



Decoding Aircraft Emergencies

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Background

ABOUT

- Explore in-flight emergency air situations using squawk 7700 codes from OpenSky
 - Over 4.2 million rows of data from csv & parquet.gz files loaded into PostgreSQL.
 - Data spans flights seen by the network's 2500+ members between 1 January 2018 and 29 January 2020.
- Interactive visualization created using Javascript, SQLAlchemy, Flask & Heroku.



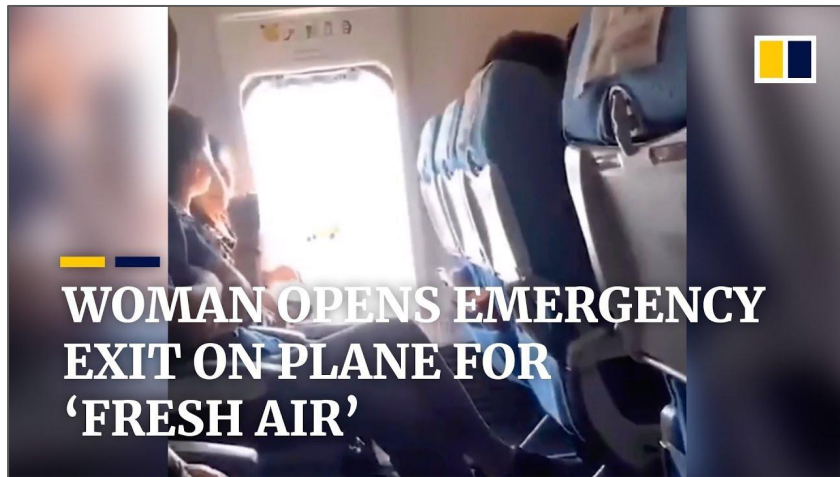
APPROACH



1. Identify data sources and dependencies
2. Collect and clean aircraft, emergency and flight trajectory data
3. Join 3 datasets on flight_id & icao
4. Load data in PostgreSQL using SQLAlchemy
5. Create Flask App and connect routes to PostgreSQL
6. Create charts and map using Javascript libraries
7. Customize html and css for final application
8. Visualize dashboard in Heroku



Approach

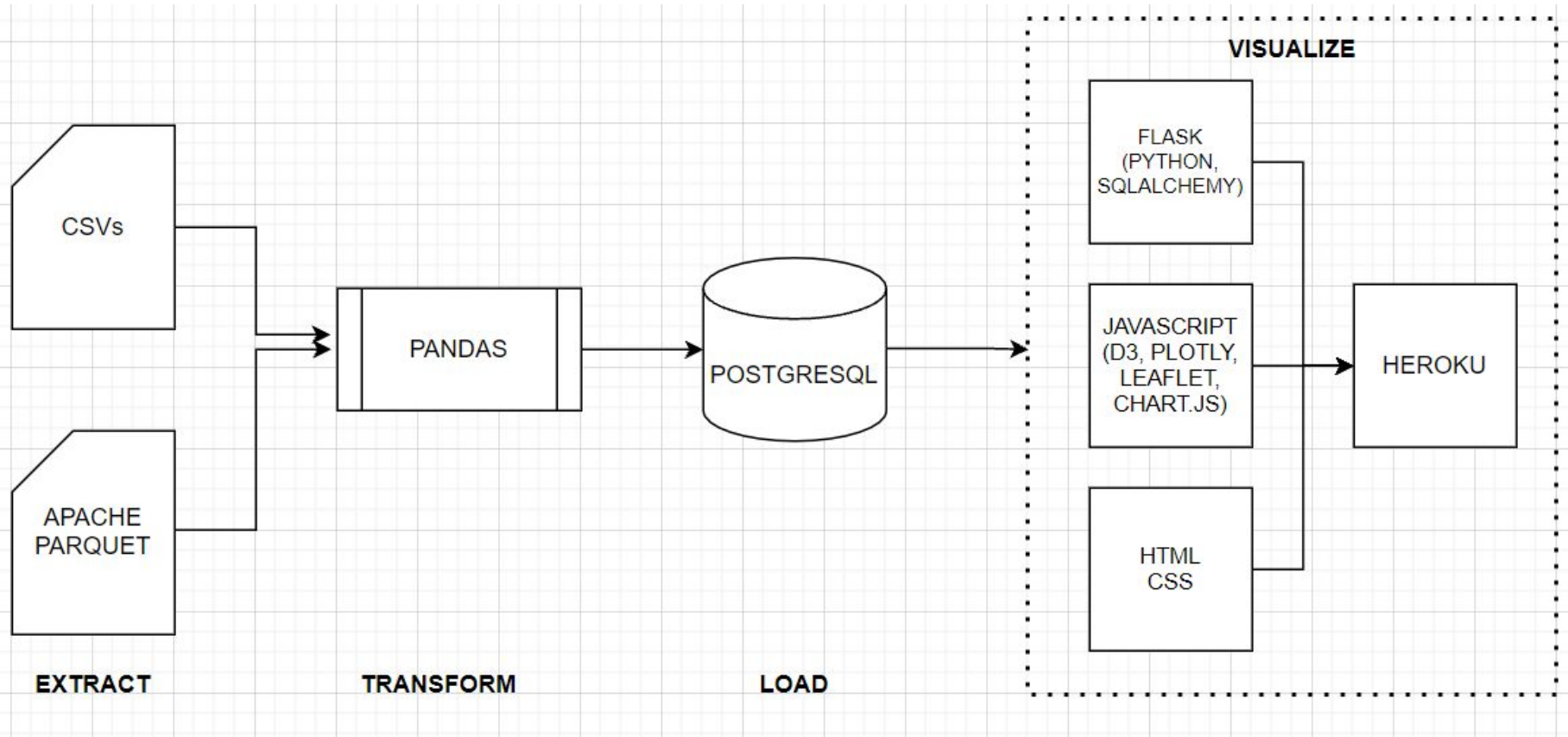


LIMITATIONS & ASSUMPTIONS

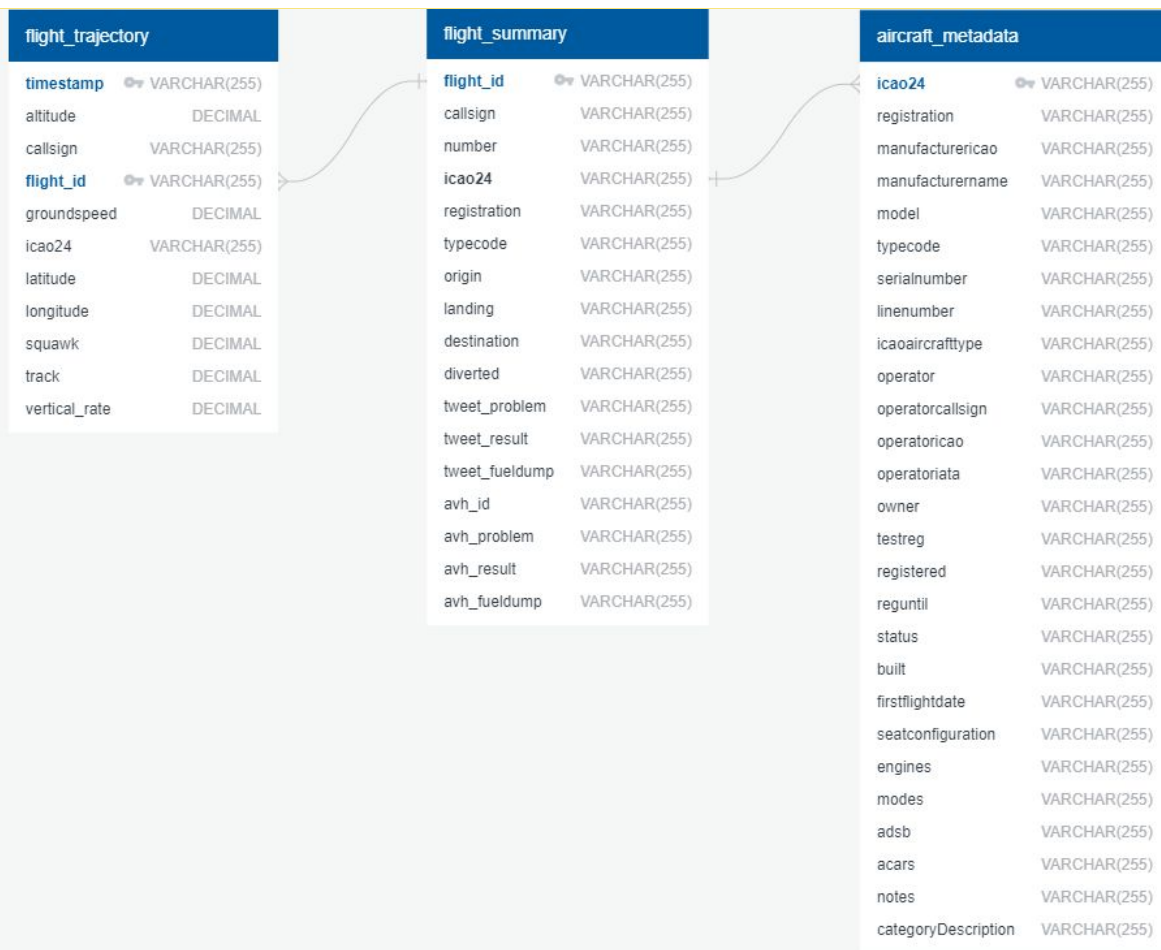
- Limited time of project
- Flight data is from Jan 2018 to Feb 2020
- Only 813 flights of squawk code 7700 data, however each flight has many rows of data
- Assume data is correct via OpenSky



ETL Architecture



Aircraft ERD



POSTGRESQL

pgAdmin 4

File Object Tools Help

Browser

- aircraft_project
 - Casts
 - Catalogs
 - Event Triggers
 - Extensions
 - Foreign Data Wrapper
 - Languages
 - Publications
 - Schemas (1)
 - public
 - Collations
 - Domains
 - FTS Configurati
 - FTS Dictionarie
 - FTS Parsers
 - FTS Templates
 - Foreign Tables
 - Functions
 - Materialized Vi
 - Procedures
 - Sequences
 - Tables (3)
 - aircraft_met
 - Columns
 - Constraints
 - Indexes
 - RLS Poli
 - Rules
 - Triggers
 - flight_summr
 - flight_trajec
 - Trigger Functio
 - Types
 - Views
 - Subscriptions

- animals_db

Dashboard Properties SQL Statistics Dependencies Dependents aircraft_project/postgres@PostgreSQL 13 *

aircraft_project/postgres@PostgreSQL 13

Query Editor Query History

```
1 select * from flight_trajectory
2
```

Data Output Explain Messages Notifications

	timestamp	altitude	callsign	flight_id	groundspeed	icao24	latitude	longitude	squawk	track	vertical
	[PK] character varying (255)	numeric	character varying (255)	[PK] character varying (255)	numeric	character varying (255)	numeric	numeric	numeric	numeric	numeric
17	2019-02-18 07:47:12-05	2725.0	EZY13MR	EZY13MR_20190218	33.25527876362642	400d8c	56.01493835449219	1258433949333	7700	502534126162	67.999
18	2019-02-18 07:47:13-05	2725.0	EZY13MR	EZY13MR_20190218	33.77581649236572	400d8c	56.0145853333554	1428070068364	7700	861505168652	67.999
19	2019-02-18 07:47:14-05	2700.0	EZY13MR	EZY13MR_20190218	33.77581649236572	400d8c	56.01429748535156	1873668323873	7700	861505168652	67.999
20	2019-02-18 07:47:15-05	2675.0	EZY13MR	EZY13MR_20190218	33.77581649236572	400d8c	56.01402282714844	7059659091224	7700	861505168652	67.999
21	2019-02-18 07:47:16-05	2675.0	EZY13MR	EZY13MR_20190218	33.77581649236572	400d8c	56.01361083984375	9544122869374	7700	861505168652	67.999
22	2019-02-18 07:47:17-05	2650.0	EZY13MR	EZY13MR_20190218	33.77581649236572	400d8c	56.01332842293432	4747695922852	7700	861505168652	67.999
23	2019-02-18 07:47:18-05	2650.0	EZY13MR	EZY13MR_20190218	33.77581649236572	400d8c	56.01296997070312	5702237215935	7700	861505168652	67.999
24	2019-02-18 07:47:19-05	2625.0	EZY13MR	EZY13MR_20190218	33.25527876362642	400d8c	56.01263013936705	6721801757812	7700	502534126162	67.999
25	2019-02-18 07:47:20-05	2625.0	EZY13MR	EZY13MR_20190218	33.25527876362642	400d8c	56.01237487792969	7533291903435	7700	502534126162	03.999
26	2019-02-18 07:47:21-05	2600.0	EZY13MR	EZY13MR_20190218	32.74023336987452	400d8c	56.01210021972656	8282359730123	7700	429424827082	
27	2019-02-18 07:47:22-05	2600.0	EZY13MR	EZY13MR_20190218	31.88240954468947	400d8c	56.01168823242188	9530806107996	7700	173664449722	
28	2019-02-18 07:47:23-05	2600.0	EZY13MR	EZY13MR_20190218	31.36959382054295	400d8c	56.01137322894597	4983520507812	7700	354354195201	
29	2019-02-18 07:47:24-05	2575.0	EZY13MR	EZY13MR_20190218	31.36959382054295	400d8c	56.01104736328125	1915283203125	7700	115335422163	
30	2019-02-18 07:47:25-05	2575.0	EZY13MR	EZY13MR_20190218	30.51042322107136	400d8c	56.01076804985435	3007965087886	7700	115335422163	
31	2019-02-18 07:47:26-05	2550.0	EZY13MR	EZY13MR_20190218	30.51042322107136	400d8c	56.01039563195179	3416595458984	7700	115335422163	

Query Editor

Query History

```
1 select count(*) from flight_trajectory
2
```

Data Output

Explain

Messages

Notifications

	count bigint
1	4344359

TRANSFORMATIONS

- Lowercase column names so that they can be loaded into postgresql
- Convert data types
- Remove NaN values and rows



DECODING AIRCRAFT EMERGENCIES

Analyzing Aircraft Emergencies

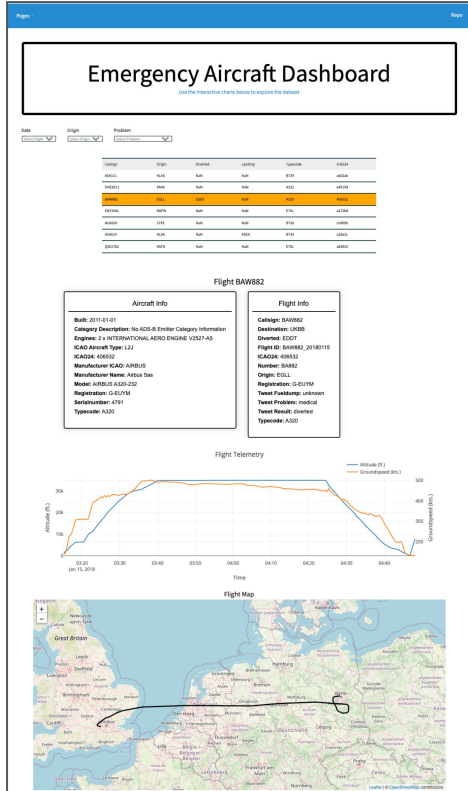
MOST FREQUENTLY USED SQUAWK CODE

Squawk 7700 is the squawk code for a general emergency. The first emergency code is Squawk 7500. 7700 is a code that is actually fairly commonly seen by Air Traffic Control.

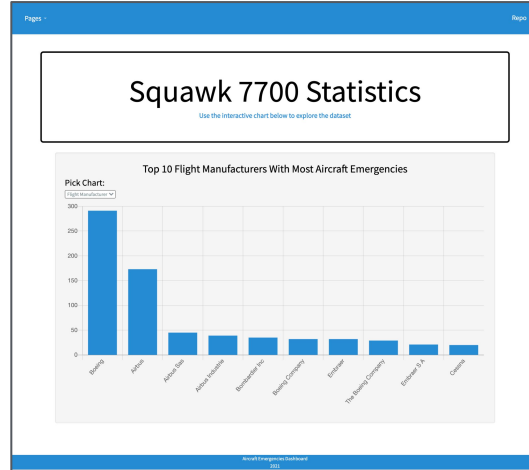
Data Output		Explain	Message
	squawk numeric	count bigint	
1	7700	813	
2	1000	93	
3	5677	17	
4	7407	10	
5	5614	9	

Final Application

1.



2.



3.

About the Project

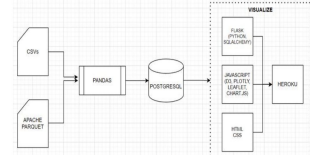
Background

As frequent flyers, our team was interested in exploring in-flight emergency air situations using squawk 7700 codes. We created an interactive web dashboard using Heroku to explore over 4.2 million rows of data from OpenSky which we loaded into PostgreSQL.

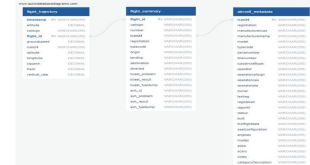
Data is derived from the OpenSky dataset in order to illustrate in-flight emergency situations triggering the 7700 transponder code. Data spans flights seen by the network's more than 2500 members between 1 January 2018 and 29 January 2020. Multiple charts update from data that is stored in PostgreSQL. The project is powered by a Python Flask API and Heroku.

Aviators can use this data to highlight safety issues they need to address and compare aircraft performance. Customers can use this data to learn about common frequent flight emergencies and select airlines or aircraft types with fewer emergencies.

Flow



ERD



Sources

The data used for this project are CSV and Parquet files. They can be found at the following places:

- Flight Summary and Trajectory Data
- Aircraft Information
- Squawk Code List

This project was produced using:

- Python (Jupyter Notebook, Pandas, SQLAlchemy, Flask)
- PostgreSQL
- JavaScript (D3, Chart.js, Plotly, Leaflet)
- HTML/CSS
- Heroku

Authors: Lauren Tu, Matthew Bishop, Grey Hardy, Jack Cohen

DASHBOARD LINK:

<https://gtdsproject3aircraftdata.herokuapp.com/>

Homepage

Pages -

Repo

Emergency Aircraft Dashboard

Use the interactive charts below to explore the dataset

Date

Origin

Problem

Select Flight

Select Origin

Select Problem

Callsign	Origin	Diverted	Landing	Typecode	ICAO24
ARG1511	SACO	NaN	SABE	B738	e06442
DAL14	KATL	NaN	NaN	B763	a14c29
JBU263	KJFK	NaN	NaN	A320	aa600a
DALE5	KATL	NaN	KLAX	A333	ab2655
EDW24	LSZH	LSZH	LSZH	A343	4b1901
ASA111	KLAS	NaN	NaN	B739	a602ab
ONE8511	KMIA	NaN	NaN	A332	e491b4

Flight ARG1511

Aircraft Info

Category Description: No ADS-B Emitter Category Information

ICAO Aircraft Type: L2J

ICAO24: e06442

Manufacturer ICAO: BOEING

Manufacturer Name: Boeing

Model: 737NG 86J/W

Registration: LV-FQB

Serialnumber: 36886

Flight Info

Callsign: ARG1511

Destination: SABE

Flight ID: ARG1511_20180101

ICAO24: e06442

Landing: SABE

Number: AR1511

Origin: SACO

LV-FQB

You are screen sharing

Stop Share

Origin = London Heathrow (EGLL)

Date

Select Flight ▼

Origin

✓ Select Origin

SACO

KATL

KJFK

KATL

LSZH

KLAS

KMIA

EGLL

KDFW

CYXE

KLAS

KSFO

LLBG

KSMF

KLAX

BIKF

Problem

Select Problem ▼

Design	Origin	Diverted
51511	SACO	NaN
.14	KATL	NaN
263	KJFK	NaN
.65	KATL	NaN
N24	LSZH	LSZH
111	KLAS	NaN
E8511	KMIA	NaN

Diverted to Berlin-Tegel Airport (EDDT)

Callsign	Origin	Diverted	Landing	Typecode	ICAO24
EDW24	LSZH	LSZH	LSZH	A343	4b1901
ASA111	KLAS	NaN	NaN	B739	a602ab
ONE8511	KMIA	NaN	NaN	A332	e4919d
BAW882	EGLL	EDDT	NaN	A320	406532
ENY3342	KDFW	NaN	NaN	E75L	a272b8
WJA506	CYXE	NaN	NaN	B736	c0499b
ASA619	KLAS	NaN	KSEA	B739	a28a2c

Due to Medical Problem

Flight BAW882

Aircraft Info

Built: 2011-01-01
Category Description: No ADS-B Emitter Category Information
Engines: 2 x INTERNATIONAL AERO ENGINE V2527-A5
ICAO Aircraft Type: L2J
ICAO24: 406532
Manufacturer ICAO: AIRBUS
Manufacturer Name: Airbus Sas
Model: AIRBUS A320-232
Registration: G-EUYM
Serialnumber: 4791
Typecode: A320

Flight Info

Callsign: BAW882
Destination: UKBB
Diverted: EDDT
Flight ID: BAW882_20180115
ICAO24: 406532
Number: BA882
Origin: EGLL
Registration: G-EUYM
Tweet Fuedump: unknown
Tweet Problem: medical
Tweet Result: diverted
Typecode: A320

Due to Medical Problem

Flight BAW882

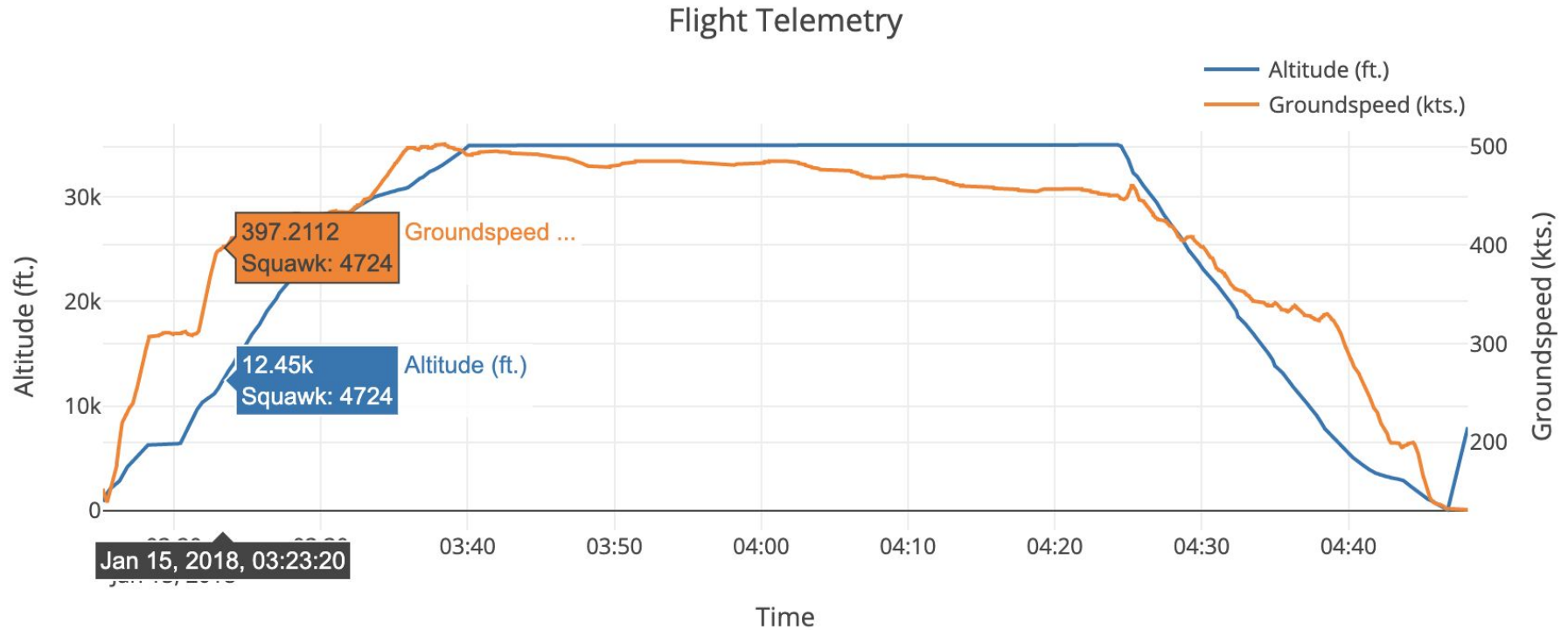
Aircraft Info

Built: 2011-01-01
Category Description: No ADS-B Emitter Category Information
Engines: 2 x INTERNATIONAL AERO ENGINE V2527-A5
ICAO Aircraft Type: L2J
ICAO24: 406532
Manufacturer ICAO: AIRBUS
Manufacturer Name: Airbus Sas
Model: AIRBUS A320-232
Registration: G-EUYM
Serialnumber: 4791
Typecode: A320

Flight Info

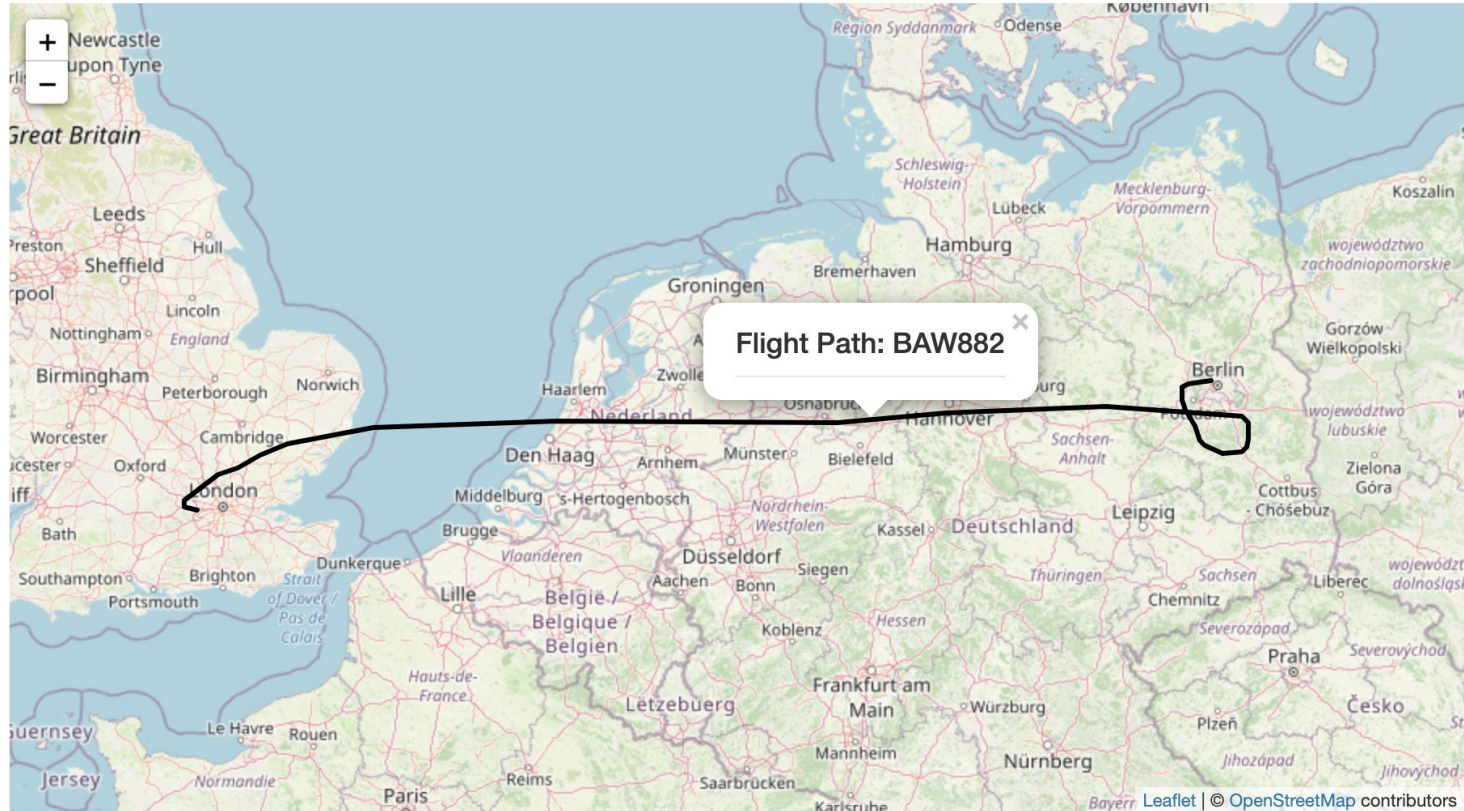
Callsign: BAW882
Destination: UKBB
Diverted: EDDT
Flight ID: BAW882_20180115
ICAO24: 406532
Number: BA882
Origin: EGLL
Registration: G-EUYM
Tweet Fuedump: unknown
Tweet Problem: medical
Tweet Result: diverted
Typecode: A320

Rapid Altitude Loss



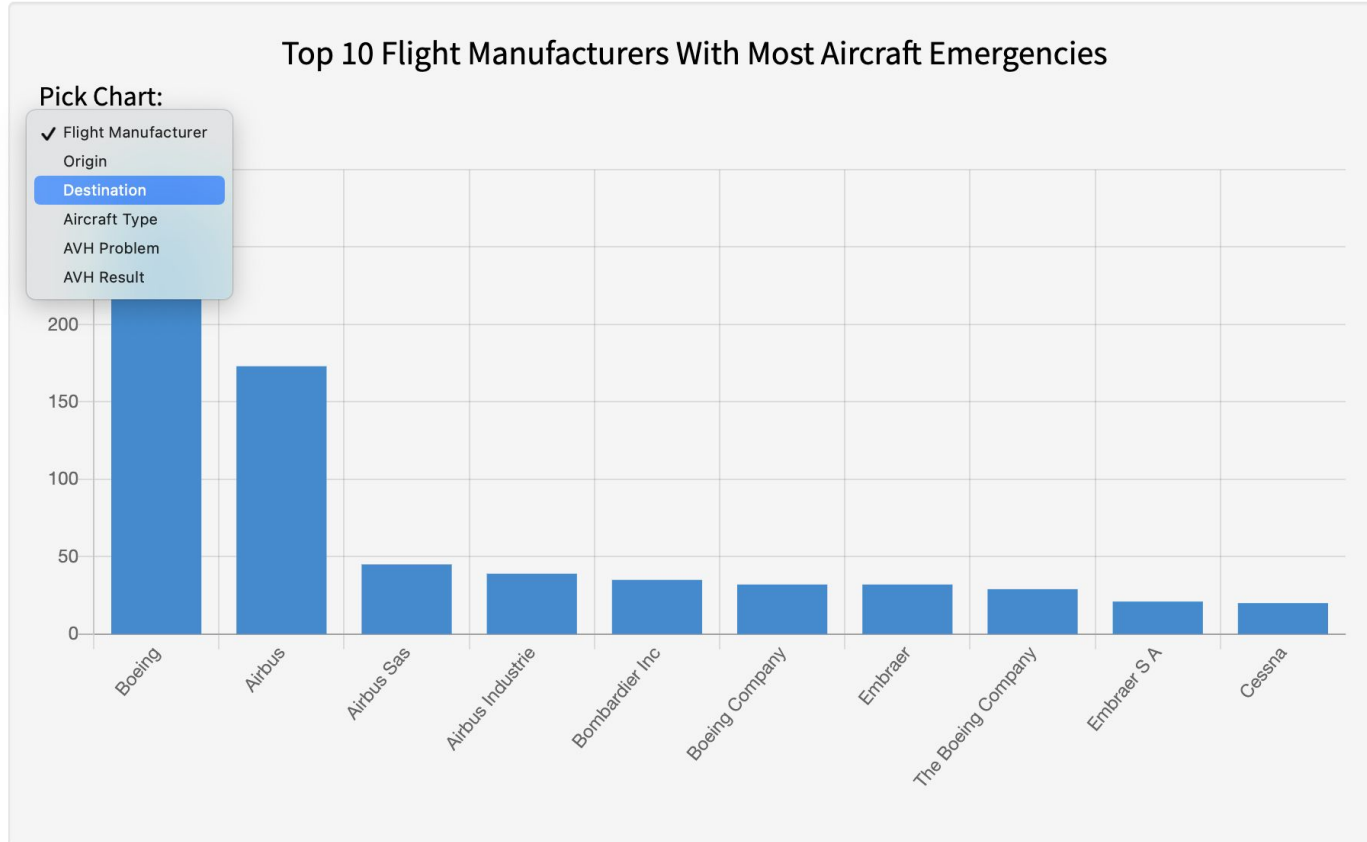
Circle Back on Path

Flight Map

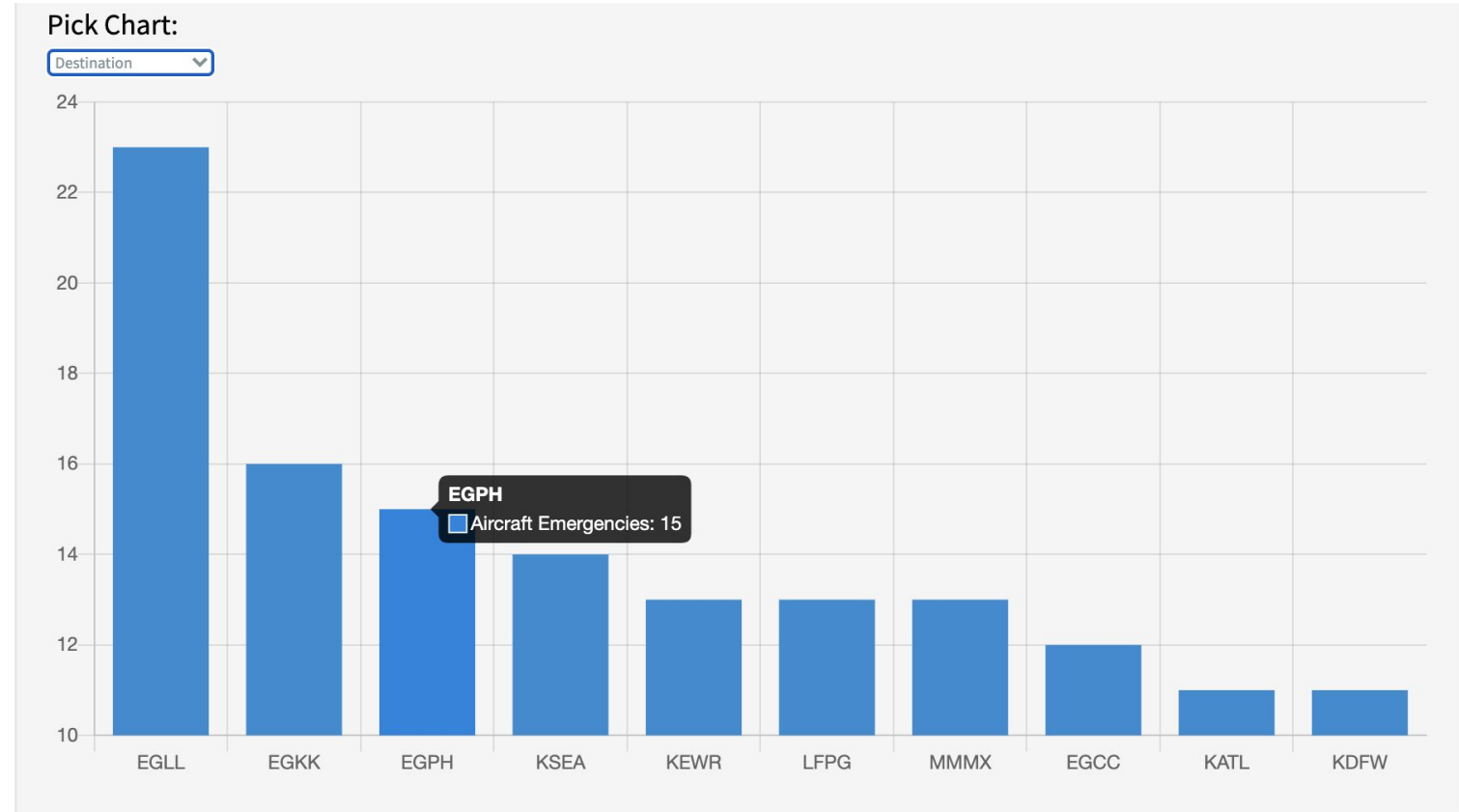


DECODING AIRPLANE EMERGENCIES [PART 2]

Planes manufactured by Boeing have the most emergencies.



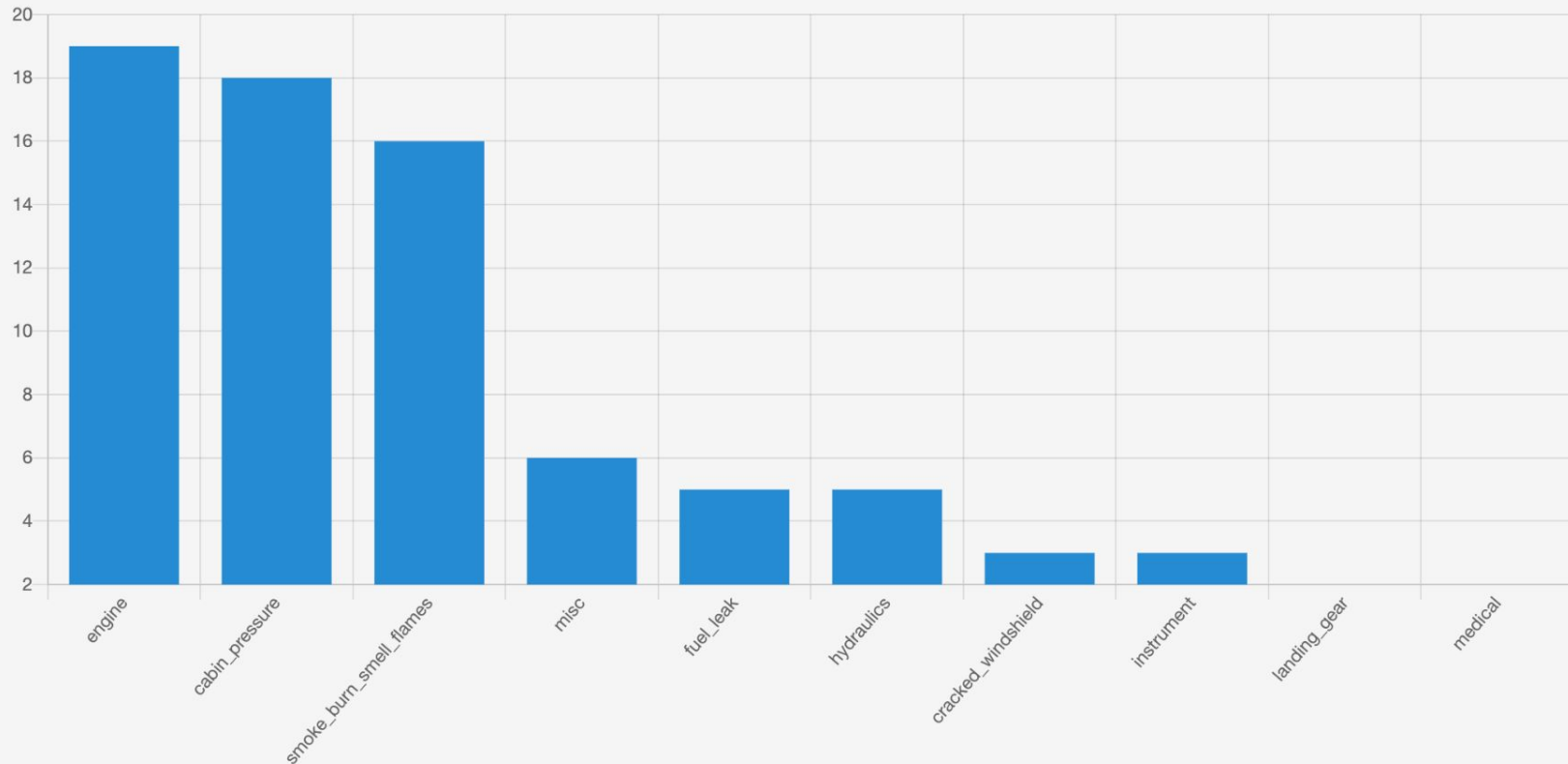
Planes enroute to Heathrow (EGLL) experience the most emergencies.



Engine problems are the most common issues, followed by cabin pressure and smoke, burn, smell flames,.

Pick Chart:

AVH Problem ▾



Conclusion

“The mission of the FAA is to provide the safest, most efficient aerospace system in the world.”



BUSINESS IMPLICATIONS

- Airlines can use this data to highlight safety issues they need to address and compare aircraft performance
- Help governing entities and aerospace companies like the FAA, etc. determine where source of problems are coming from
- Customers can use this data to learn about frequent flight emergencies and select airlines or aircraft types with fewer emergencies



QUESTIONS?