NAARMO RVSM

Annual Safety Review: 2021

September 28, 2022

Prepared by:
North American Approvals Registry and Monitoring Organization (NAARMO)
FAA WJH Technical Center

Presentation Overview

- Monitoring Operator Compliance with State Approval Requirements
- ICAO RMA Coordination Group Meeting/ RMA Bulletin
- Performance Based Communication and Surveillance (PBCS)
- RVSM Height Monitoring
- Analysis of Large Height Deviations (LHDs)
- Summary of Annual RVSM Collision Risk Model Parameters and Estimates
- Summary – Any Other Business
- Reference Material For Background Information

MONITORING OPERATOR COMPLIANCE WITH STATE APPROVAL REQUIREMENTS

Monitoring Operator Compliance with State Approval Requirements (Traffic Scrutiny)

This ongoing process seeks to:

- ✓ Capture non approved RVSM aircraft
- ✓ Identify repeat offenders.

Repeat Quarterly

Report results to responsible State regulatory authority for approval clarification or appropriate action

Collect Traffic Sample Data:

Aircraft Registration and Flight Plan Item 10 Required:

The air traffic movement data used for the traffic scrutiny is obtained from the FAA's Traffic Flow Management System (TFMS) and merged with NASQuest for full identification within CONUS airspace.

Analyze Traffic Data:

RVSM approval and verify results with data verification:

This process involves the exploration of systematic reasons for removing entries from the list, including:

- •Lag in State notification of approval to the RMA
- •Lag in updates to the approvals database
- •Mistakes in the original traffic movement data
- •"Code-sharing" between airlines
- •Newest operator codes not contained in reference sources
- •Entries that appeared in only one of the traffic samples

US, Canada and Mexico Traffic Sample

- The air traffic movement data used for the traffic scrutiny is obtained from the FAA's Traffic Flow Management System (TFMS) and merged with NASQuest for full identification within CONUS airspace.

- **US** - The sample contained operations from December 2021 totalling **204,688** operations.

- **Canada** - The sample totalled **57,768** operations

- **Mexico** - The sample was not provided for this assessment period

Traffic Scrutiny Results

- These operations have been investigated and compared to current approvals
  - Prepared for RMACG/17 Part 1 in April 2022 and GTE 22 in September 2022

State of Registry	Traffic Sample provided for 2021	Airframes Confirmed to have no approval as of April 2022	Airframes Confirmed to have no approval as of August 2022
United States	204,688	54	47
Canada	57,768	8	6
Mexico	0	85*	78*

**Airframes were identified in the CONUS and CANADA sample*

Mexican Registrations with Concerns

Non-Approved RVSM Operations:

CARSAMMA Flight Plan Audits as of March 2022*: **106** aircraft remain with unresolved approvals. *Last Flight Plan Audit received

EUR Bulletin Report of Non-Approved Aircraft: **19** Mexican aircraft remain with unresolved approvals, and **10** of those have been listed for a six month period of time or more.

NAARMO Traffic Scrutiny December 2021: **78** aircraft were found with unresolved approvals, from the CONUS, NY West and Canadian traffic samples. 9 aircraft repeated in the traffic samples, leaving a remainder of 69 aircraft with unresolved approvals.

Aircraft identified by more than one of the above reporting regions: **38**

RMA COORDINATION GROUP MEETING/ RMA BULLETIN/PBCS

RMA Coordination Group Meeting

- **13** RMAs participate in the **ICAO Regional Monitoring Agency Coordination Group** (RMACG) Meeting
- The purpose of the annual meeting is to:
  - Harmonize processes applied by RMAs & Coordinate data exchange
- **Propose amendments to RMA guidance material - ICAO Doc 9937 -** Operating Procedures and Practices for Regional Monitoring Agencies in Relation to the Use of a 300 m (1000 ft.) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive
- **Propose amendments to State guidance material – ICAO Doc 9574 –** Manual on a 300 m (1000 ft.) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive
- RMACG is currently evaluating the removal of the 1000 hour portion of the recurrent RVSM height monitoring requirement specified in **Annex 6**
  - There is agreement in principle to the proposal. The removal will require:
    - Robust documented justification
    - Formal endorsement by the ICAO Separation and Airspace Safety Panel (SASP)
    - Action RMACG/16:6 requested all RMAs to provide data on operators that are taking advantage of the 1000 hours monitoring requirement

RMA Bulletin Summary

Purpose of RMA Bulletin to publish details of aircraft/operators:

- Not approved for operations in RVSM airspace

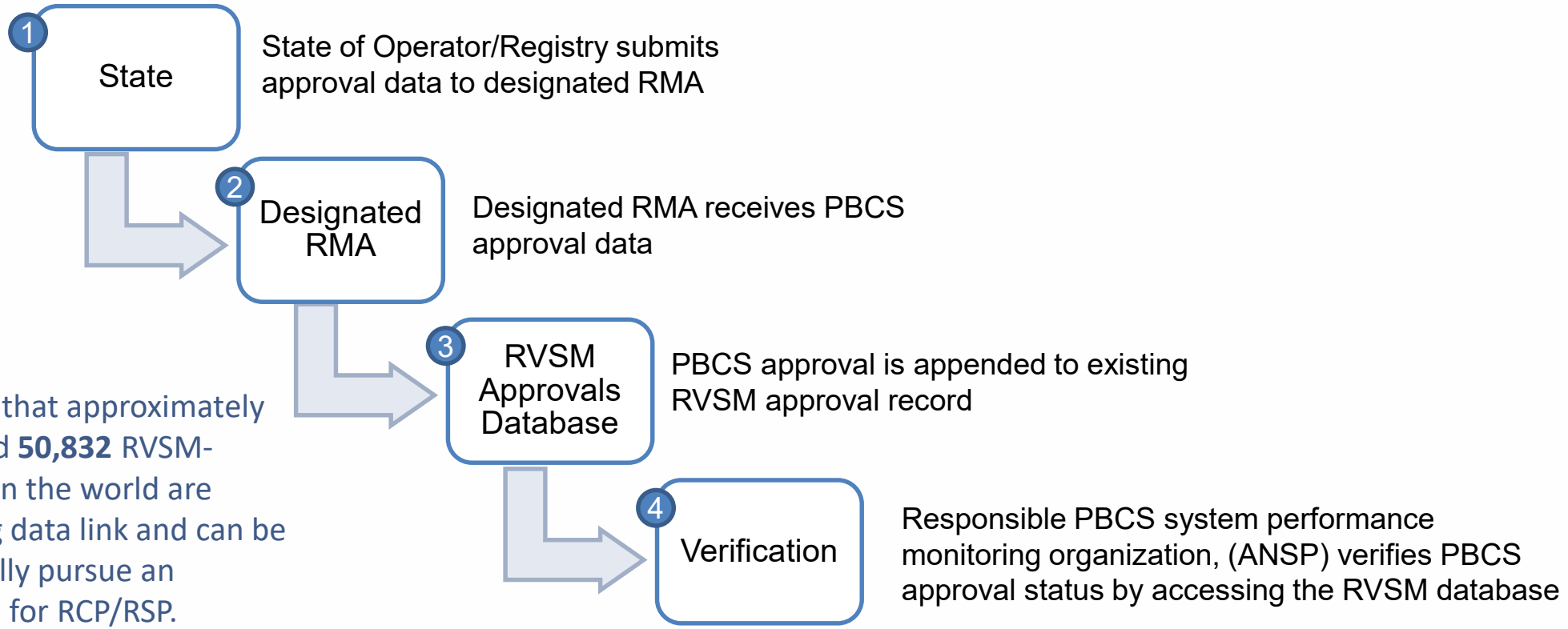
- Bulletins are published after scheduled audits of flight plans & other data sources (such as height monitoring and surveillance data).
- Two RMAs that are currently publishing bulletins are EUR RMA & Eurasia RMA

Activity Summary as of September 2022

- Mexico
  - **19** Mexican-registered aircraft reported as operating in RVSM Airspace without record of a valid RVSM approval. **10** of the Mexican-registered aircraft reported have been on the list 6 months or more
- Canada
  - **1** Canadian-registered aircraft reported as operating in RVSM Airspace without record of a valid RVSM approval.
- United States
  - **100** US-registered aircraft were reported as operating in RVSM Airspace without record of a valid RVSM approval.

PERFORMANCE-BASED COMMUNICATION AND SURVEILLANCE (PBCS) APPROVALS

Submitting and Receiving PBCS Approvals Data



Note: It is estimated that approximately **14%** of the estimated **50,832** RVSM-approved airframes in the world are observed to be using data link and can be assumed to potentially pursue an operational approval for RCP/RSP.

Reports of Non-compliant PBCS Performance Communication Flow

ICAO SARPS

1. ANSP — The ANSP responsible for provision of air traffic services in the FIR in which non-compliant data link performance was detected
2. Designated RMA (FIR) — The RMA that has an airspace responsibility associated with the reporting ANSP
3. Designated RMA (State) — The RMA that has responsibility for the State of Operator
4. State — State of Operator/Registry of the aircraft/fleet observed with non-compliant data link performance

Note: The only RMAs affected by Step 2 include AAMA, JASMA, MAAR, NAARMO, NAT CMA, and PARMO

All RMAs are affected by Step 3; however, the scope of the workload associated with Step 3 should be minimal.

- ***41*** *PBCS non-compliance reports were addressed during* ***January – December 2021****, and reported to States of Operator/Registry.*
- *NAARMO/PARMO = **41***
- *NAARMO = 28*
  - *U.S. = 14*
  - *Canada = 10*
  - *Mexico = 1*
  - *EUR RMA = 3*

RVSM HEIGHT MONITORING

Altimetry System Error (ASE) Process

- Altimetry System Error (ASE) is determined by comparing the identified geometric height of the aircraft and the geometric height of the barometric pressure surface associated with the altimetry measurement

- Automatic Dependent Surveillance- Broadcast (ADS-B) Out provides a source of aircraft position data for use in ASE calculations

- **Effective Aug. 31, 2021**, height monitoring using ADS-B will now only be conducted for flights occurring on **Mondays.** Aircraft due for periodic monitoring or that must verify performance can fly any Monday to obtain and record a monitoring result
  - Since Nov 2019 there are 172.8 Million ASE samples; 40,000 aircraft (30K are U.S.)

Coordination with Canada on ADS-B ASE

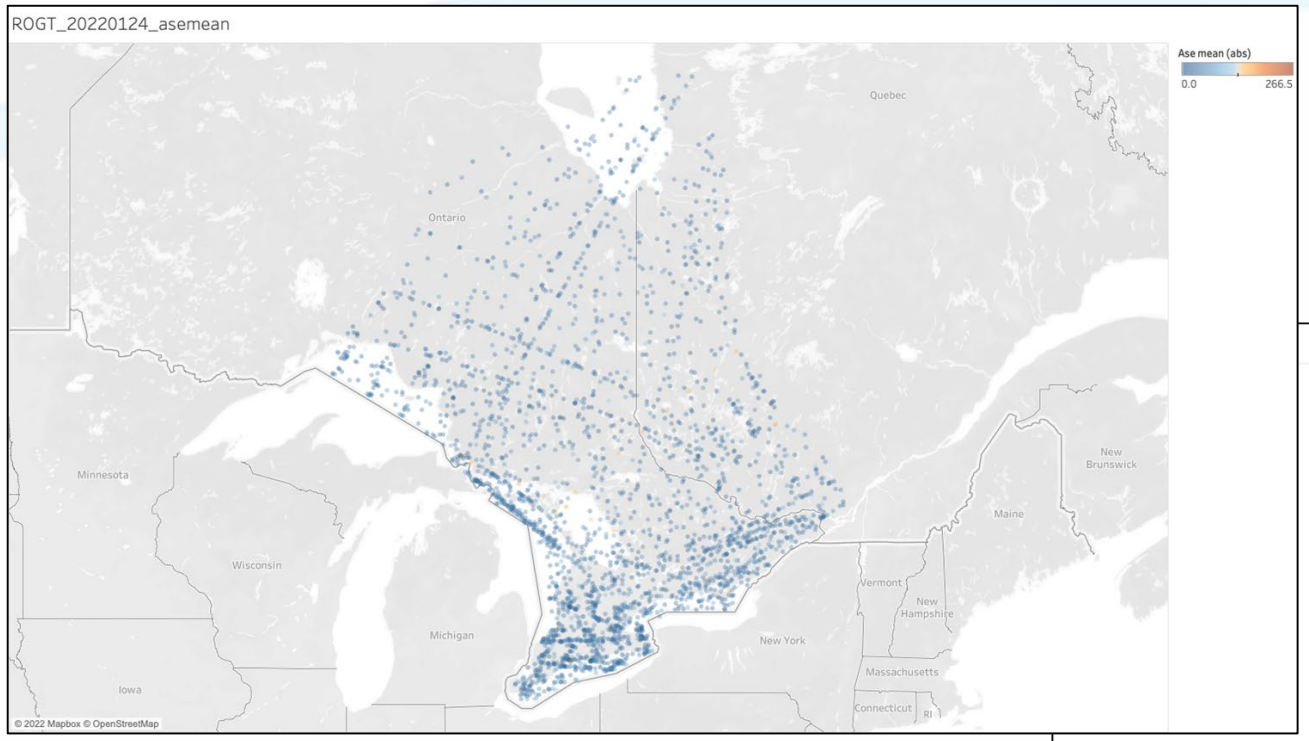
- In May 2022, NAARMO met with several members of he NAV CANADA Surveillance Engineering group to discuss the feasibility of using Canadian ADS-B data for ASE monitoring

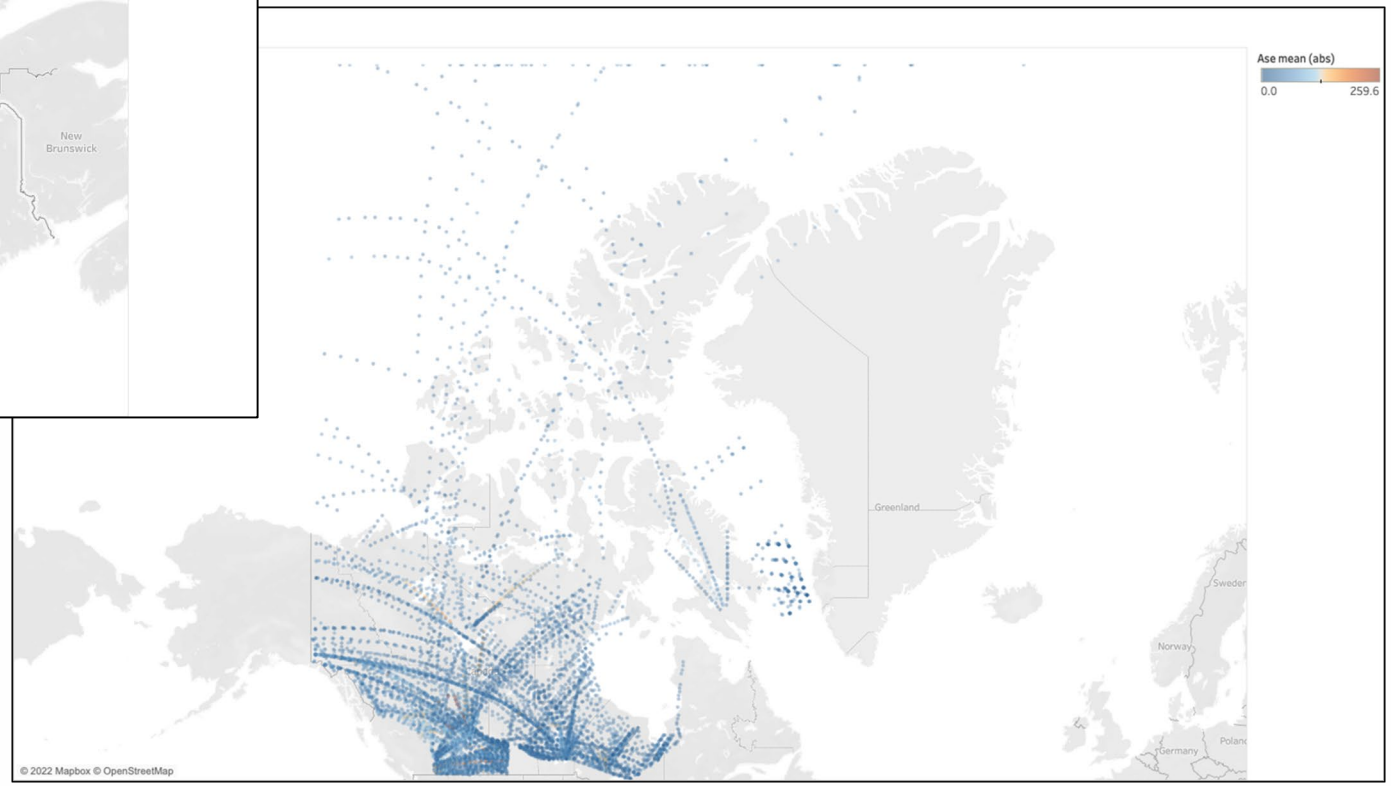
- Several ADS-B Data samples from January 24, 2022 were provided and processed.
  - No issues were identified and the results were incorporated into the NAARMO database.

- Data exchange was targeted for August 2022, and was dependent on the modification of the current FAA agreements with NAV CANADA and Transport Canada.
  - Agreement modifications are still being addressed

- It would also be beneficial for ASE monitoring in North America if available ADS-B data from Mexico could be provided to NAARMO for processing.

Processed Canadian ADS-B ASE Samples





ADS-B Height Monitoring

Automatic Dependent Surveillance-Broadcast (ADS-B) Height Monitoring System (AHMS) – provides a source of aircraft position data for use in the ASE calculations.

STATE	2019	2020	2021
Canada	858	1121	1048
Mexico	427	514	456

Aircraft registration numbers monitored by year

GMU Height Monitoring

GPS-based Monitoring Unit (GMU) – a portable device brought on board and operated by trained technicians.

STATE	2016	2017	2018	2019	2020	2021
Canada	136	109	124	119	94	110
Mexico	48	41	37	32	18	24

Registration numbers monitored by year

AGHME Height Monitoring

Aircraft Geometric Height Measurement Element (AGHME) – a ground based monitoring system built by the FAA.

STATE	2019	2020	2021
Canada	134	125	111
Mexico	39	11	30

Aircraft registration numbers monitored by year

AGHME Height Monitoring

- Operational: Atlantic City and Ottawa
- Non-operational: Lethbridge – problems with receivers
- Work continues on updating legacy receivers with Software Defined Radio (SDR) technology – Atlantic City AGHME
- Decommissioning of Wichita AGHME
- Future AGHME locations to be decommissioned: Oregon, Arizona

Altimetry System Error – Report (ASE-R)

- The means by which NAARMO informs states, operators and other RMAs of large ASE events of concern.
- The large ASE Watch List process was developed to establish criterion for identifying candidate aircraft for ASE-Rs.
  - Mean ASE plus one standard deviation of 200ft. or greater
    - 378 out of 40,000 aircraft were identified for Large ASE analysis
    - 25 active ASE-Rs as of September 2022
    - Manually analyze plots for trends to make ASE-R determination
- Foreign aircraft with questionable performance are sent to the responsible RMA or state authority.

NAARMO Long-Term Height Monitoring (LTHM) Summary 2022

CANADA	Total # of Approved Airframes	Resultant Monitoring Burden (# Airframes)	Total # of Airframes Not Monitored within two years as of **June 30,2022**
IGA	554	554	193
Commercial	1003	324	107
Total Canada	**1,557**	**878**	**300**
MEXICO	**Total # of Approved Airframes**	**Resultant Monitoring Burden (# Airframes)**	**Total # of Airframes Not Monitored within two years as of June 30,2022**
IGA	23	23	2
Commercial	506	186	20
Total Mexico	**529**	**209**	**22**
US	**Total # of Approved Airframes**	**Resultant Monitoring Burden (# Airframes)**	**Total # of Airframes Not Monitored within two years as of June 30,2022**
IGA	13,425	13425	496
Commercial	7,582	643	19
Total US	21,007	14,068	515
NAARMO Total	**23,093**	**15,155**	**837**

LARGE HEIGHT DEVIATION REPORTING CAPABILITIES: DATA SOURCES

DATA SOURCES:

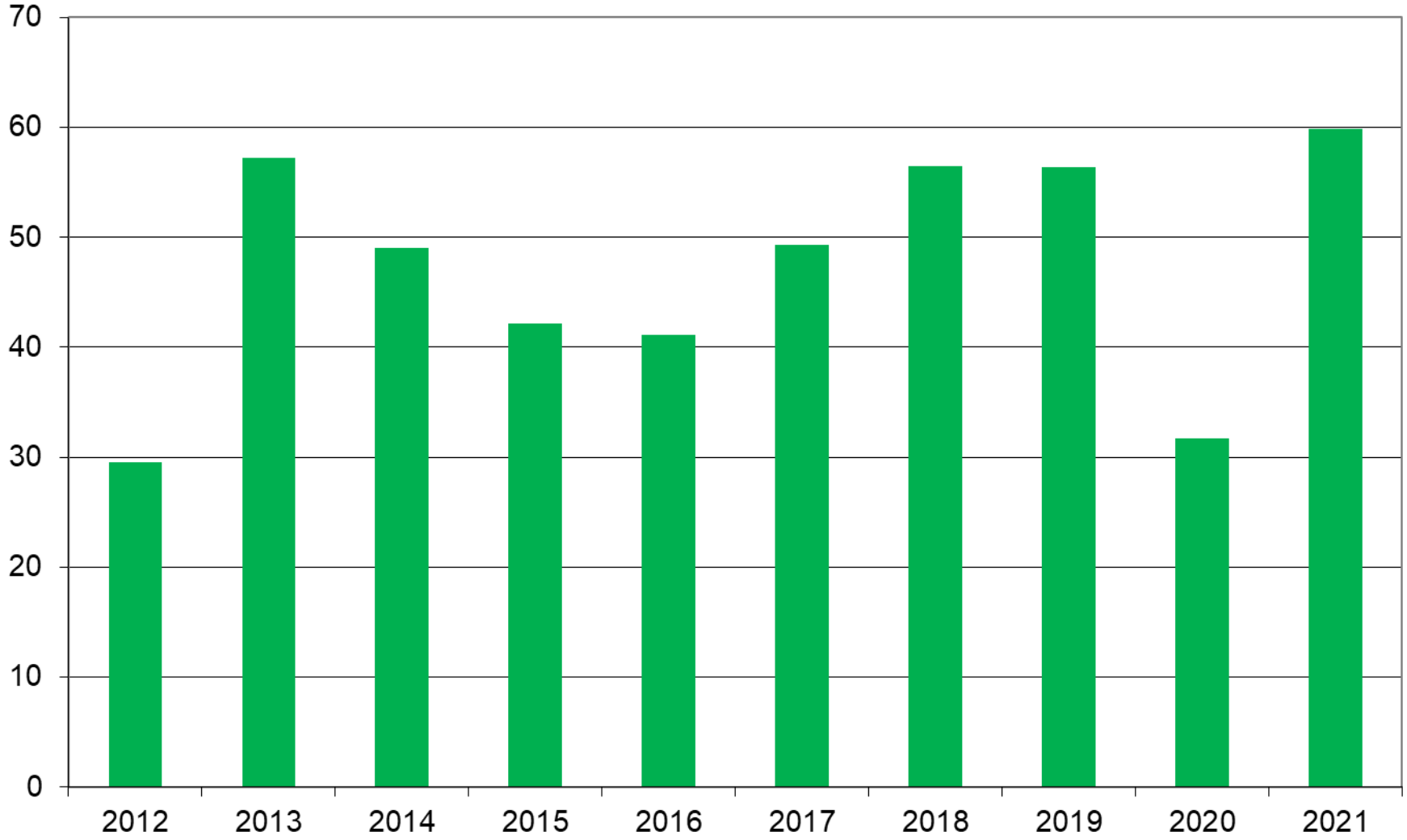
1. **CEDAR** (Comprehensive Electronic Data Analysis and Reporting)
   - Large Height Deviation Data
2. **ATSAP** (Air Traffic Safety Action Program) database
   - Large Height Deviation Data
3. **ERIT** (End-route Radar Intelligent Tool) traffic sample
   - Estimates of occupancy
4. **TFMS** (Traffic Flow Management System) traffic sample
   - Average Aircraft Dimensions and flight hours

Note: Further information in references

Continental United States

LHD ANALYSIS

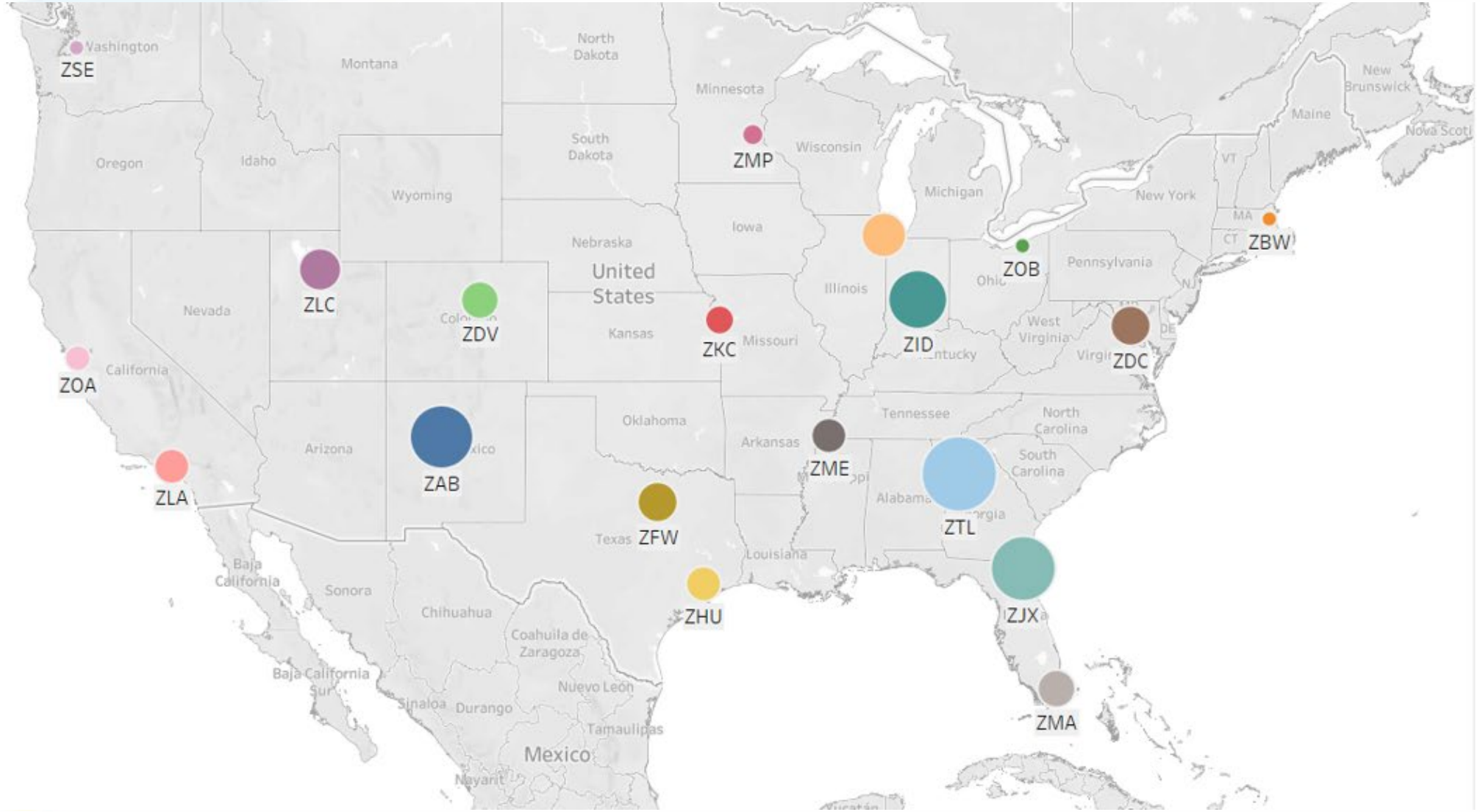
Analysis of US Large Height Deviations:
Average Qualifying LHD Events Per Month



LHD Summary

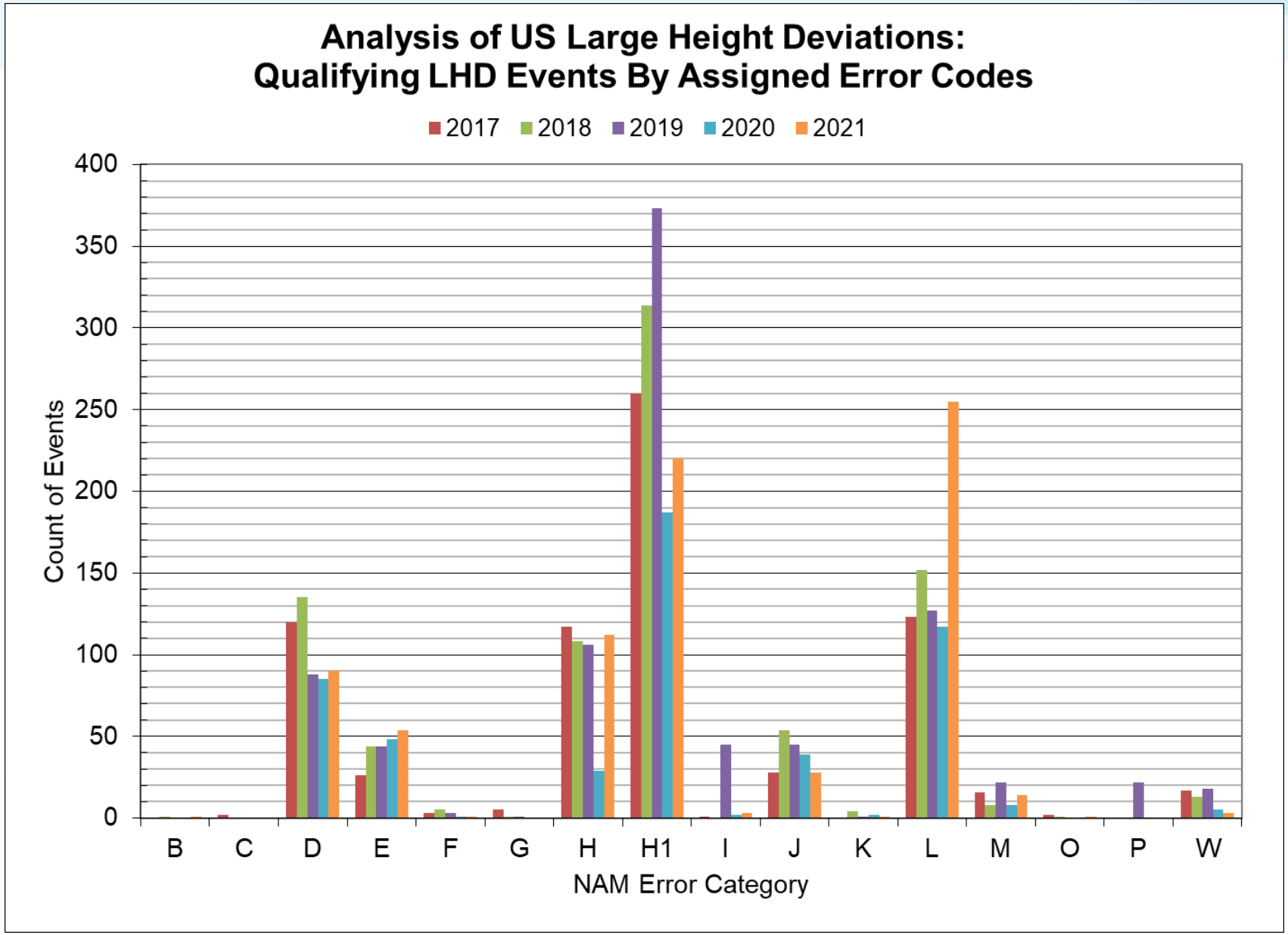
Category	Recorded Events	Events Affecting the Risk Calculation	Duration (minutes)	FLs Crossed
Pilot Errors	227	79	1.83	118
ATC Errors	304	149	32.6	126
TCAS	406	0	0	61
All Others	28	14	1.08	8

Contributing Event Report Location



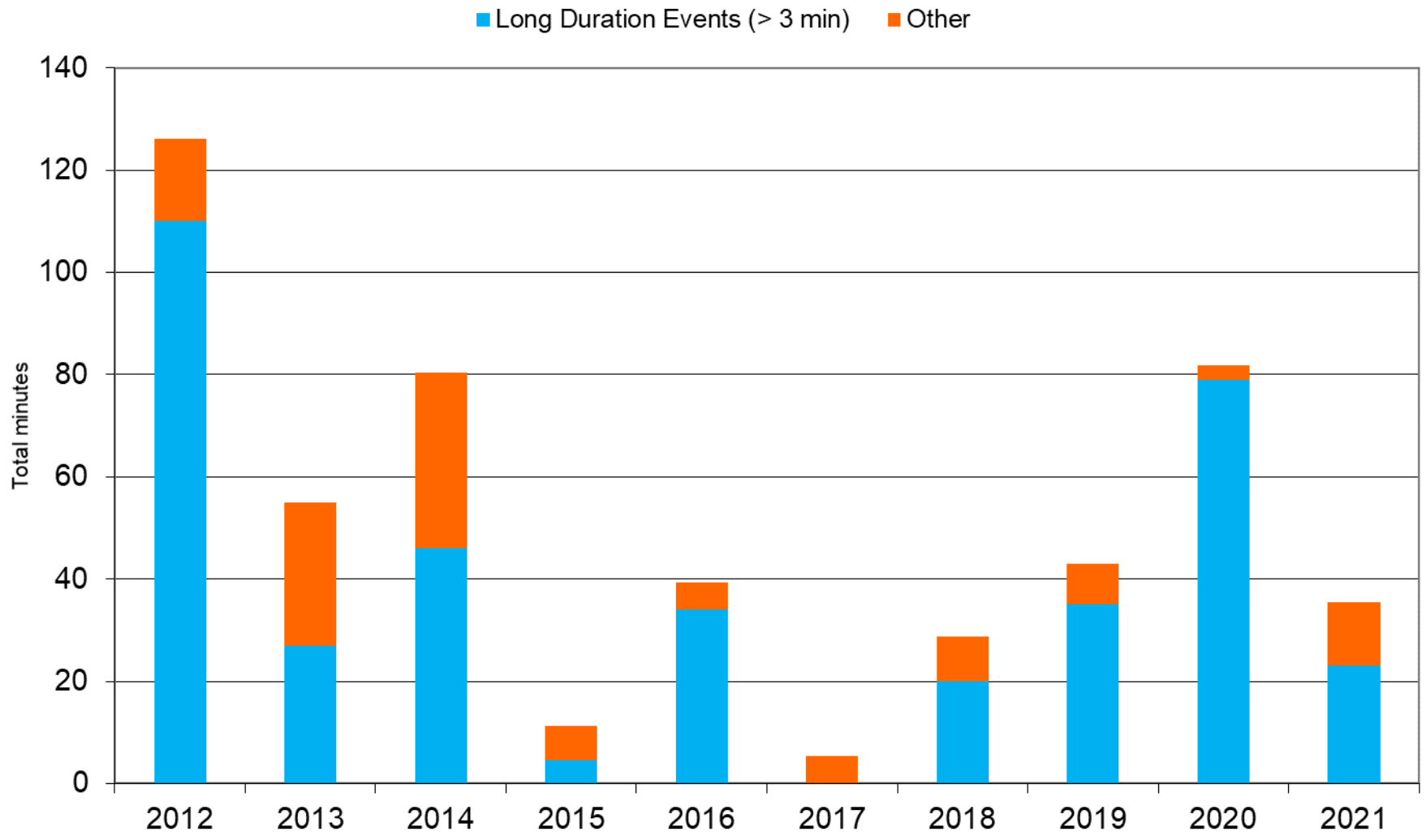
Vertical Event Codes

A	Contingency action due to engine fault
B	Contingency action due to pressurization failure
C	Contingency action due to other cause
D	Failure to climb/descend as cleared
E	Climb/descent without ATC clearance
F	Non-RVSM
G	ATC FL re-clearance resulting in a loss of lateral or longitudinal separation
H	Deviation due to TCAS
H1	TCAS RA caused by high rate of closure when aircraft is climbing or descending to a cleared flight level.
I	Aircraft unable to maintain level
J	ATC failure to correctly record, communicate, or follow through on FL changes and/or other clearances
K	Aircrew not maintaining level as cleared
L1	ATC failure to capture incorrect read back of control instructions
L2	ATC failure to maintain situational awareness
L3	ATC failure to resolve transposed call signs
L4	ATC Coordination error
M	Actions taken due to mechanical or equipment failure
O	Other
W	Weather

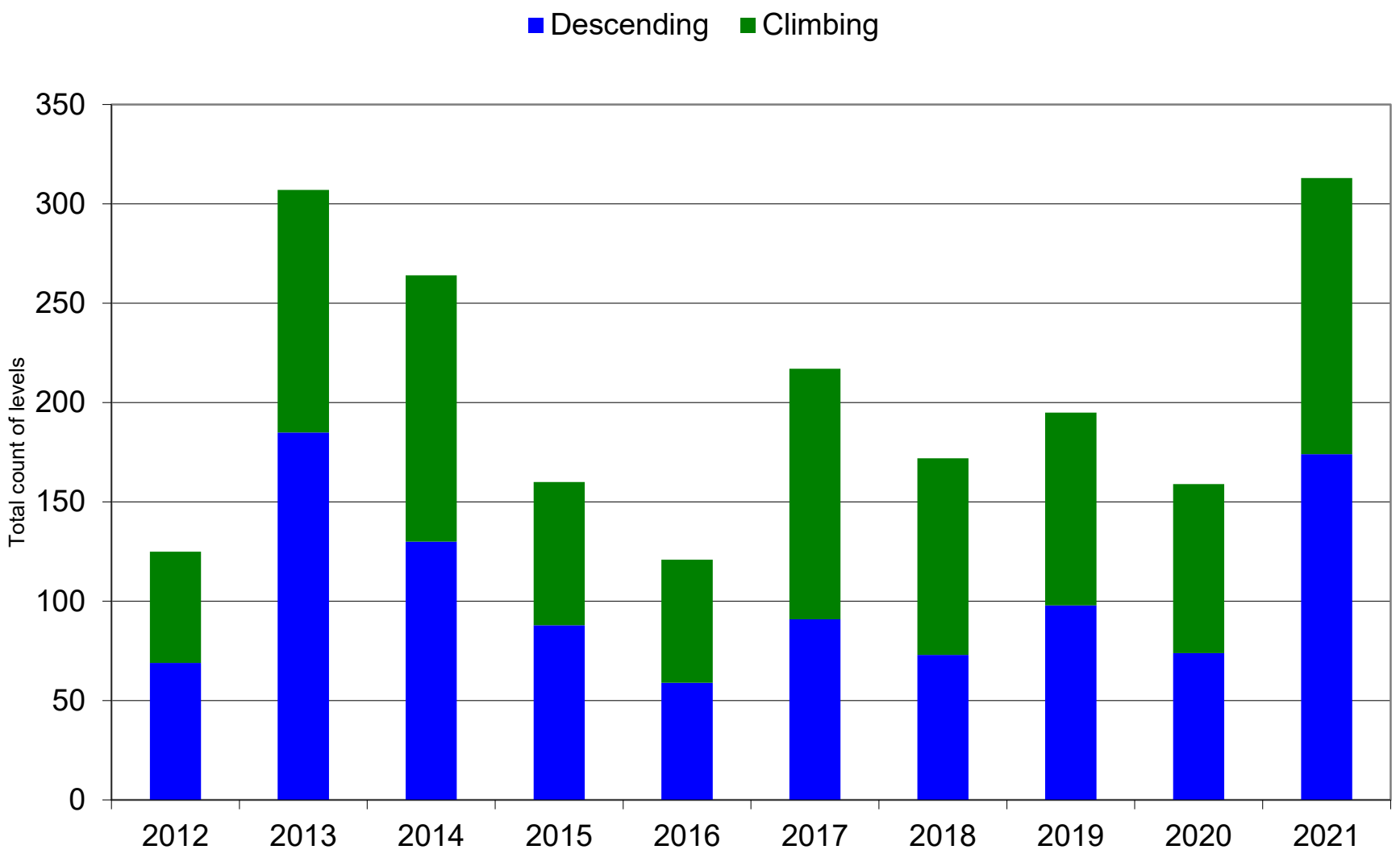


Category Breakdown – ATC, Pilot, TCAS

Total Minutes Spent at Incorrect Flight Level



Total Un-cleared Flight Levels Crossed



Observations from Sub-Group LHD Analysis

- **1** long duration events (3 or more minutes) in 2021
  - Multiple aircraft involved. ATC misses the readback by incorrect aircraft. Aircraft flew for 23min unprotected before ATC notices.
  - **11** events with 4 or more Levels Crossed

- ATC errors contributed the most amount of levels crossed and almost all of the duration events this year.

- Still seeing many instances where a controller does not hand off or call out an aircraft going into another sector.

Comparative Rate of Reported Risk-Bearing Events for 2021

State	Total Events Per Flight Hour	Pilot Errors Per Flight Hour	ATC Errors Flight Per Hour	Average Annual Flying Hours
Canada	*5.2 (11)*	2.3	2.8	2,127,752
Mexico	24.2 *(35)*	0.7	23.5	1,444,875
United States	29.6 *(228)*	10.2	19.3	7,710,613

All rates are ($x10^{-6}$)

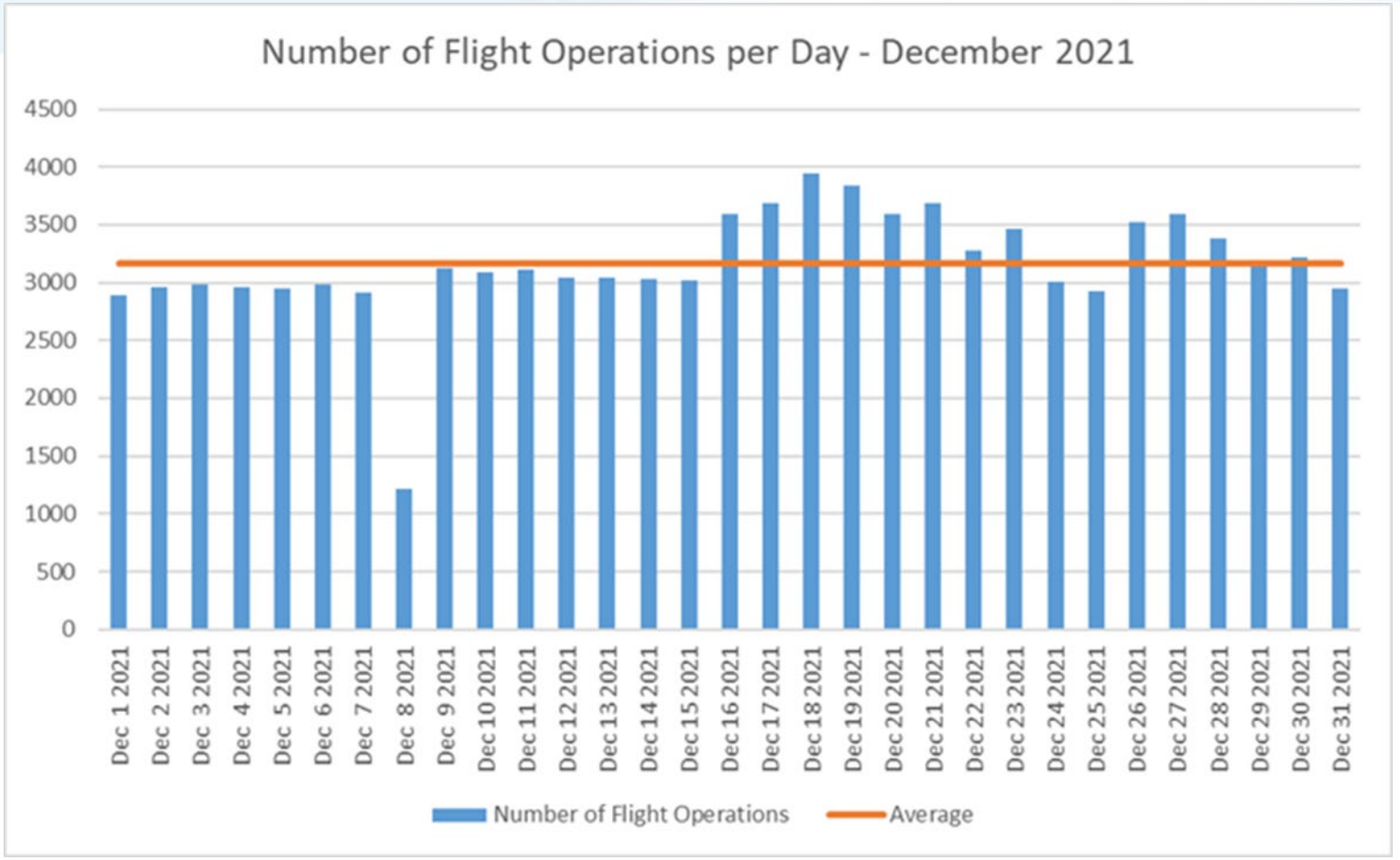
Canada

LHD ANALYSIS & VERTICAL RISK ESTIMATES

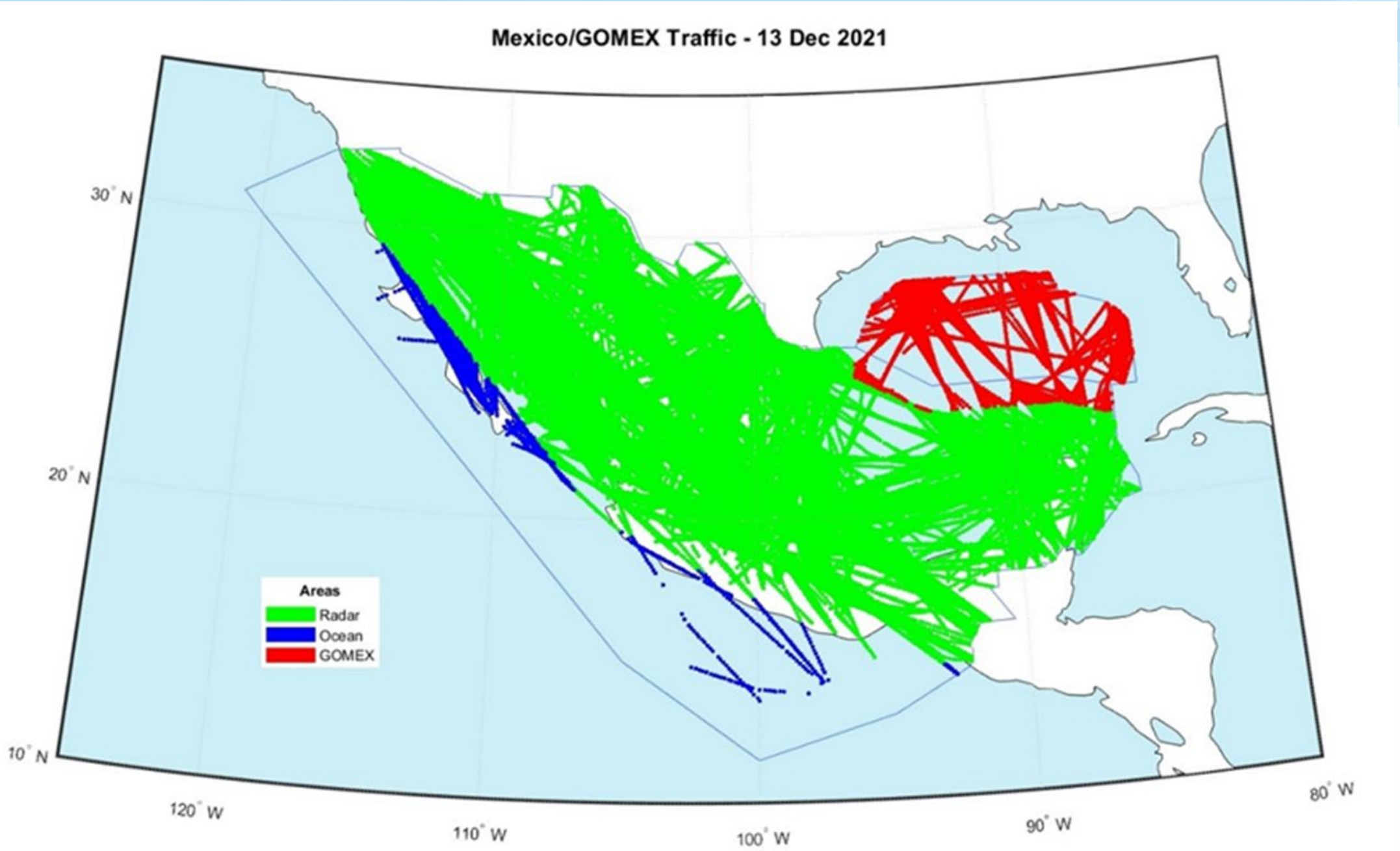
Mexico

LHD ANALYSIS

Mexico/GOMEX Airspace



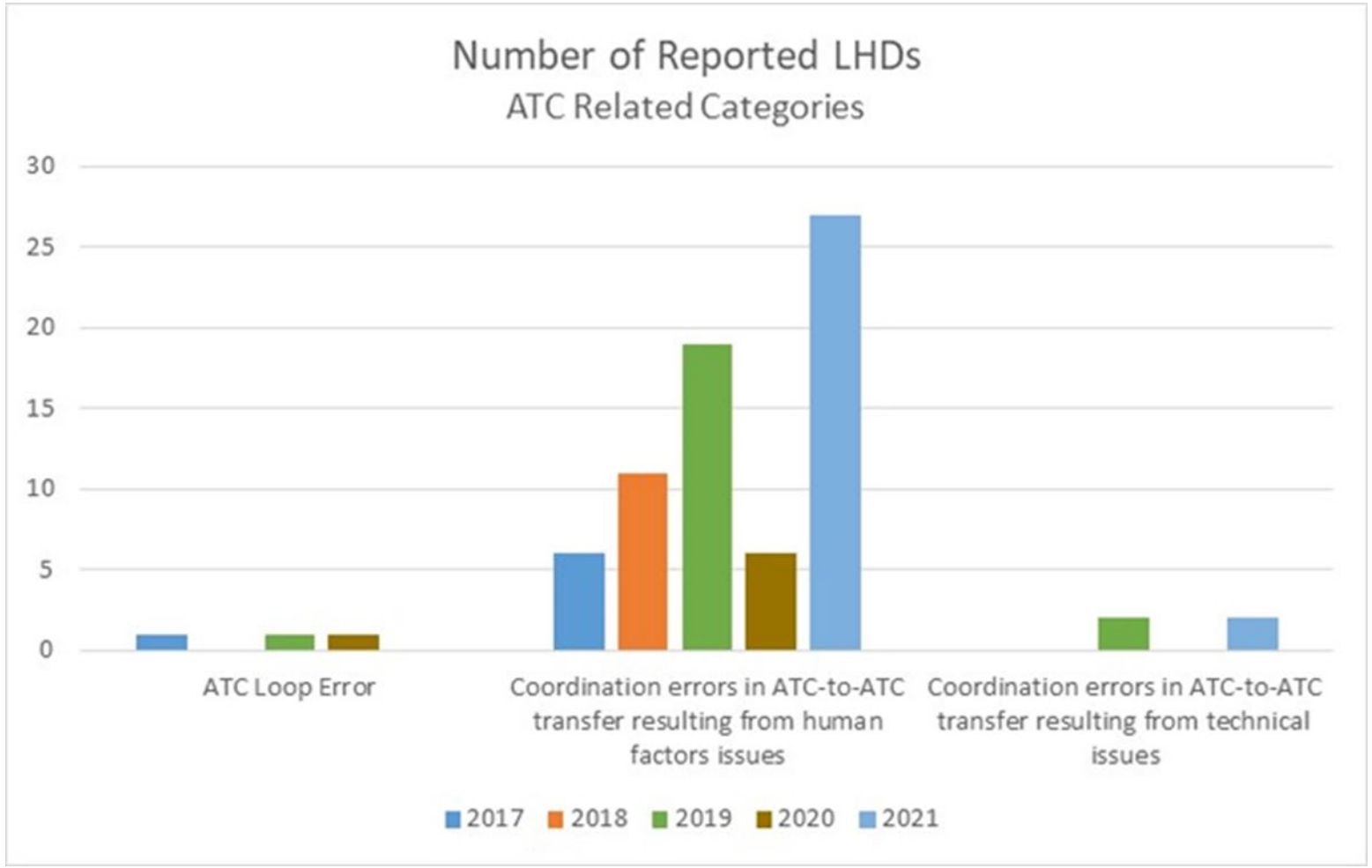
December 2021 traffic levels were 22% higher compared to December 2020


Mexico/GOMEX Traffic - 13 Dec 2021
30° N
20° N
10° N
120° W
110° W
100° W
90° W
80° W
Areas
Radar
Ocean
GOMEX

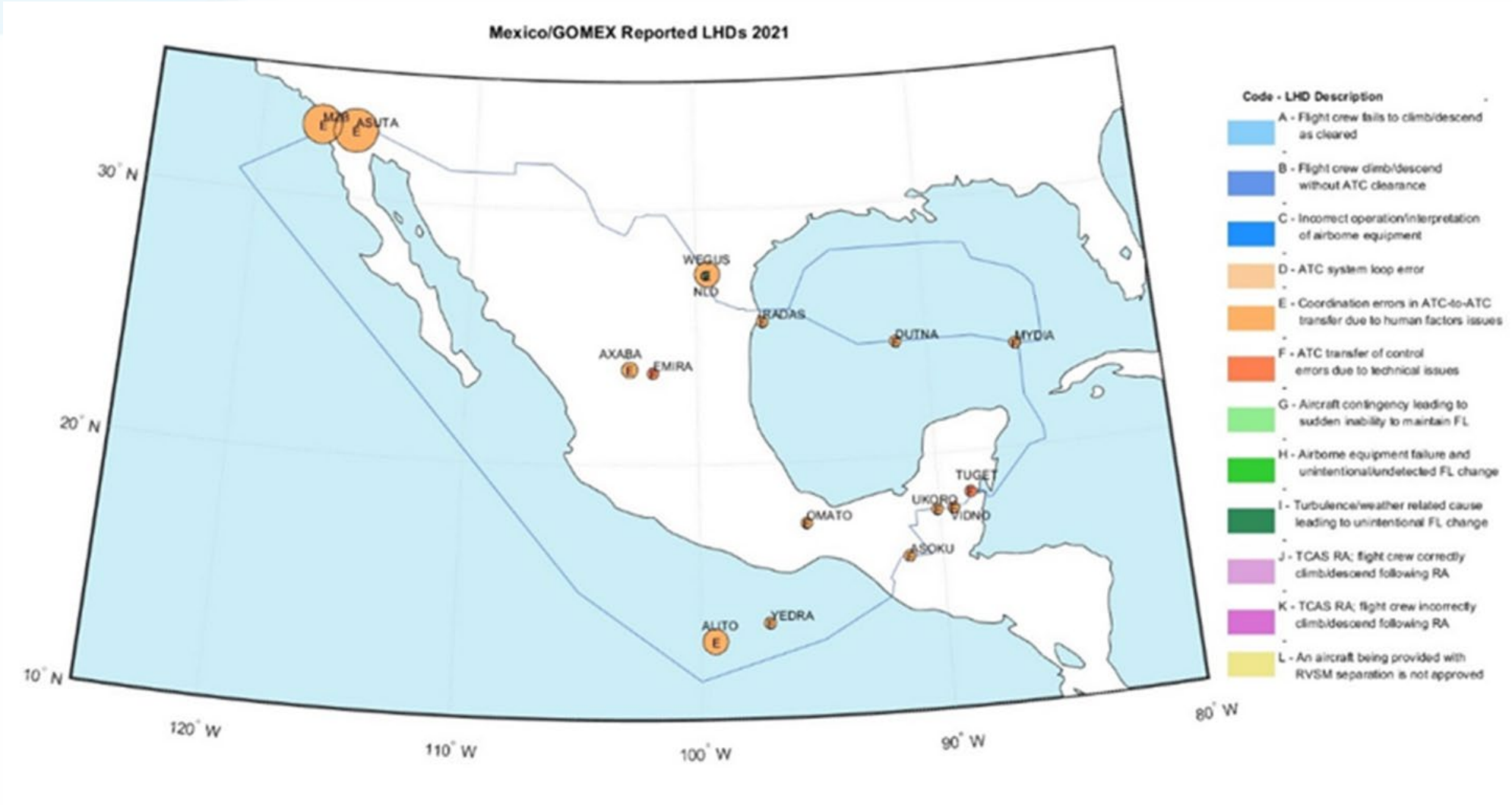
Summary of Mexico/GOMEX Risk Bearing LHD Events - 2021

LHD Category Code	LHD Category Description	Number of LHD	Duration at Incorrect FL	Number of FLs Crossed
E	Coordination errors in the ATC -to-ATC transfer of control responsibility as a result of human factors issues	32	33	0
F	Coordination errors in the ATC -to-ATC transfer of control responsibility as a result of an outage or technical issues	2	2	0
G	Aircraft contingency event leading to sudden inability to maintain assigned flight level (e.g. pressurization failure, engine failure)	1	0	0
	TOTALS	**35**	**35**	**0**

Mexico/GOMEX
LHD Summary



Mexico/GOMEX Airspace LHD Locations - 2021

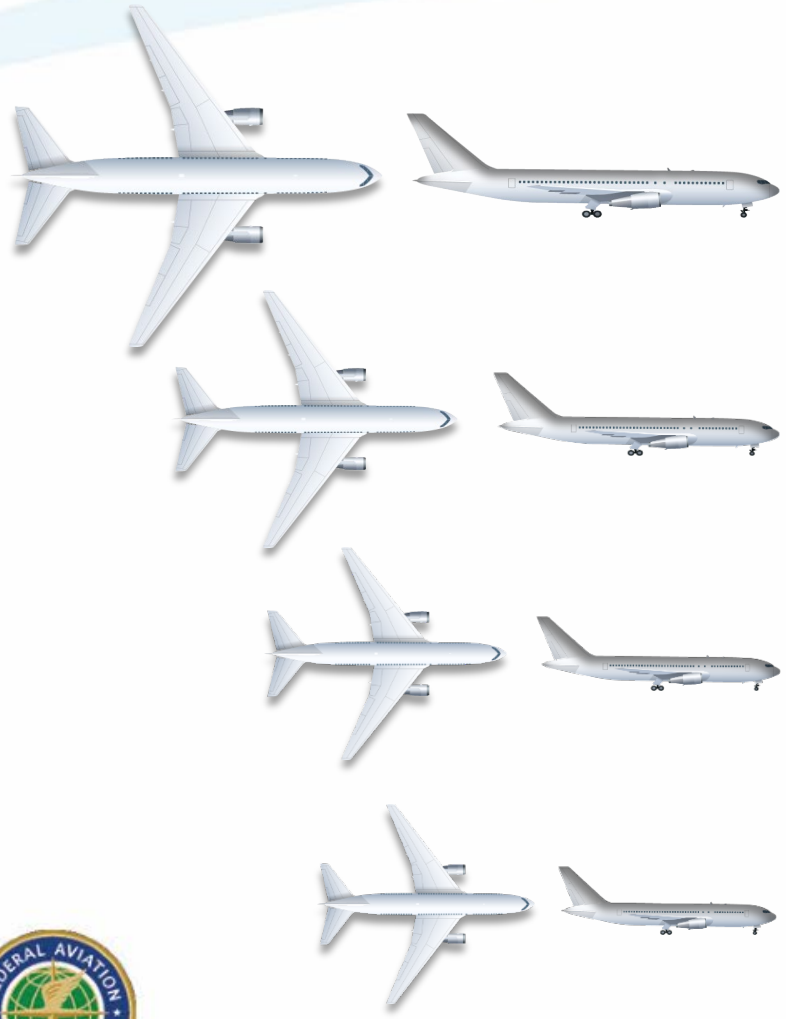


SUMMARY OF COLLISION RISK PARAMETER ESTIMATES

Estimates of Annual Flight Hours (millions)

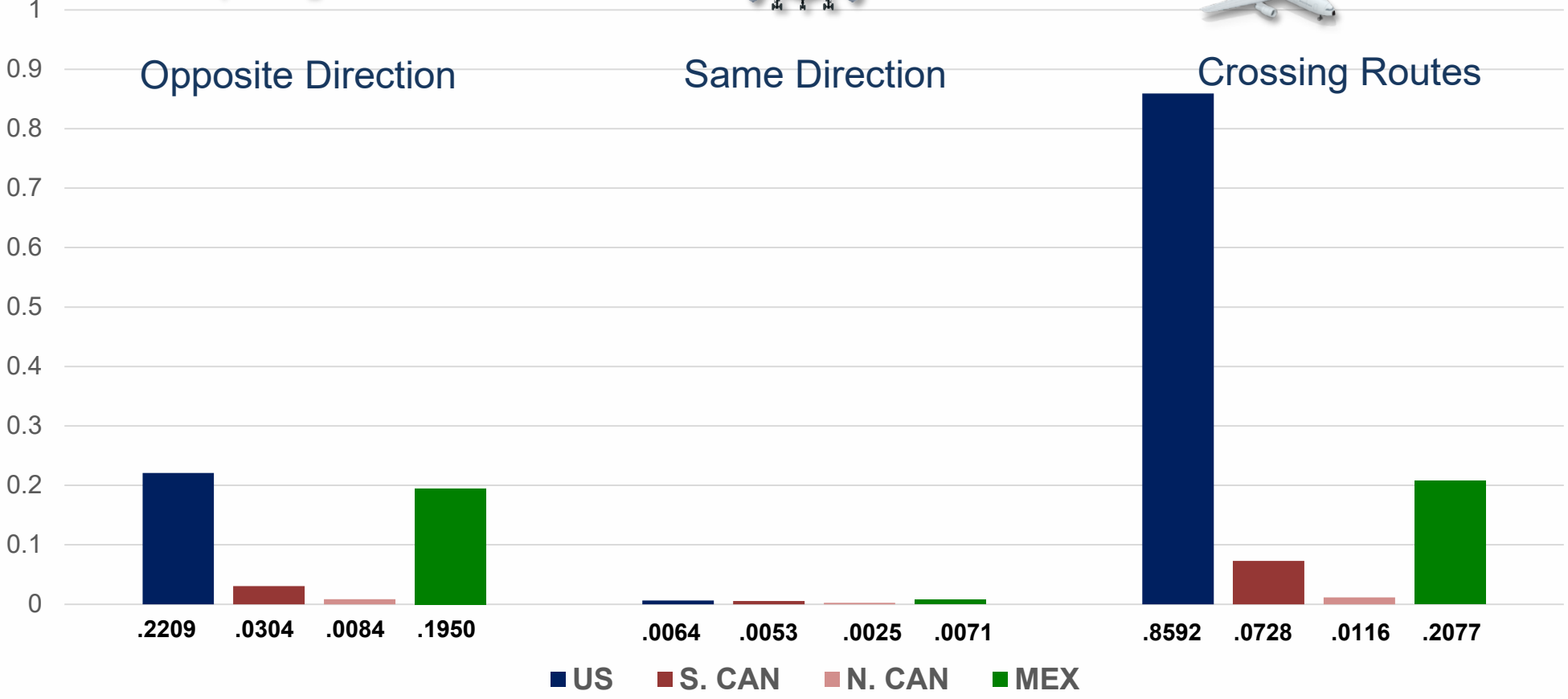
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Southern Canada RVSM	1.59	1.64	1.69	1.76	1.81	1.86	1.87	2.06	0.75	1.38
Northern Canada RVSM	0.61	0.83	0.95	1.02	2.17	1.22	1.24	1.29	0.40	0.75
CONUS RVSM	11.1	10.0	9.8	9.94	9.73	10.3	9.88	10.1	6.5	7.71
Mexico RVSM				0.8	0.8	0.9	1.0	1.2	0.9	1.4

Average Aircraft Sizes in North America



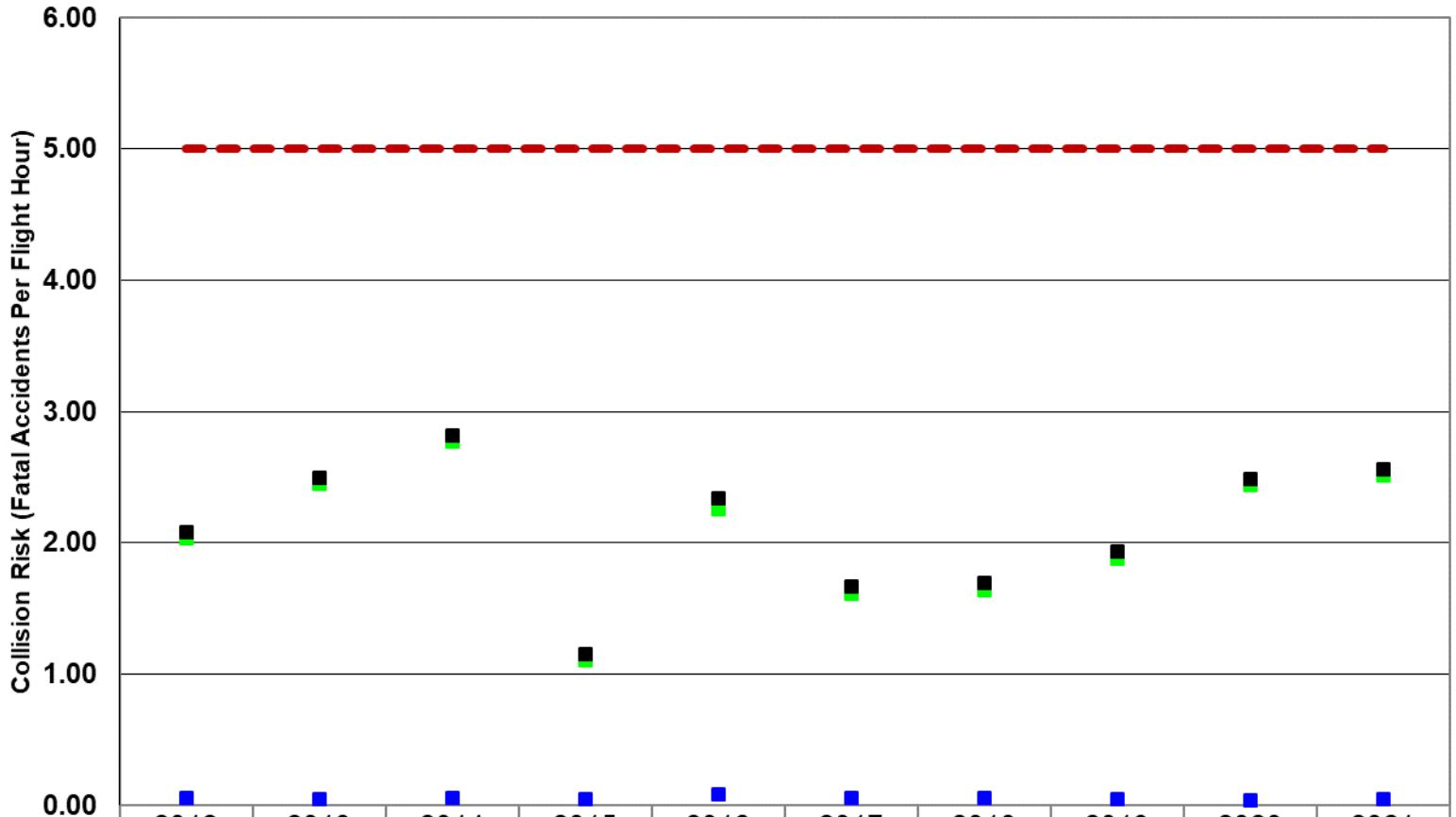
Airspace	Length (ft)	Wingspan (ft)	Height (ft)	Source
Northern Canada	**196**	**180**	**54**	NavCanada Traffic Sample 2021
Southern Canada	**161**	**147**	**45**	NavCanada Traffic Sample 2021
CONUS	**128**	**112**	**39**	TFMS Traffic Sample 2021
Mexico	**126**	**112**	**38**	TFMS Traffic Sample Dec 2021

2021 Passing Frequencies



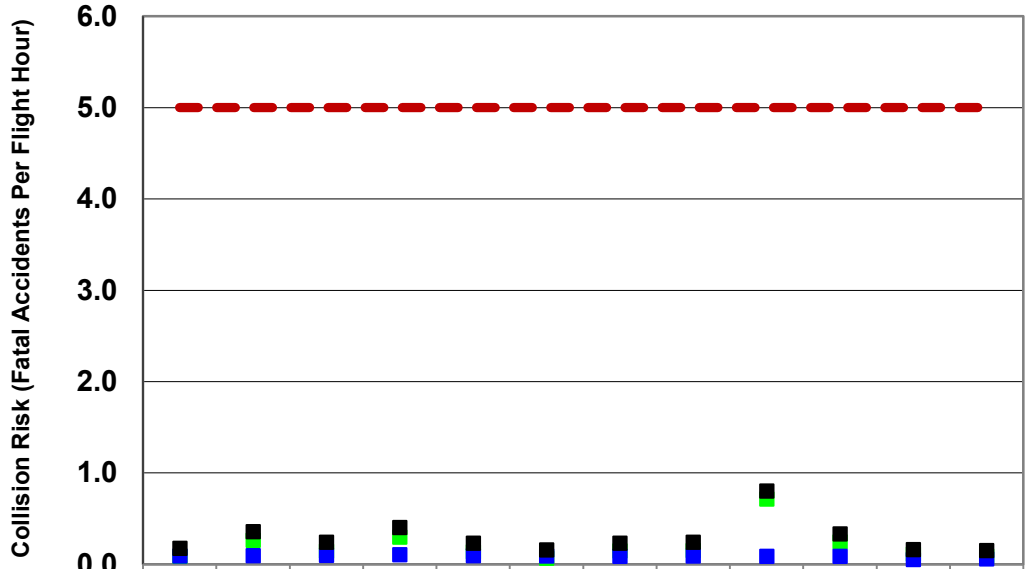
SUMMARY OF ANNUAL RVSM COLLISION RISK ESTIMATES

US Domestic RVSM Estimates of Vertical Collision Risk (x10^{-9} fapfh)



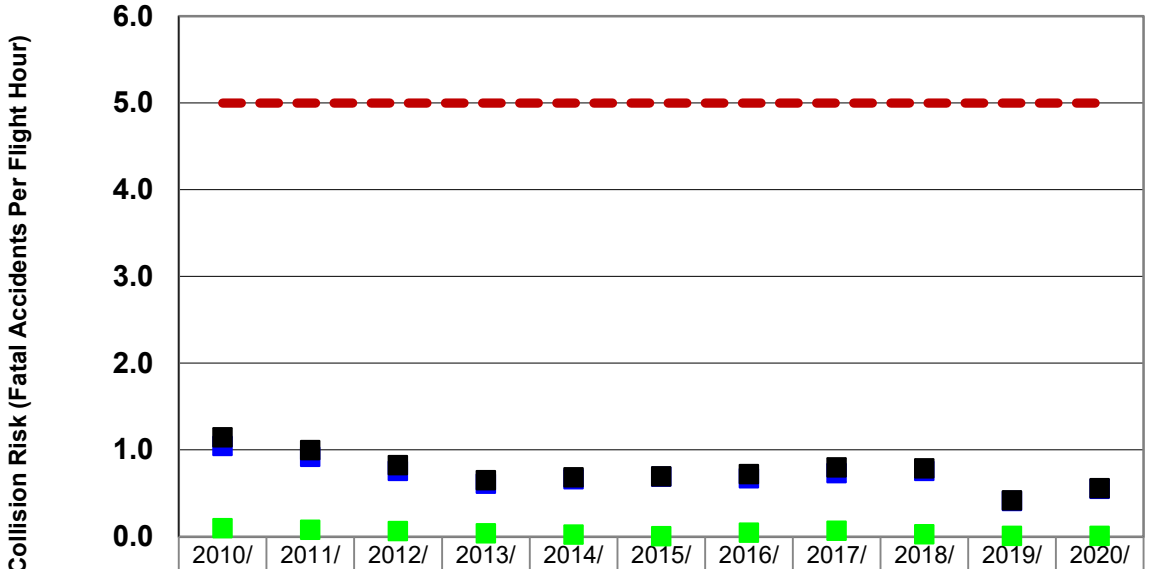
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
TLS	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Operational Risk	2.03	2.45	2.77	1.10	2.26	1.62	1.64	1.88	2.44	2.51
Technical Risk	0.05	0.05	0.05	0.05	0.09	0.05	0.05	0.05	0.04	0.05
Total Risk	2.09	2.50	2.82	1.15	2.34	1.67	1.70	1.93	2.48	2.56

Southern Canada RVSM – Annual Estimates of Vertical Collision Risk



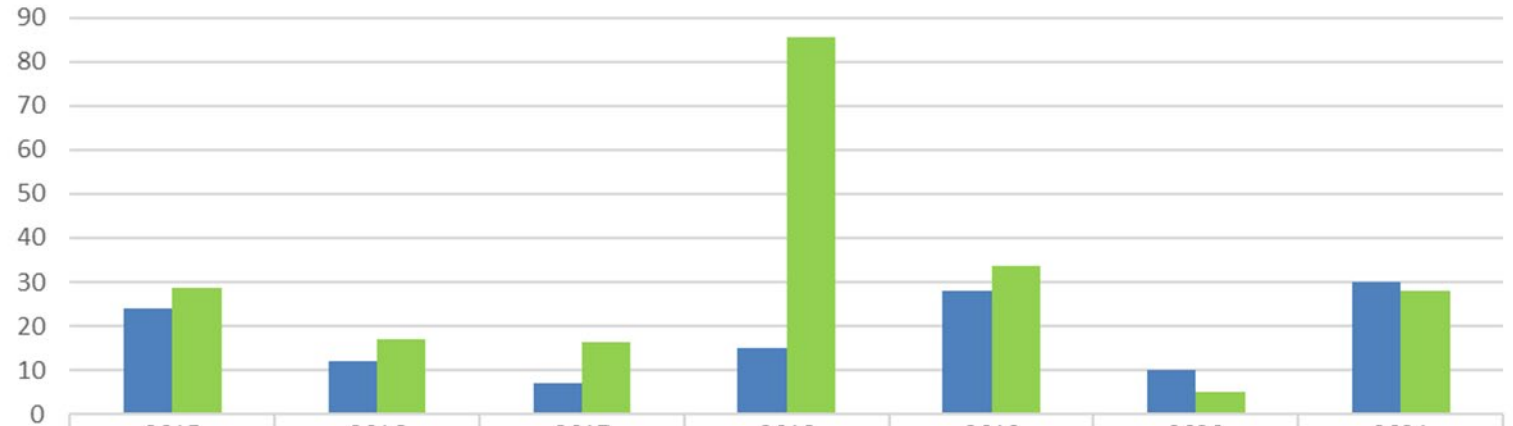
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
TLS	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Operational Risk	0.09	0.26	0.14	0.30	0.14	0.06	0.15	0.15	0.71	0.25	0.11	0.09
Technical Risk	0.09	0.09	0.10	0.10	0.09	0.09	0.08	0.09	0.09	0.09	0.05	0.06
Total Risk	0.18	0.36	0.24	0.40	0.23	0.16	0.23	0.24	0.80	0.33	0.16	0.15

Northern Canada RVSM - Annual Estimates of Vertical Collision Risk



	2010/ 2011	2011/ 2012	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020	2020/ 2021
TLS	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Operational Risk	0.10	0.08	0.06	0.04	0.02	0.01	0.05	0.07	0.03	0.01	0.01
Technical Risk	1.05	0.92	0.76	0.61	0.66	0.69	0.67	0.73	0.76	0.41	0.55
Total Risk	1.15	1.00	0.82	0.65	0.68	0.70	0.72	0.80	0.79	0.42	0.56

Mexico and GoMEX Airspace
Risk-bearing LHDs



	2015	2016	2017	2018	2019	2020	2021
Number of LHDs	24	12	7	15	28	10	30
LHD Duration (min)	28.5	17	16.5	85.5	33.5	5	28

Mexico and GOMEX Airspace
Vertical Collision Risk Estimates (×10-9 fapfh)

Summary

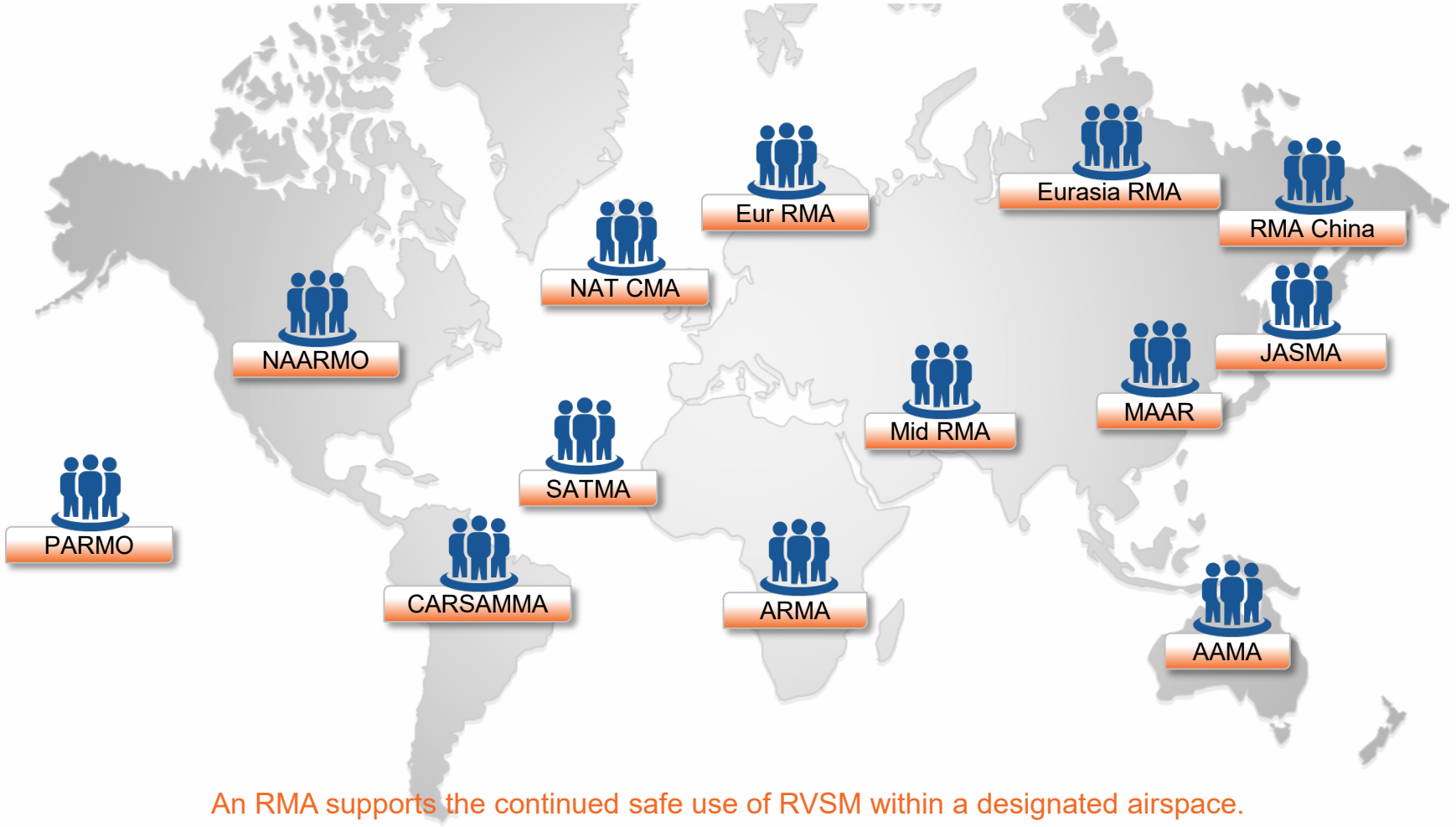
- NAARMO would like more frequent traffic samples from Canada and Mexico
  - Quarterly Traffic Samples would be preferred
- Thorough LHD reporting is essential for estimates of operational risk and varying trends present in each State's analysis reflect unique characteristics of the airspaces under evaluation.
- Submit PBCS approval updates to NAARMO
- Have already begun LHD event review for 2022
- Future NAM reviews should continue to be coordinated yearly with ICAO.

REFERENCE MATERIAL / BACKGROUND INFORMATION

RMA BACKGROUND

Regional Monitoring Agencies Worldwide

In all regions where RVSM has been implemented, regional monitoring agencies (RMAs) have been established by the appropriate planning and implementation regional groups (PIRGs) to satisfy the goals of the RVSM monitoring program.



An RMA supports the continued safe use of RVSM within a designated airspace.

RMA Duties and Responsibilities

1. Establish and maintain a database of aircraft approved by the respective State authorities for operations within RVSM airspace in that region
2. Receive reports of height deviations of aircraft observed to be non-compliant, based on the following criteria:
   a) TVE ≥ 90 m (300 ft.)
   b) ASE ≥ 75 m (245 ft.)
   c) AAD ≥ 90 m (300 ft.)
3. Take the necessary action with the relevant State and operator to:
   a) Determine the likely cause of the height deviation
   b) Verify the approval status of the relevant operator
4. Recommend, wherever possible, remedial action

Reference: ICAO Doc 9937, Appendix A

RMA Duties and Responsibilities (cont.)

5. Analyze data to detect height deviation trends
6. Undertake such data collections as are required by the PIRG to:
   a) investigate height-keeping performance of the aircraft in the core of the distribution;
   b) establish or add to a database on the height-keeping performance of:
      - the aircraft population
      - aircraft types or categories
      - individual airframes

Reference: ICAO Doc 9937, Appendix A

RMA Duties and Responsibilities (cont.)

7. Monitor the level of risk as a consequence of operational errors and in-flight contingencies as follows:
   a) Establish a mechanism for collation and analysis of all reports of height deviations of 90 m (300 ft) or more resulting from the above errors/actions
   b) Determine, wherever possible, the root cause of each deviation together with its size and duration
   c) Calculate the frequency of occurrence
   d) Assess the overall risk (technical combined with operational and in-flight contingencies) in the system against the overall safety objectives
   e) Initiate remedial action as required

Reference: ICAO Doc 9937, Appendix A

RMA Duties and Responsibilities (cont.)

8. Initiate checks of the “approval status” of aircraft operating in the relevant RVSM airspace, identify non-approved operators and aircraft using RVSM airspace and notify the appropriate State of Registry/State of the Operator accordingly;
9. Circulate regular reports on all height-keeping deviations, together with such graphs and tables necessary to relate the estimated system risk to the TLS
10. Submit annual reports to the PIRG.

Reference: ICAO Doc 9937, Appendix A

RMA Bulletin Summary

- The purpose of an RMA Bulletin is to publish details of aircraft/operators:
  - Not approved for operations in RVSM airspace
  - Non-compliant with performance (ASE)
  - Non-compliant with long-term monitoring requirements
- The bulletins are published at predefined times following scheduled audits of flight plans and other data sources (such as height monitoring and surveillance data).
  - EUR RMA conducts a formal audit at the end of each 3 months of the year.
  - RMA EURASIA conducts a monthly audit of flight plans.
    - Although initial publication of the Bulletin will be at predefined times, an amendment will be issued whenever an approval for a listed aircraft is received
- It remains the responsibility of each State to determine what may be considered as ‘appropriate action’ to be taken in accordance with the requirements defined in ICAO Annex 6.
  - 2020 RMACG/15 Virtual meeting received paper about Germany developing a policy to implement rejection of flight plans for non-approved.
  - 2021 RMACG/16 Virtual meeting was updated by EUR RMA on the status of EUR RVSM region’s flight plan rejection by the EUROCONTROL IFPS to address non-RVSM approved aircraft that have been listed on the EUR RMA Bulletin for a period greater than 6 months.

Verification

- This process involves the exploration of systematic reasons for removing entries from the list, including:
  - Lag in State notification of approval to the RMA
  - Lag in updates to the approvals database
  - Mistakes in the original traffic movement data
  - “Code-sharing” between airlines
  - Newest operator codes not contained in reference sources
  - Entries that appeared in only one of the traffic samples

US Traffic Sample

- The air traffic movement data used for the traffic scrutiny is obtained from the FAA's Traffic Flow Management System (TFMS) and merged with NASQuest for full identification within CONUS airspace.

Canadian Traffic Sample

- Canada provided a sample of traffic movement data for December **2021.**
- The sample contained date, Callsign, Registration number, Aircraft Type and Aircraft Equipment Information for operations from December **2021**.
- The sample totalled 57,768 operations
- We would like to increase the rate to quarterly.
  - Consistent with Global RMA trends to increase the scrutiny frequency.

Mexico Traffic Sample

- NAARMO did not receive a traffic sample from Mexico for this assessment period therefore no scrutiny work was completed for this airspace.
- Many aircraft are included in the US traffic sample because they fly between Mexico and CONUS airports.
- NAARMO is discussing collection of the Mexican traffic sample.

LHD BACKGROUND

Overview of Data Sources

U.S. Domestic Airspace

Large Height Deviation reports

Extracted from:

1. **CEDAR** (Comprehensive Electronic Data Analysis and Reporting)
   - ❖ FAA Orders 7210.632 and 7210.633
2. **ATSAP** (Air Traffic Safety Action Program) database

- Data obtained from analysis of reports provides primary estimator of operational risk

Traffic sample from En-route Radar Intelligent Tool (ERIT)

- Obtained from 24 radar sites - chosen to be representative of the traffic in the Continental U.S.
- 55 days from 2021
- Used to estimate passing frequencies

Traffic sample from Traffic Flow Management System (TFMS)

- 31 days from 2021
- Used for estimates of annual flight hours and average aircraft size

FALCON

- RADAR Replay
- Used for estimates of duration spent at incorrect flight level and height deviation.

Comprehensive Electronic Data Analysis and Reporting Database (CEDAR)

- **The CEDAR database contains two types of reports:**
  - **Electronic Occurrence Report (EOR)** – An alert identified by an automated system such as Traffic Analysis and Review Program (TARP) or Operational Error Detection Patch (OEDP) that *automatically* uploads into the Comprehensive Electronic Data Analysis and Reporting (CEDAR) tool.
  - **Mandatory Occurrence Report (MOR) –** An occurrence involving air traffic services for which the collection of associated safety-related data and conditions is mandatory.

Air Traffic Safety Action Program (ATSAP)

- **Air Traffic Safety Action Program (ATSAP)** – The Voluntary Safety Reporting Program (VSRP) for ***Air Traffic Control*** (ATC) personnel based on the Aviation Safety Action Program (ASAP)
- When ATC observes a safety problem or experiences a safety-related event, he or she should note the problem or event and describe it in enough detail so that it can be evaluated by someone not directly involved that understands air traffic risk.
- The report must be submitted using the ATSAP Web site within 24 hours of the end of the employee's duty day.
- ATSAP narratives are important for our process but information is sensitive and even the redacted version is not included in this presentation.

FALCON

- FALCON is a tool that allows users to review radar sessions within the En route environment. It includes voice data in near real-time.
- Usage of FALCON allows the group to determine accurate durations for events for which no duration could be estimated in the past.
- More tools used during event review provides a more accurate estimation of risk

Example CEDAR LHD Report

Example of a climb or descend without clearance deviation and similar sounding call-signs.

XXX4470 enroute at FL340 with Sector R1 was mistakenly switched to R2 instead of XXX4770 who was enroute at FL300 and who the frequency change was originally intended for. XXX4470 correctly readback the frequency change to R1 which went undetected and uncorrected by R1. XXX4470 checks in with R2 but mistakenly identifies themselves as XXX4407. R2 questioned if the aircraft callsign was XXX4770 (the aircraft they were expecting) to which XXX4470 says 'affirmative, it's XXX4470.' R2 did not query/clarify at this moment any further. R2 instructed XXX4770 to FL280 to which XXX4470 readback the descent clearance and incorrectly identified themselves as XXX4770.At 2226z, XXX4470 queries R2 regarding their route which quickly and ultimately ends up leading to the realization by R2 and R1 of the mistaken aircraft identity. R2 instructs XXX4470 to stop their descent but not before the suspected loss in R1 airspace. There were also two other aircraft in this overall scenario, but there was no observed loss involving these aircraft. The Brasher Warning was issued to XXX4470 by R2 at 2239z

LHD Analysis for Continental US

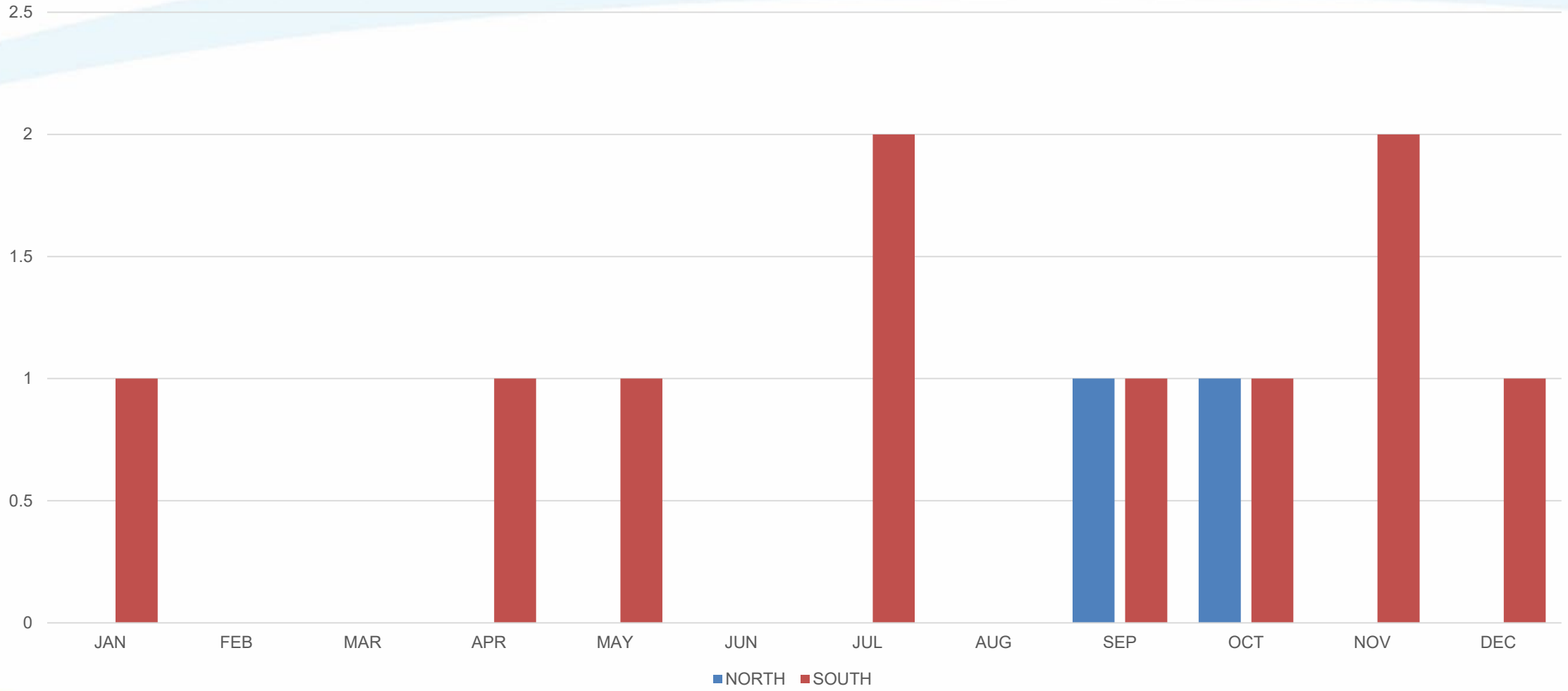
Scrutiny Group Objectives

1. Assign error code(s) according to relevant classification scheme (differs by region)
2. Assign relevant values
   - **Duration**: length of time an aircraft was level at an altitude that was not cleared or planned by air traffic control - recorded in one second increments
   - **Levels crossed**: total number of flight levels between the point that the aircraft exits the cleared flight level and is once again under ATC supervision

Analysis of LHD reports over time helps:

- Identify frequently occurring error types
- Identify if errors appear to occur randomly in time
- Detect positive and negative trends
- Assist in recommending change if warranted

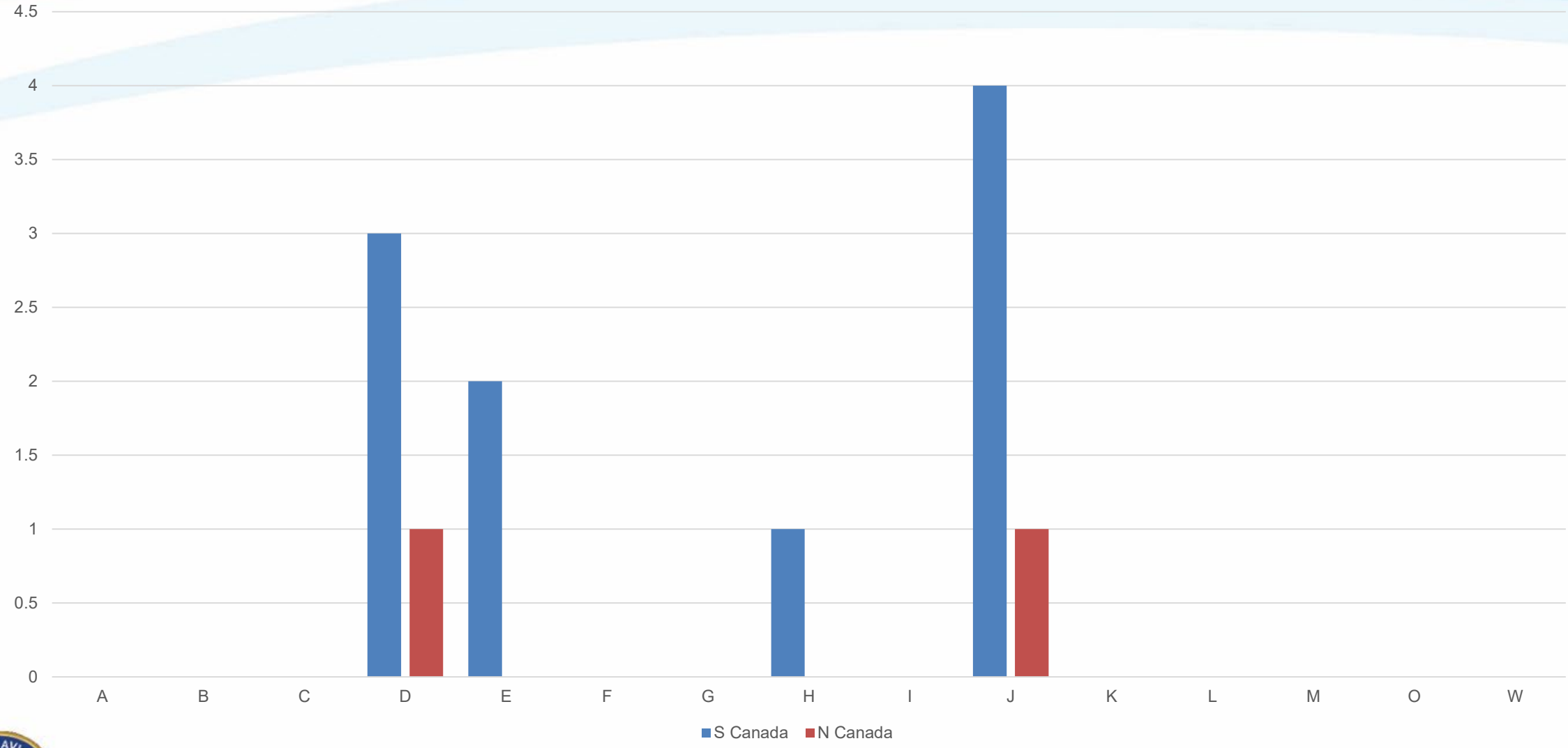
Canada Qualifying LHD Reports by Month - 2021



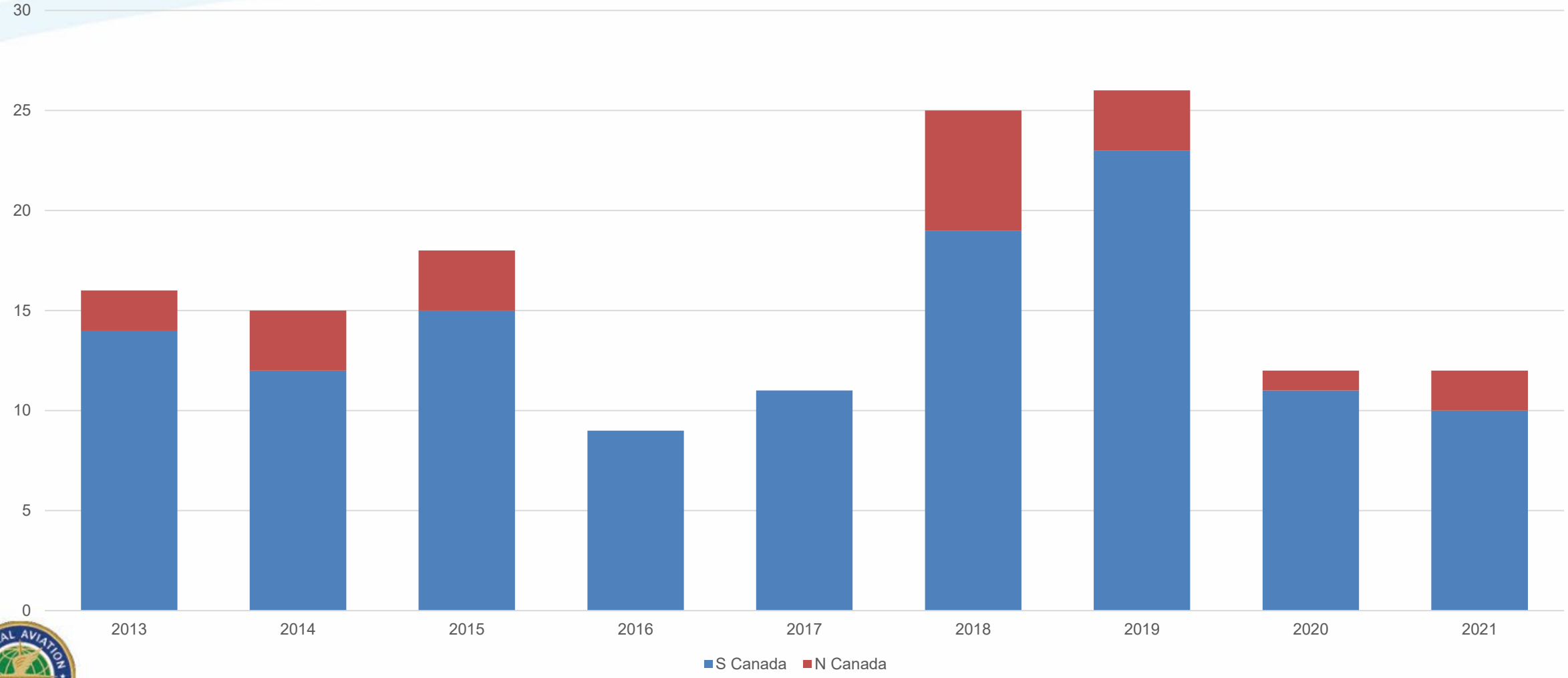
Summary of Canada
Risk Bearing LHD Events - 2021

LHD Code	Description	No. of LHD Events	LHD Duration (Min)	No. of FLs Crossed Without Clearance
Southern Canada				
D	Failure to climb/descend as cleared	3	0	3
E	Climb/descent without ATC clearance	2	0	4
H	Deviation due to TCAS	1	0	0
J	ATC failure to correctly record, coordinate, or follow through on FL changes and/or other clearances	4	0	8
Northern Canada				
D	Failure to climb/descend as cleared	1	0	
J	ATC failure to correctly record, coordinate, or follow through on FL changes and/or other clearances	1	0	0

Number of LHD Events by Category in Canada - 2021



Number of Risk Bearing Events Canada Trend Analysis



Go back

US Domestic RVSM Passing Frequency Estimates

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Estimate of Annual Passing Events - Crossing	3,595,057*	3,666,505	3,572,698	3,211,630	3,830,288	3,841,649	3,946,952	3,617,833	2,306,795	3,451,925
Passing frequency – SAME (per flight hour)	0.0080^	0.0071	0.007	0.0067	0.0085	0.0097	0.0127	0.0108	0.0028	.0064
Passing frequency – OPP (per flight hour)	0.2391^	0.2321	0.2393	0.2228	0.2529	0.2340	0.2308	0.2269	0.1853	.2209
Passing frequency – CROSS (per flight hour)	0.6449	0.7361	0.7316	0.6459	0.7872	0.7470	0.8008	0.7176	0.7092	.8952

* First update since 2005 – notable impact on passing frequency for crossing
^ Updated algorithm for estimating same and opposite passing frequencies

Southern Canada RVSM Passing Frequency Estimates

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Passing frequency **– SAME** (per flight hour)	.0173	.0183	.0142	.0121	.0135	0.0124	0.0134	0.0122	.0124	.0058	0.053
Passing frequency **– OPPOSITE** (per flight hour)	.0377	.0390	.0478	.0449	.0397	0.0376	0.0386	0.0378	.0401	.0245	0.0304
Passing frequency **– CROSSING** (per flight hour)	.0783	.0715	.0730	.0664	.0641	.0600	0.1208	0.1324	.1224	.0611	0.0728

Northern Canada RVSM Passing Frequency Estimates

	2010/ 2011	2011/ 2012	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020	2020/ 2021
2-Year Average Passing frequency **– SAME** (per flight hour)	0.0124	0.0102	0.0090	0.0074	0.0052	0.0061	0.0064	0.0054	.0076	**.0026**	0.0025
2-Year Average Passing frequency **– OPP** (per flight hour)	0.0120	0.0108	0.0086	0.0063	0.0078	0.0074	0.0072	0.0094	.0090	**.0059**	0.0084
2-Year Average Passing frequency **– CROSS** (per flight hour)	0.02150	0.0189	0.0156	0.0126	0.0138	0.0144	0.0140	0.0153	.0152	**.0085**	0.0085

Mexico RVSM Passing Frequency Estimates

	2015	2016	2017	2018	2019	2020	2021
Estimate of Annual Passing Events - Crossing	134,022	163,836	169,301	232,822	190,262	**146,000**	**228,289**
Passing frequency **– SAME** (per flight hour)	0.0053	0.0067	.0027	0.002	0.018	**0.002**	**0.002**
Passing frequency **– OPP** (per flight hour)	0.1450	0.2553	.2276	0.241	0.255	**0.189**	**0.217**
Passing frequency **– CROSS** (per flight hour)	0.4731	0.5305	.3583	0.244	0.209	**0.203**	**0.561**