

Data dictionary and glossary:
Patterns of laser strikes on US aircraft: 2010 to 2018
12 November 2019

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Section 1: Overview of the study

This study, Patterns of laser strikes on US aircraft: 2010 to 2018, reviewed eight years of laser incident reports (2010-2018) compiled by the Federal Aviation Administration (FAA) of unauthorized laser illuminations of larger capacity transport aircraft, specifically large civilian transport aircraft designed to carry 60 or more passengers.

The study used data from three sources:

1. Laser Incidents (Federal Aviation Administration)
2. Air Traffic Activity System: Airport Operations (Federal Aviation Administration)
3. Annual Estimates of the Resident Population (US Census Bureau)

The data from the third source was used to determine which metropolitan areas were used in the study, and the other two sources were used to identify details from laser encounters, as well as the magnitude and distribution of air carrier aircraft.

The FAA Laser Incidents data were cleaned both before and during the initial data analysis process to identify duplicate records, misspellings, misidentifications, and other errors. Many of those pre-analysis cleaning activities, particularly those involving aircraft model identifiers and geographical locations, were inferred using information in each record, and general knowledge about the commercial airline industry.

The study and its findings were published on 2 December 2019 and is available at http://www.airsafe.com/analyze/laser_strikes_2010_2018.html.

Section 2: Database variables

The following tables contain the definitions of the two types of data that were used in the analysis as processed by the R program used in this study:

1. FAA laser incident data (laser incident data) - In the data frame 'laserhits'
2. Traffic data from the FAA's Air Traffic Activity System (traffic data)

The tables below will indicate the status of the variables after they have been processed by the R program.

Coding conventions

Every record in the laser incident database contains information from a laser encounter involving a single aircraft. Each variable in the database is of one of the following four types:

1. Numeric
2. Categorical (factor) data consisting of a character string of fixed length
3. Ordinal (ordered) data consisting of a fixed or varying length of alphanumeric characters.
4. Character (all character input is in ASCII)

Treatment of missing and unknown data

Data that is missing, unavailable, not relevant, not applicable, or unknown will be replaced by the value NA in the data frames used by the R program.

Table 1: Database variables for 'laserhits' data frame

Variable Name	Short description	Data type	Notes
Event_ID	Unique Identification for Each Event	Character	<p>Each event (database record) is assigned a unique nine-character alphanumeric identifier. The first character is the letter 'E' for event, the next four are the year, and the last four represents the event number or that year. the next four numbers are a running tally of events within that year.</p> <p>This unique identifier was added during the analysis process. Gaps in the numerical sequence in a particular year correspond to laser incidents in the original FAA data that were not relevant to this study (for example, helicopters and airliners with less than a 60-seat capacity)</p>
Date	Date of occurrence	Ordinal	During the pre-analysis cleaning process, the date was changed from an eight- or nine-character format (eg. 1-Jan-15) to the 10-character format YYYY-MM-DD (eg. 01-01-2015) with four numbers for the year, and two each for the month (01 to 12) and day (01 to 31) with the three numbers separated by a dash. The date is based on the UTC time of the event.
Day_num	Day of the incident	Numeric	Day of the incident with possible integer values from 1 to 31
Month	Month of the incident	Categorical	A three-character variable with the format Xxx corresponding the abbreviation for the month of the occurrence
Year	Year of the incident	Numeric	Year of the incident with possible integer values from 2010 to 2018
Weekday	Day of the week of the occurrence	Categorical	A three-character variable with the format Xxx corresponding the abbreviation for the day of the week of the occurrence

Time	Time of the occurrence	Ordinal	UTC time of the occurrence in the format HH:MM with the first two characters corresponding to the hour, followed by a colon and two characters corresponding to the minute of the occurrence.
Raw_time	Time of the occurrence	Ordinal	In the FAA files, this was a four-character format using numbers (eg. 0023). In uploading the data, leading zeros may be ignored. The result could be a one to four character value associated with the UTC time of the occurrence. All characters are numbers, and may include up to three leading zeros. A function in the R program transforms this value into the 'Time' variable.
Hour_Category	Hour of the occurrence	Ordinal	A one-character or two-character variable identifying the hour. The values range from 1 to 24. For example, a value of 1 corresponds to a UTC time ('Time' value) from 00:00 to 00:59.
Flight_ID	Flight or aircraft operator identifier	Character	A descriptor for the flight that is typically either a flight number, call sign, or aircraft registration number. Flight number of airline flights typically begin with the ICAO three-letter airline designation.
Model	Aircraft model designator	Character	A four-character designator for the aircraft model. For the aircraft of interest to this study (airline models with the capacity for 60 or more passengers), the first one or two characters are associated with the following manufacturers: A - Airbus AT - ATR B - Boeing C, CR - Bombardier DC, MD - McDonnell Douglas DH - De Havilland Canada E - Embraer

Aircraft_Type	Airline aircraft type	Categorical	A one-character category designator for the type of airline aircraft (only the first four, with a passenger capacity of 60 seats or greater, were included in any analysis: 1 - Single aisle jet airliner 2 - Twin aisle jet airliner 3 - Regional jet airliner (60-100 seats) 4 - Prop-driven airliner 5 - Executive jet 6 - Jet airliner (under 60 seats) 7 - Other multi-engine prop 8 - Other single-engine prop 9 - Helicopter 10 - Large military jet 11 - Other military fixed wing 12 - Military helicopter 13 - Lighter than air craft 14 - Other Jet 15 - Prop-driven airliner (under 60 seats)
Altitude	Aircraft altitude during laser incident	Numeric	Aircraft altitude during laser incident given as integer value
Airport	IATA or ICAO location identifier	Categorical	Three-letter IATA code or four-letter ICAO code for the reported location (airport or navigational aid) of the laser incident.
Laser_color	Color or color combination of laser	Character	Reported color of laser. In the pre-analysis cleaning process, reported laser colors were standardized by making inputs with multiple colors into the form Multiple (Color1, Color2) or Multiple (Color1 or Color2) with the colors listed alphabetically.
Injuries	Reported injuries	Categorical	Binary (Yes/No) variable to indicate if there were any injuries. code assigned, and for non-flight related events.
City	Location of the laser encounter	Character	City or geographical name of the event location. For clarity, the city name used may have been changed during the cleaning process be different from the location given by the appropriate airport or navaid database.

State	State or territory of occurrence	Character	US state or territory where the incident occurred.
Metro_area	Metropolitan area of occurrence	Character	A US Census identified metropolitan area. During the pre-analysis cleaning process, the location given in the 'Airport' variable was assigned to the appropriate metropolitan area. Details on the metro areas are provided in the Definitions section.
Altitude_log	Log value of altitude	Numeric	In creating this variable, zero altitude values were changed to one before the log value was taken.
Altitude_cat	Altitude category	Categorical	Altitudes were sorted into the following categories: under_FL20 - Below 2,000 feet FL20_to_FL180 - 2,000 to 17,999 feet FL180_to_FL400 - 18,000 to 39,999 feet FL400_plus - 40,000 feet and above
State_abb	US Postal service code for the US state or territory.	Categorical	US Postal service two-character state or territory abbreviation

Table 2: Operational data on air carriers taken from the FAA Operations Network (OPSNET) and placed in the data frame flight.data

Variable Name	Short description	Data type	Notes
State.abb	US Postal service code for the US state or territory.	Categorical	US Postal service two-character state or territory abbreviation
Airport	IATA location identifier	Categorical	Three-letter IATA code for the airport
Air_carrier_ops	Day of the incident	Numeric	The number of arrivals or departures of an air carrier aircraft at an airport
Total_ops	Month of the incident	Numeric	A three-character variable with the format Xxx corresponding the abbreviation for the month of the occurrence
Percent_air_carrier	Percentage of air carrier operations at an airport	Numeric	Percent of total airport traffic attributable to air carrier operations. Total air traffic includes itinerant operations from air carrier air taxi, general aviation, and military aircraft, as well as local civil and military flights.

Section 3: Included events and air carrier aircraft models

The previous section defined both the variables used to describe the included event, as well as the format and coding used to summarize the details of each event.

Air Carrier Models

The following models were considered to be air carrier aircraft and were included in the analysis. Other FAA laser encounter records were not used in the analysis.

Manufacturer	Aircraft Model
Airbus	A220, A300, A310, A318, A319, A320, A321, A330, A340, A350, A380
ATR	ATR 72
Boeing	707, 727, 737, 747, 747 LCF, 757, 767, 777, 787
Boeing (McDonnell-Douglas)	717, DC-8, DC-9, DC-10, MD-10, MD-11, MD-80, MD-90
Bombardier (Canadair)	C100, CRJ-700, CRJ-900
Bombardier (de Havilland)	Dash 8
Embraer	ERJ 170, ERJ 175, ERJ 190

Note: Variations of all the above models will also be included. For example, the MD-80 family of models includes the MD-81 and MD-83, and Avro RJ family of models includes the RJ70 and RJ85. Military variants of the above models, are excluded from this list and from this study.

Section 4: Definitions

The following definitions are used throughout the database, the study, and the study's supporting documents.

Air carrier aircraft: An aircraft with seating capacity of more than 60 seats or a maximum payload capacity of more than 18,000 pounds, carrying passengers or cargo for hire or compensation. This includes US and foreign-flagged carriers.

Air taxi aircraft: Aircraft designed to have a maximum seating capacity of 60 seats or less or a maximum payload capacity of 18,000 pounds or less, carrying passengers or cargo for hire or compensation.

Civil: Operations by all classes of private and commercial takeoffs and landings at FAA and Federal Contract Tower facilities.

FAA: Federal Aviation Administration

General Aviation: Takeoffs and landings of all civil aircraft, except for air carriers or air taxis.

Flight: An airport arrival or departure (overflights excluded)

Itinerant: Operations performed by an aircraft, either IFR or VFR, that land at an airport arriving from outside the airport area, or depart from an airport and leave the airport area.

Metro Area: The short form of the term Metropolitan Statistical Area.

Metropolitan Statistical Area: A geographic entity delineated by the Office of Management and Budget for use by federal statistical agencies. Metropolitan statistical areas consist of the county or counties (or equivalent entities) associated with at least one urbanized area of at least 50,000 population, plus adjacent counties having a high degree of social and economic integration with the core as measured through commuting ties.

Military: Operations by all classes of military takeoffs and landings.

MSA: Metropolitan Statistical Area

Section 5: Data sources and references

The following resources were used to develop the information that makes up the data dictionary and glossary

Air Traffic Activity System: Airport Operations

Federal Aviation Administration

<https://aspm.faa.gov/opsnet/sys/Airport.asp>

Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2018

US Census Bureau

<https://www.census.gov/data/datasets/time-series/demo/popest/2010s-total-metro-and-micro-statistical-areas.html>

Bureau of Economic Analysis Income by Metropolitan area

<https://www.bea.gov/data/income-saving/personal-income-county-metro-and-other-areas>

US Census delineation files Core based statistical areas (CBSAs), metropolitan divisions, and combined statistical areas (CSAs)

<https://www.census.gov/geographies/reference-files/time-series/demo/metro-micro/delineation-files.html>

US Census Glossary

<https://www.census.gov/glossary/>

Metropolitan and Micropolitan Statistical Areas Map (September 2018)

<https://www.census.gov/geographies/reference-maps/2018/geo/cbsa.html>

https://www2.census.gov/geo/maps/metroarea/us_wall/Sep2018/CBSA_WallMap_Sep2018.pdf?#

Laser Incidents

Federal Aviation Administration

<https://www.faa.gov/about/initiatives/lasers/laws/>

OPSNET Reports: Definitions of Variables

https://aspmhelp.faa.gov/index.php/OPSNET_Reports:_Definitions_of_Variables

The following definitions are used throughout the database and the supporting documents. Some of the definitions are based on definitions used by leading accident investigation and air safety policy organizations, in particular ICAO and NTSB. Other definitions are specific to this database.

<https://www.census.gov/content/dam/Census/library/visualizations/2019/comm/percent-pop-change-metro-micro.pdf>

NOTE:

Combined Statistical Area includes Metropolitan Statistical area plus adjacent Micropolitan areas. Must exclude micropolitan areas.

Example for Philadelphia

Metropolitian

<https://censusreporter.org/profiles/31000US37980-philadelphia-camden-wilmington-pa-nj-de-md-metro-area/>

Combined Statistical area(with nearby Micropolitan)

<https://censusreporter.org/profiles/33000US428-philadelphia-reading-camden-pa-nj-de-md-csa/>

https://www2.census.gov/geo/maps/econ/ec2012/csa/EC2012_330M200US428M.pdf