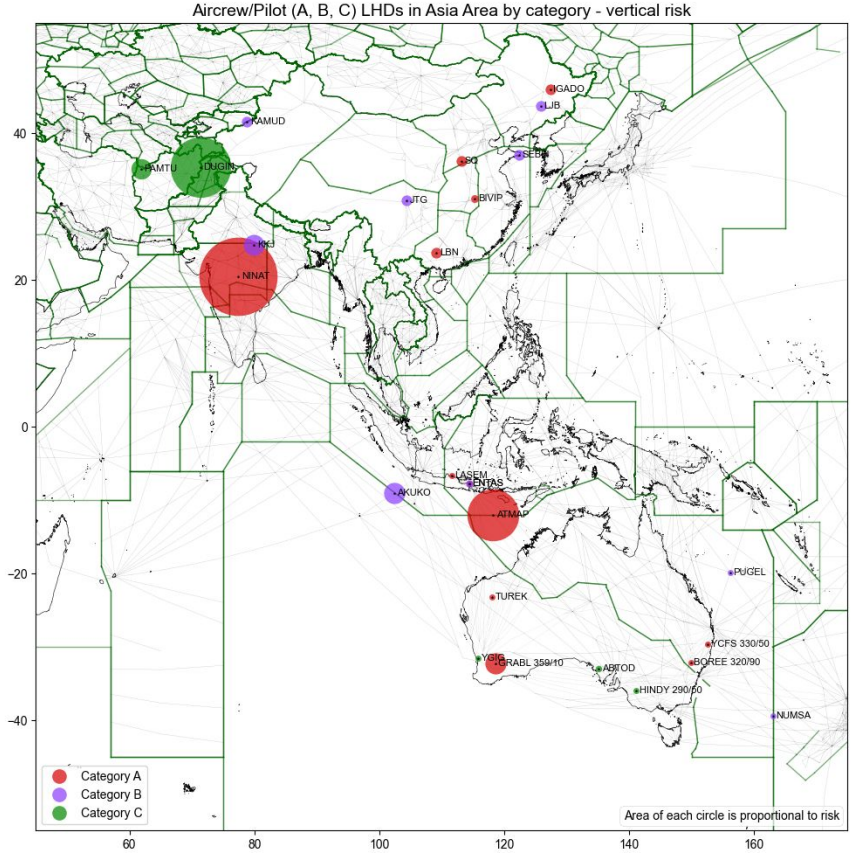
Attributions	Category Code	Description	Number of Occurrences	Duration (minutes)	Number of Tracks/Routes Crossed	Horizontal Deviation (NM)
Aircrew/ Pilot	A	Flight crew deviate without ATC Clearance	0	0	0	0
	B	Incorrect estimate or route provided due to incorrect operation or interpretation of airborne 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	29	0	0
	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

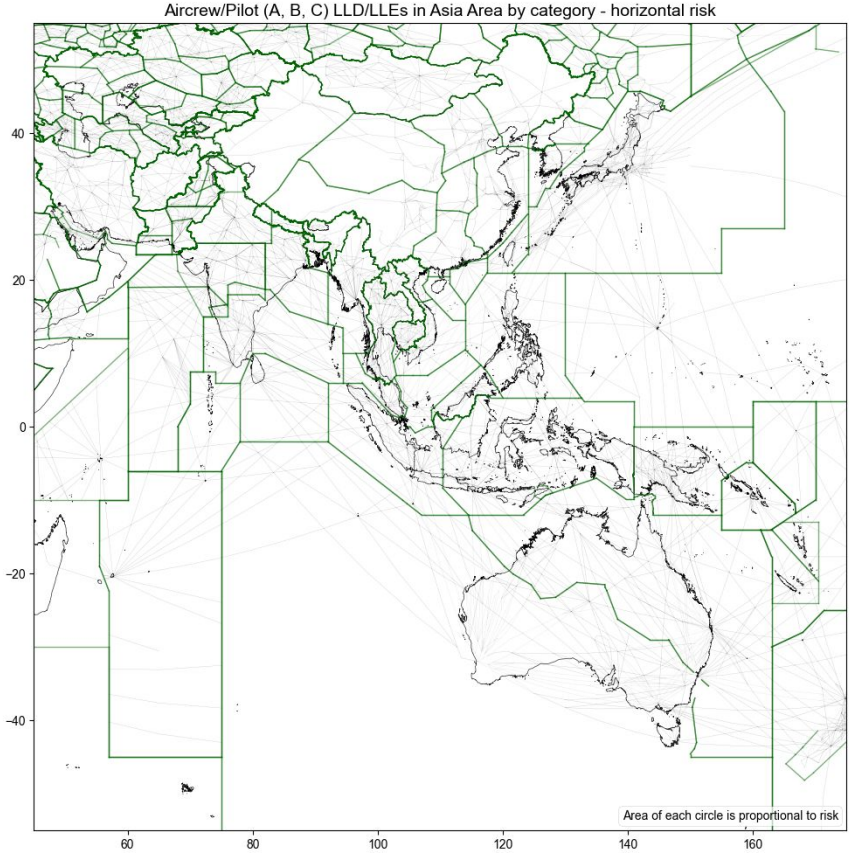
Asia : Summary of LLDs and LLEs

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	**1**	**29**	**0**	**0**

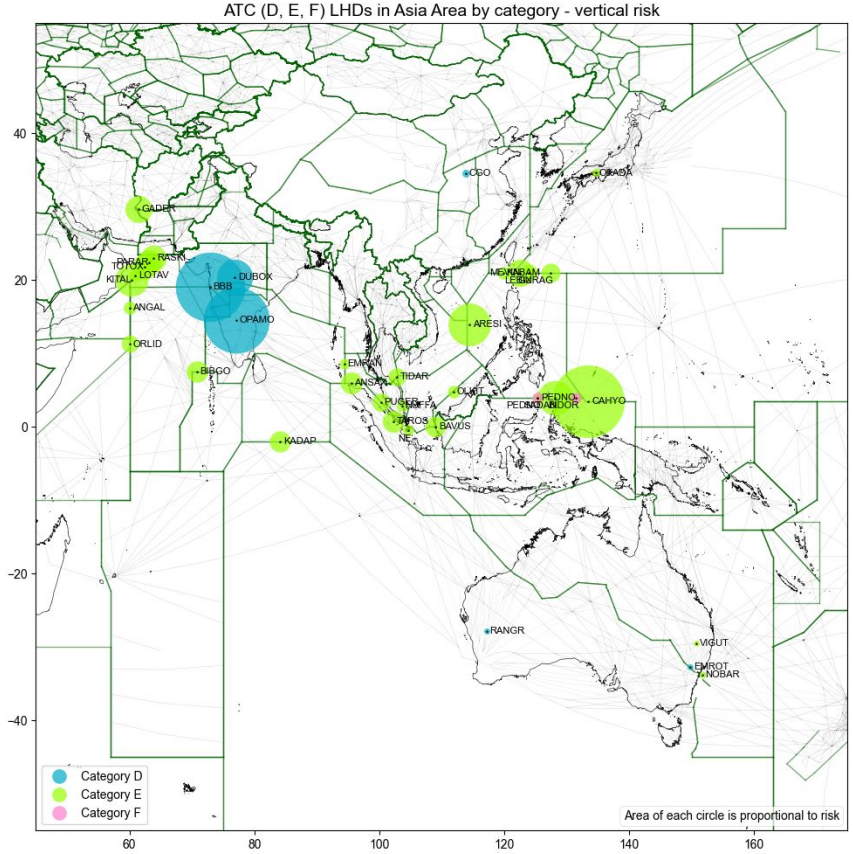
Asia : Geolocation of LHDs/LLDs/LLEs

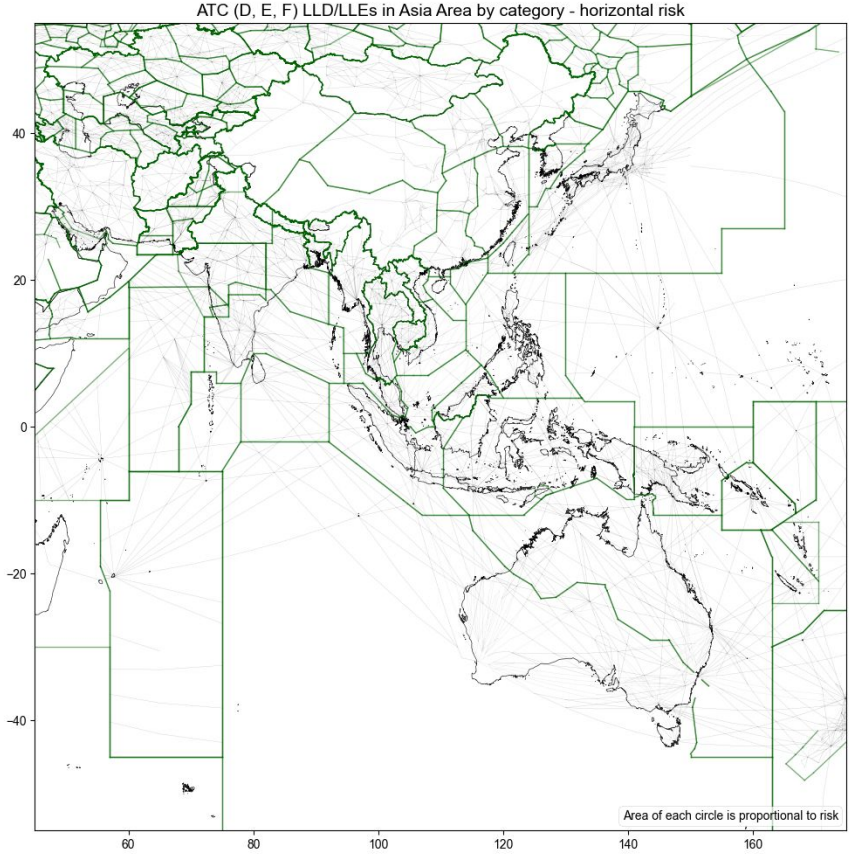
Asia : Aircrew/Pilot (A, B, C)



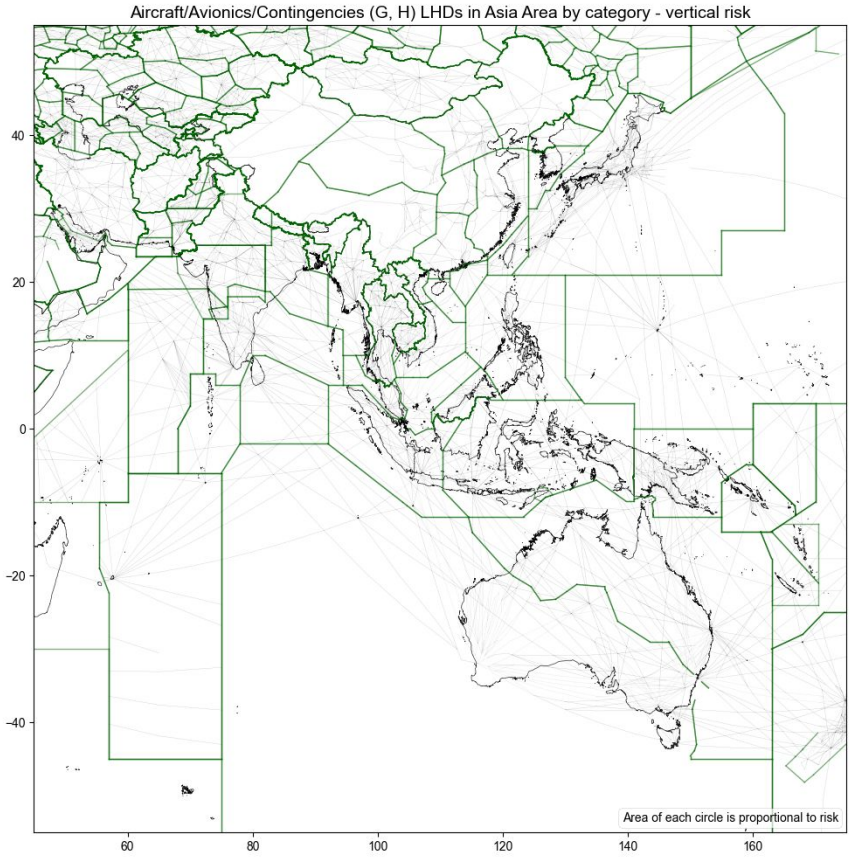


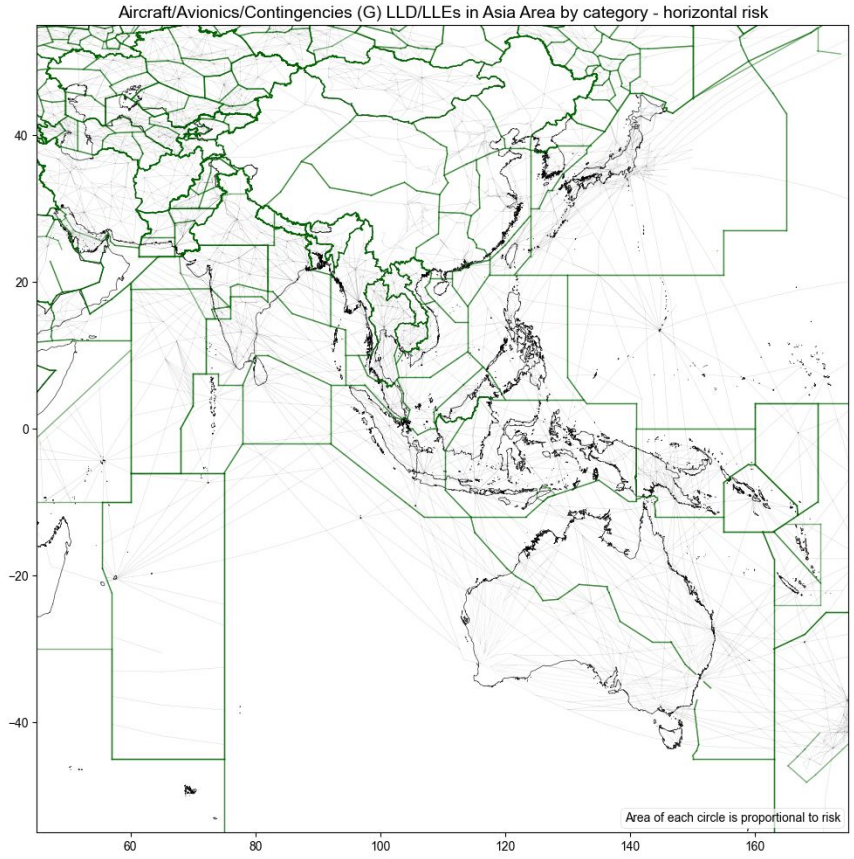
Asia : ATC (D, E, F)


ATC (D, E, F) LHDs in Asia Area by category - vertical risk
GADER
RASKI
DUBOX
BBB
ANGAL
OPAMO
ORLID
BIBGO
KADAP
ARESI
CGO
RANGR
VIGUT
EMROT
NOBAR
CAHYO
Category D
Category E
Category F
Area of each circle is proportional to risk
40
20
0
−20
−40
60
80
100
120
140
160

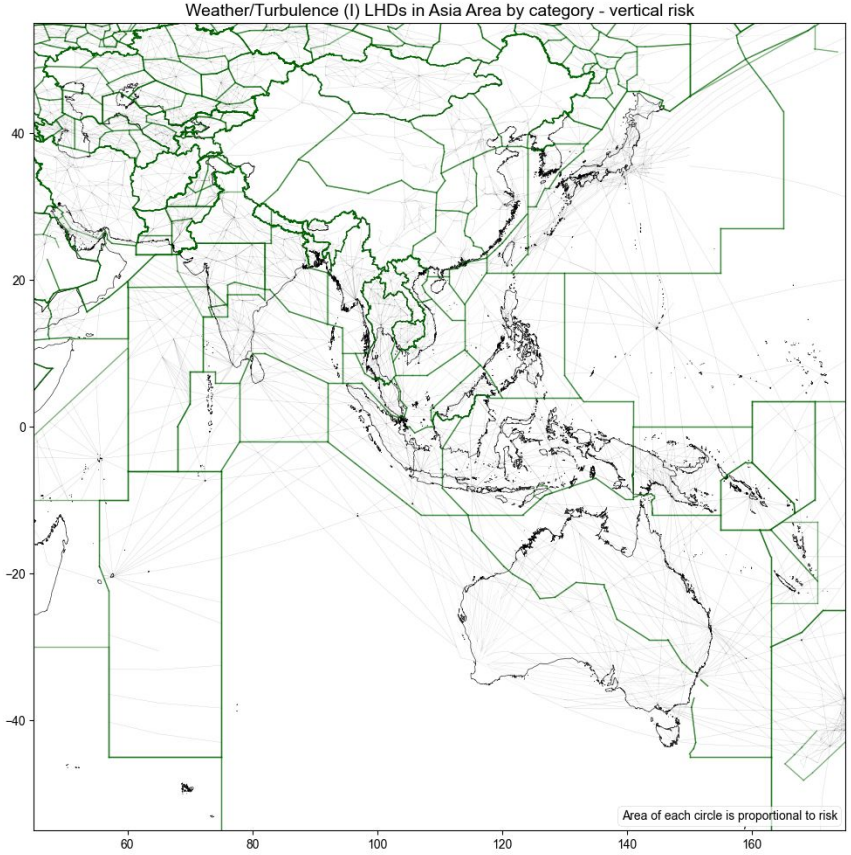

ATC (D, E, F) LLD/LLEs in Asia Area by category - horizontal risk
Area of each circle is proportional to risk
40
20
0
−20
−40
60
80
100
120
140
160

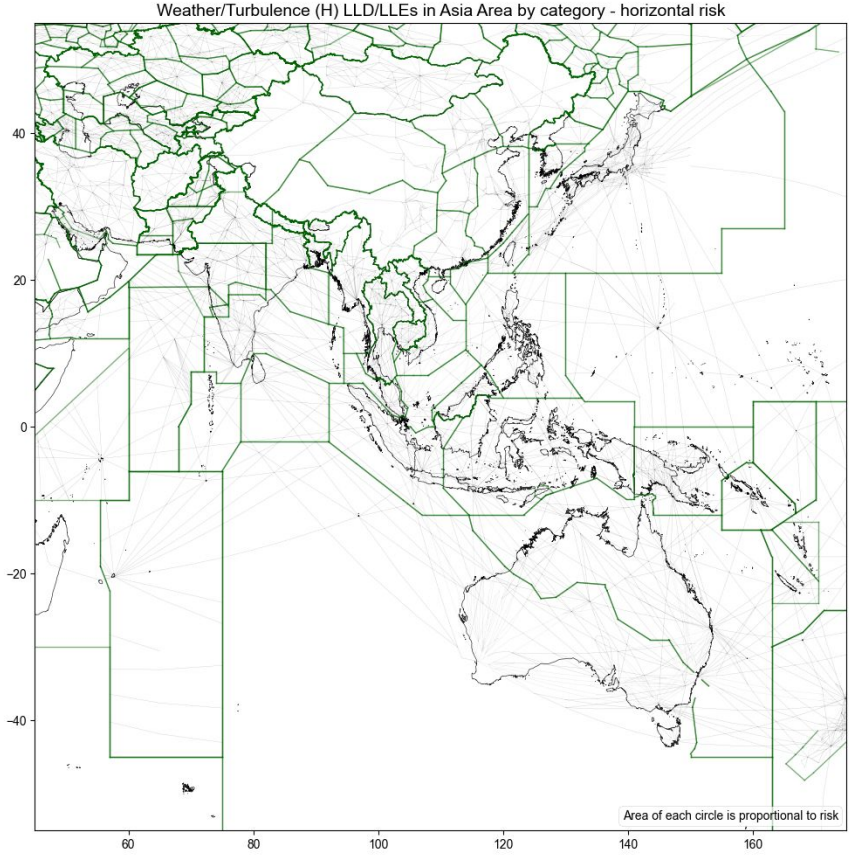
Asia : Aircraft Avionics/Contingencies (G, LHD:H)



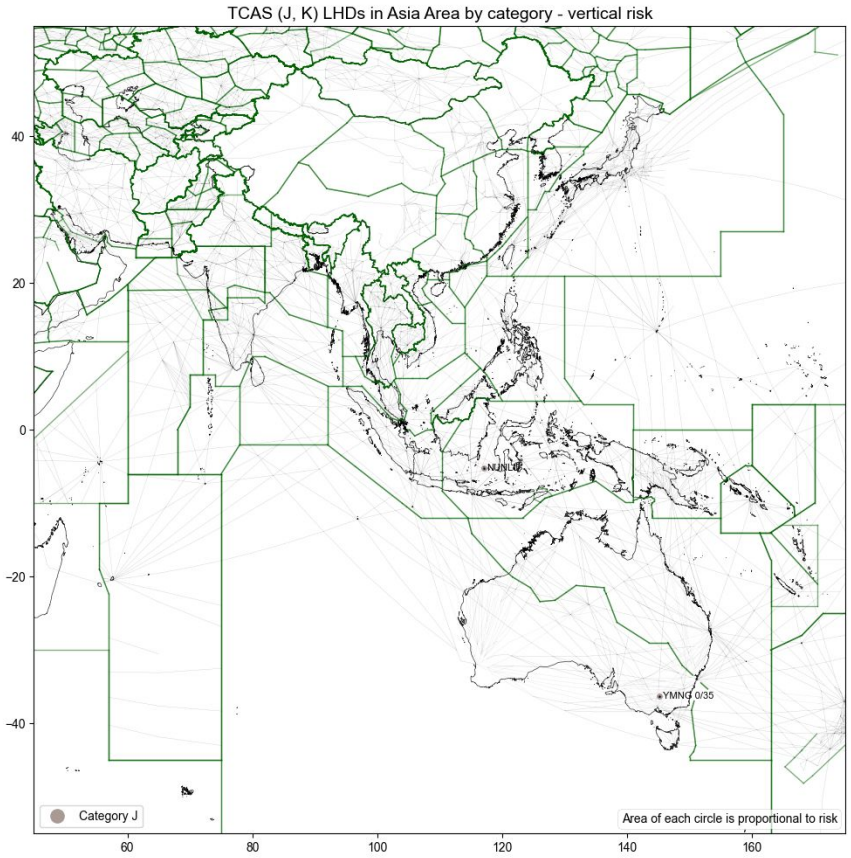


Asia : Weather/Turbulence (LHD:I, LLD/LLE:H)





Asia : TCAS (LHD:J, K)



Asia : Hot Spots

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

Nature of Occurrences : The most commonly reported occurrences are classified as category E (coordination errors as a result of human factors issues.

Contributing Factors : The interfaces are the oceanic airspace with some gaps in communication and surveillance coverage.

Trend : The number of LHDs reduced from 8 in 2020 to 1 in 2021. However, the operational risk decreased to zero in 2020 and 2021.

Mitigations :

- The new procedure implemented over waypoint APAGO and CHILA (Dhaka-Yangon)
- ADS-B data sharing between Kolkata ACC and Yangon ACC was implemented
- AIDC implementation between Kolkata ACC and Yangon ACC is in progress.

Boundary	The Number of LHDs		
	2019	2020	2021
Kolkata-Yangon	59	8	1
Boundary	**Operational Risk ($\times 10^{-9}$ FAPFH)**		
	2019	2020	2021
Kolkata-Yangon	0.31	0	0

Result from the identifying hot spots process: Hot Spot A1 does not satisfy any criteria in 2020 and 2021. It is **proposed to be removed from the hot spot list,** if it can be confirmed that AIDC is successfully implemented between Kolkata ACC and Yangon ACC

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

Nature of Occurrences : The most commonly reported occurrences are classified as category E (coordination errors as a result of human factors issues.

Contributing Factors : This interface is an oceanic airspace with some gaps in the communication and surveillance coverage.

Trend : The number of LHDs significantly decreased in 2020 and then slightly increased in 2021. The operational risk was 0 in 2020 and increased to 0.05 x 10^{-9} FAPFH in 2021.

Mitigations : The AIDC between Chennai OCC and Kuala Lumpur ACC commenced in January 2021 and the updated LOA was signed on 26 May 2021. The AIDC between Chennai OCC and Yangon ACC was trialed in January 2018 and did not have further update.

Result from the identifying hot spots process:
Hot Spot A2 satisfies hot spot criteria in terms of the number and **should remain on the hot spot list**.

Boundary	The Number of LHDs		
	2019	2020	2021
Chennai-Kuala Lumpur	88	13	21
Chennai-Yangon	16	3	8
Boundary	**The Operational Risk (x 10^{-9} FAPFH)**		
	2019	2020	2021
Chennai-Kuala Lumpur	1.14	0.00	0.05
Chennai-Yangon	0.49	0	0

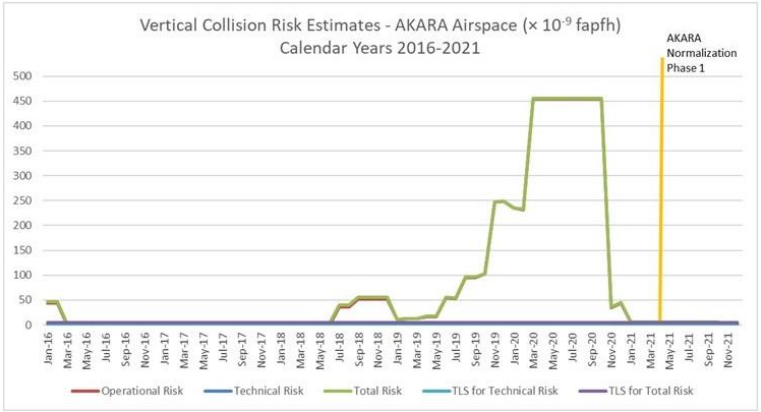
Asia : LHD Hot Spot B (AKARA Airspace)

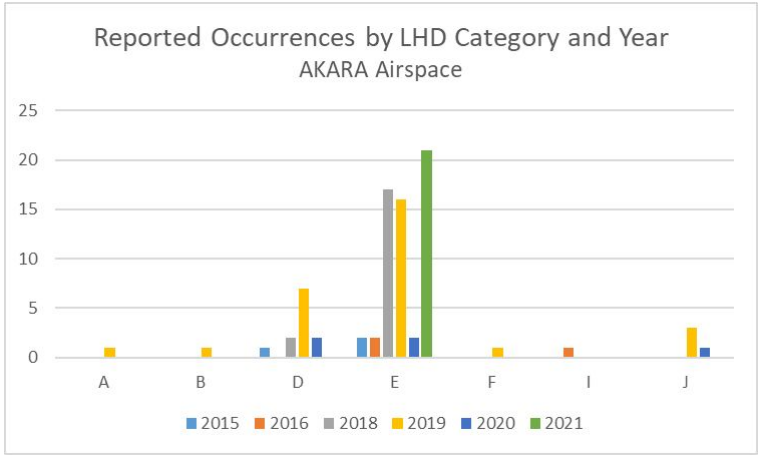
Nature of Occurrences : Reported occurrences classified as category E are most common. Available surveillance and direct speech circuit provide mitigation.

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

Trend : Identified as a hot spot in 2015. All reported category E occurrences were mitigated/prevented in 2021, as can be observed from the decrease in vertical collision risk estimate in 2021.

Mitigations : Significant route structure change was implemented in March 2021. The Phase 1 implementation included a new eastbound unidirectional ATS route, Y590/Y591, parallel to airway A593.





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

Nature of Occurrences : The most reported occurrences are category E (coordination errors as a result of human factors issues. Category F LHDs (coordination errors as a result of equipment outage or technical issues) are emerging from AIDC failures.

Contributing Factors : Communication and surveillance coverage gaps along the boundaries of Manila FIR.

Trend : In 2021, the number of LHDs increased at Manila FIR boundaries interfacing with Kobe/Fukuoka, Ho Chi Minh and Manila-Ujung Pandang.

Mitigations :

- Reducing ATC workload by re-sectorization of Manila ACC into more sectors with the new ATM system.
- Enhancing the coverages of VHF radios, radars and ADS-B.
- ADS-C/CPDLC coverage was expanded, now covering the whole Manila FIR.
- AIDC has been successfully implemented with Hong Kong, Singapore, Taibei and Ujung Pandang ACC. The connection with Ho Chi Minh, Oakland, Kota Kinabalu, Kobe, and Fukuoka is also planned.

Boundary	Number of LHDs			Operational Risk (x 10^{-9} FAPFH)		
	2019	2020	2021	2019	2020	2021
Manila-Kobe/Fukuoka	15	5	**11**	1.36	0.49	**0.45**
Manila-Ho Chi Minh	20	4	**7**	0	0	**0.77**
Manila-Hong Kong	17	5	2	0	0.19	0
Manila-Kota Kinabalu	11	2	2	0.08	0.37	0
Manila-Sanya	0	2	0	0	0	0
Manila-Singapore	17	3	2	0.28	0	0
Manila-Taibei	16	3	4	0	0	0.07
Manila-Ujung Pandang	3	0	**7**	0.02	0	**0.36**
Manila-Oakland	0	0	2	0	0	0

Result from the identifying hot spots process:
The 3 boundaries highlighted in orange satisfy the hot spot criteria. It is suggested to **maintain Hot Spot D** and monitoring its progress.

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

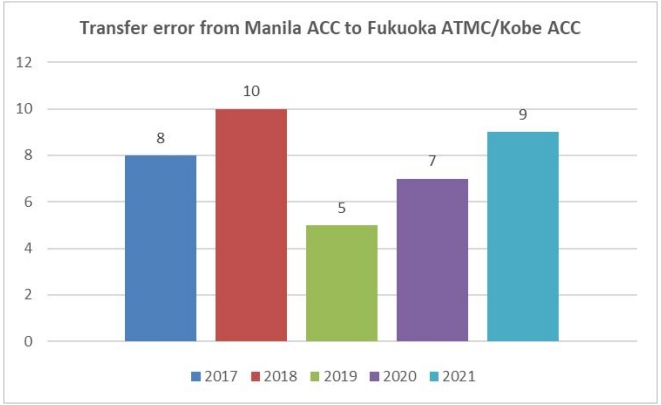
Nature of Occurrences : Transfer error due to human factors (Category E LHD)

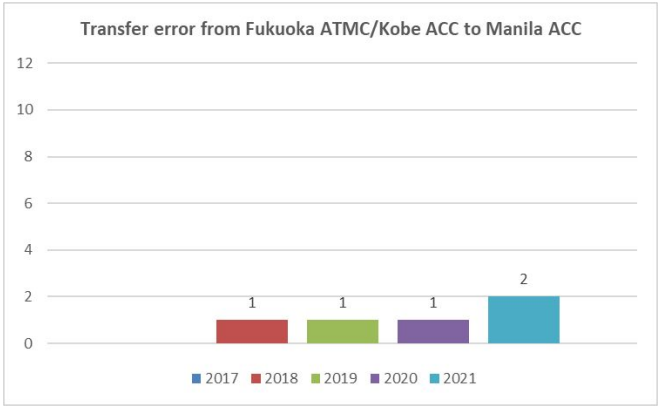
Contributing Factors : Total 11 LHDs occurred in 2021.
9 LHDs occurred on transfer from Manila ACC to Fukuoka ATMC/Kobe ACC.
2 LHDs occurred on transfer from Fukuoka ATMC/Kobe ACC to Manila ACC.

Trend : The highest number of LHDs was marked in 2021 despite of less traffic volume.

Mitigations :

- The sharing of LHD information between Kobe ACC/Fukuoka ATMC and Manila ACC, and JASMA and MAAR has been conducted.
- JASMA and MAAR started to discuss having a small meeting to improve Hot Spot D among JASMA, MAAR and relevant ACCs.





Asia : LHD Hot Spot F (Mogadishu – Mumbai)

Nature of Occurrences : The most commonly reported occurrences are classified as category E (coordination errors as a result of human factors issues).

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

Trend : The number of LHDs slightly decreased in 2021. The operational risk significantly decreased from 4.8 x 10^{-9} FAPFH in 2020 to 0.12 x 10^{-9} FAPFH in 2021.

Mitigations :
The Space-Based ADS-B may potentially reduce the LHDs and the operational risk at these Hot Spots in 2020 and 2021.

The trial of AIDC between Mogadishu ACC and Mumbai ACC was conducted in March 2021 and still faced some minor issues. The problem has to be solved before proceeding to the next phase.

Boundary	The Number of LHDs		
	2019	2020	2021
Mogadishu-Mumbai	9	8	5

Boundary	The Operational Risk (x 10^{-9} FAPFH)		
	2019	2020	2021
Mogadishu-Mumbai	0.74	4.8	0.12

Result from the identifying hot spots process:
Hot Spot F does not satisfy any hot spot criteria as the first year. However, some mitigation measures remain unfinished, thus this boundary **should remain on the hot spot list**.

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

Nature of Occurrences : The most commonly reported occurrences are classified as category E (coordination errors as a result of human factors issues).

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

Trend : At Sanaa-Mumbai boundary, the number of LHDs increased from 1 in 2020 to 4 in 2021, however the operational risk remained very low.
At Muscat-Mumbai boundary, the number of LHDs slightly decreased, but the operational risk significantly decreased from 6.37 in 2020 to 1.35 in 2021.

Mitigations :
Awareness of the safety issues and the Space-Based ADS-B may potentially reduce the LHDs and the operational risk at these Hot Spots in 2020 and 2021.
It is also recommended that AIDC is implemented with Mumbai FIR.

Boundary	The Number of LHDs		
	2019	2020	2021
Sanaa-Mumbai	5	1	4
Muscat-Mumbai	143	48	44

Boundary	The Operational Risk (x 10^{-9} FAPFH)		
	2019	2020	2021
Sanaa-Mumbai	0.20	0	0.07
Muscat-Mumbai	24.71	6.37	1.35

Result from the identifying hot spots process:
Muscat-Mumbai boundary satisfies the hot spot criteria.
Sanaa-Mumbai boundary does not satisfy any hot spot criteria as the first year.
However, some mitigation measures such as the AIDC remain unfinished, thus both boundaries **should remain on the hot spot list**.

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

Nature of Occurrences : In 2021, there were 19 LHDs at Hot Spot J. All were Category E (coordination errors as a result of human factors issues). Of these,

- 2 occurred on the Jakarta–Kota Kinabalu FIR interface, with Jakarta and Kota Kinabalu being the accepting FIR one each.
- 17 occurred on the Jakarta–Singapore FIR interface. Jakarta was the accepting unit in two occurrences. Singapore was the accepting unit in the remaining 15 occurrences.
- 4 occurrences were assessed by AAMA as non-zero-duration in Indonesian airspace.

Contributing Factors : 6 occurrences involved negative transfer, 10 involved a late FL revision, and 3 involved an aircraft being transferred at the incorrect level.

Trend : The number of occurrences has increased significantly in the past year, from 5 in 2020. As such, this Hot Spot should continue to be monitored. The increase could partially be due to improved reporting and information sharing between AAMA and CAAS.

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: The LHD cluster at the boundary between Singapore and Jakarta satisfies the criteria in terms of the number and **should remain on the hot spot list**.

Asia : LHD Hot Spot M (Colombo – Melbourne)

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

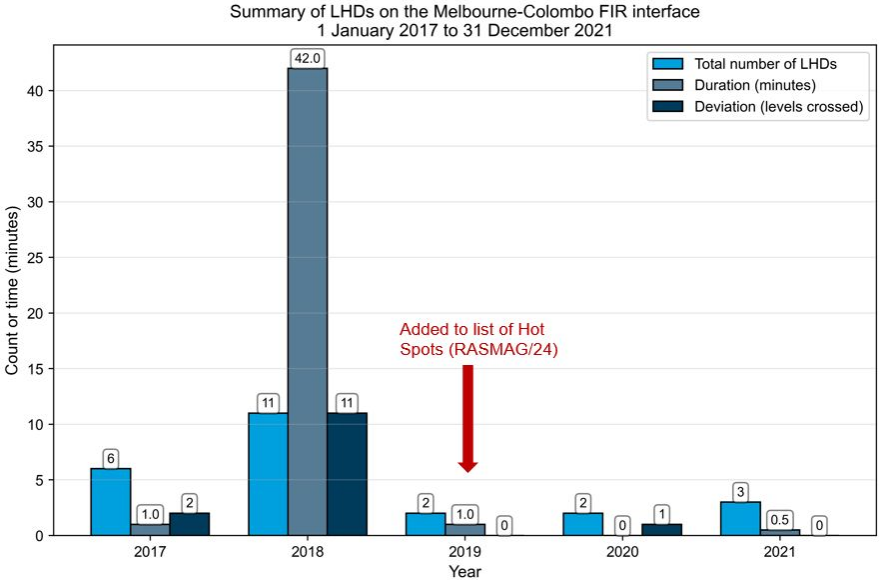
Contributing Factors : A large number were pilot errors involving the Indian Navy.

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 still does not have a suitable contact for the Indian Navy.

Mitigations : In 2020, a number of mitigation measures were introduced in Colombo FIR:

- Sectorisation of Colombo Oceanic airspace
- Safety Assessment for sectorisation
- ATC awareness and training

In March 2022, AAMA and MAAR sent a letter to DGCA India outlining the occurrences, in an effort to establish a point of contact with the Indian Navy (Action Item RASMAG 26/4). A response has not yet been received. For this reason, Hot Spot M should remain on the list.



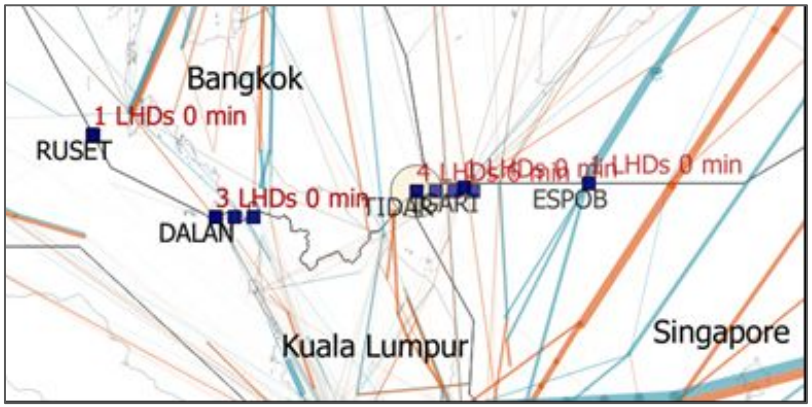
Asia : new LHD Hot Spot O (Bangkok – Kuala Lumpur/Singapore)

Nature of Occurrences : The most commonly reported occurrences are classified as category E (coordination errors as a result of human factors issues).

Contributing Factors : To be investigated

Trend : The number of LHDs at this boundary was relatively high for the past 3 consecutive years: 13 LHDs in 2019, 9 LHDs in 2020 and 9 LHDs in 2021.

Mitigations : To be identified



Reporting Rate
of LHDs/LLDs/LLEs

Reporting Rate of LHDs/LLDs/LLEs

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

Notes:

The flying hours for Indonesian airspace were calculated based on the 2020 TSD.

2021 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	1143	0	-	0	-	0	-	0	-
Mongolia	121,621	0	-	1	1 : 121,621	0	-	1	1 : 121,621
China	1,625,084	9	1 : 180,565	9	1 : 180,565	87	1 : 18,679	105	1 : 15,477
SEA	1,081,885	1	1 : 1,081,885	67	1 : 16,148	2	1 : 540,943	70	1 : 15,456
Japan	1,082,239	10	1 : 108,224	44	1 : 24,596	26	1 : 41,625	80	1 : 13,528
SW Pacific	562,818	20	1 : 28,141	21	1 : 26,801	6	1 : 93,803	47	1 : 11,975
SA/IO	1,507,558	6	1 : 251,260	128	1 : 11,778	1	1 : 1,507,558	135	1 : 11,167
Indonesia	303,491	4	1 : 75,873	36	1 : 8,430	1	1 : 303,491	41	1 : 7,402
Pacific	1,168,237	17	1 : 68,720	151	1 : 7,737	8	1 : 146,030	176	1 : 6,638
ROK and AKARA	150,851	0	-	24	1 : 6,285	0	-	24	1 : 6,285
Total	7,604,927	67	1 : 113,506	481	1 : 15,811	131	1 : 56,901	679	1 : 11,200

Notes:

The flying hours in Indonesian airspace were calculated based on the 2020 TSD.

Conclusion

RVSM TLS Compliance - Vertical

- **The 2021 PAC vertical overall risk** was 19.74 x 10^{-9} FAPFH. The vertical overall risk slightly increased from 2020 and **higher than the target level of safety (TLS)**.
- **The 2021 ASIA vertical overall risk** was 4.03 x 10^{-9} FAPFH. The vertical overall risk decreased from 2020 and improved to be **below the TLS** for the first year.

RVSM TLS Compliance - Horizontal

- **All horizontal risk estimates in 2021** were **below the TLS**.

Hot Spots

Hot Spot	Involved FIRs	Identified	Remarks
A1	Kolkata/Chennai/Dhaka - Yangon	2015	Cat. E LHDs slightly increasing. Risk reducing. **Proposed to be removed from the hot spot list.**
A2	Chennai - Kuala Lumpur	2015	Cat. E LHDs slightly increasing. Risk reducing.
B	Incheon (AKARA Airspace)	2015	Cat. E LHDs increasing. Risk reducing.
D	Manila - all adjacent FIRs	2015	Cat. E LHDs partially reducing at some interfaces. Cat. F LHDs emerging.
F	Mogadishu - Mumbai	2015	Cat. E LHDs reducing. Risk reducing.
G	Sanaa/Muscat - Mumbai	2015	Cat. E LHDs reducing. Risk reducing.
J	Jakarta - Singapore/Kota Kinabalu	2018	Cat. E LHD increasing.
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 reducing.
O	Bangkok - Kuala Lumpur/Singapore	2022	**Proposed to be added to the hot spot list.**

Reporting Rate of LHDs/LLDs/LLEs

- In 2021, the flying hours slightly increased from 7,234,881 hours in 2020 to 7,604,927 in 2021.
- The overall reporting rate of LHDs/LLDs/LLEs improved from 1 report : 13,202 hours in 2020 to 1 report : 11,200 hours in 2021
- The reporting rate in Indonesia, ROK and AKARA airspace significantly improved the in 2021.
- DPRK had no LHD/LLD/LLE report since 2016.
- Mongolia reported 1 LHD in 2021.

Thank You