Digital Plane Spotting: High-Flying Applications for Cloud-Based Data

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NCTCOG Regional GIS Meeting

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Introduction

- Armchair interest (obsession?) in civil aviation
- Wanted more information about planes flying over my apartment near DFW Airport
- Using FlightAware's PiAware software package, Python, MySQL, and ArcGIS (Personal Use license) to log and analyze unencrypted flight data from aircraft

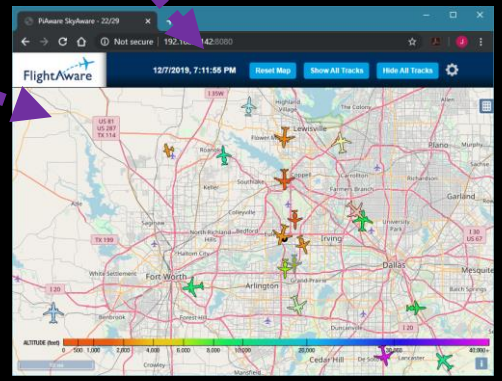
What is ADS-B/Mode S?

- 1090 MHz digital radio transmission from aircraft that can contain:
  - Identifying information (Callsign/Hex, flight number)
  - XYZ Location (Latitude, Longitude, Altitude)
  - Flight information (air speed, vertical speed, heading, etc.)
- Intended for use by secondary radar systems used by air traffic control
- Mode S (older) transmits in response to interrogation from ground stations and data stream contains less information
- ADS-B (newer) is transmitted constantly and provides a richer data stream
- Transmissions are unencrypted and can be received by third parties on the ground

What is ADS-B/Mode S?

GPS (1.2/1.6 GHz)

ADS-B (1.1 GHz)



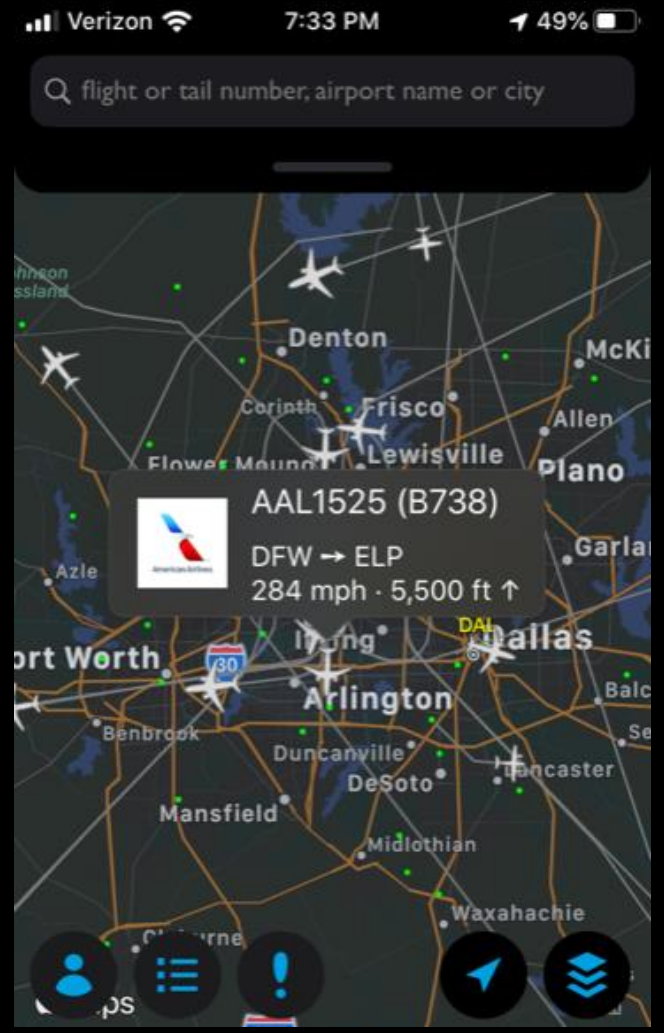
FlightAware

Additional Applications

Image Credits: FlightAware, National Coordination Office for Space-Based Positioning, Navigation, and Timing

What is FlightAware/PiAware?

- FlightAware is one of a handful flight data aggregators that uses ADS-B and other data streams to assemble a live picture of the world's commercial and civil aviation
- ADS-B data is usually collected by a volunteer network of privately-owned receivers
- FlightAware provides PiAware software and sells receiving equipment to volunteers to increase their ADS-B coverage

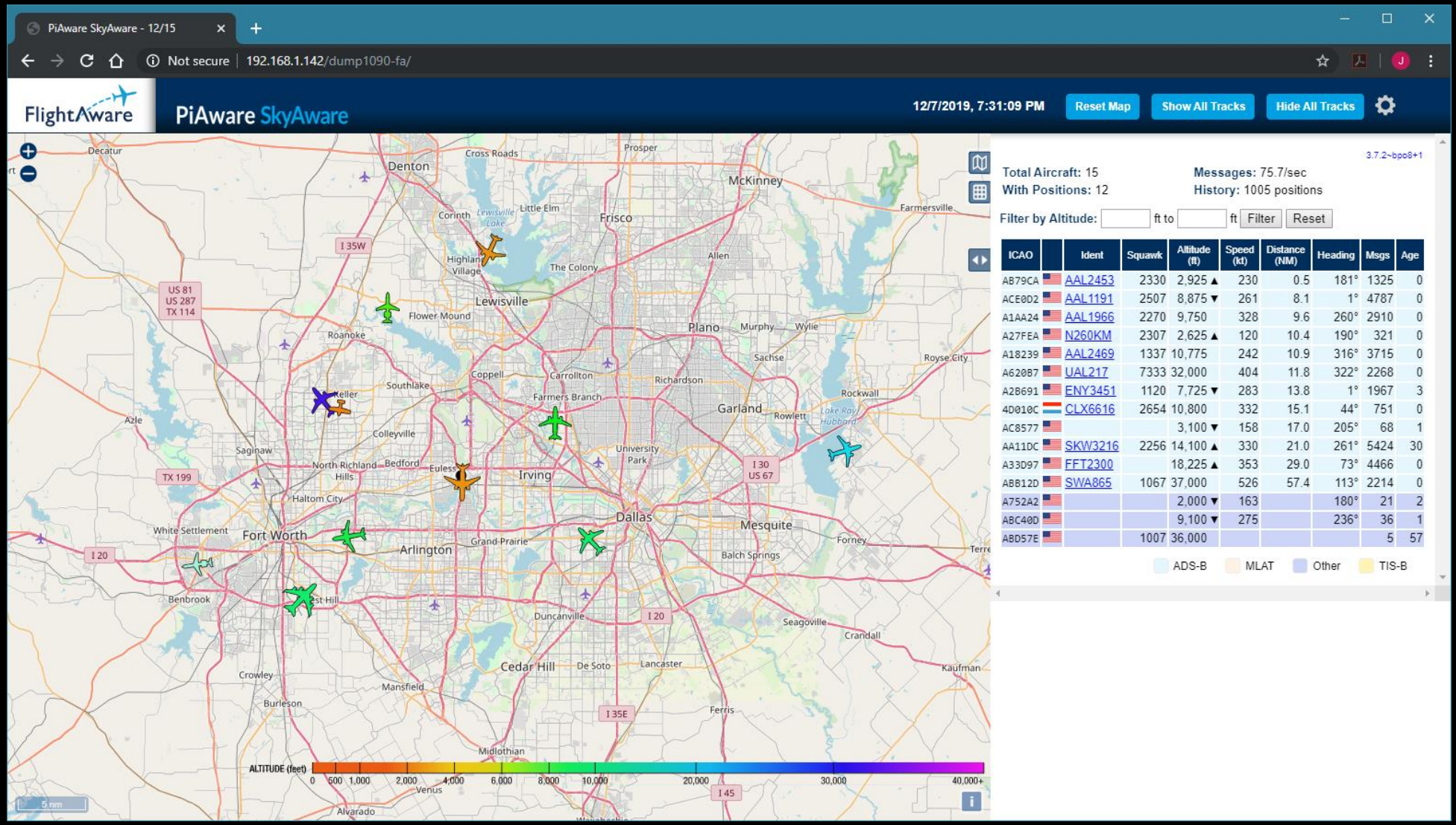


What is FlightAware/PiAware?

Receivers consist of:

- An antenna optimized to receive 1090 MHz transmissions
- A software-defined radio dongle
- A Raspberry Pi or other lightweight computer running FlightAware's PiAware software

PiAware - SkyAware

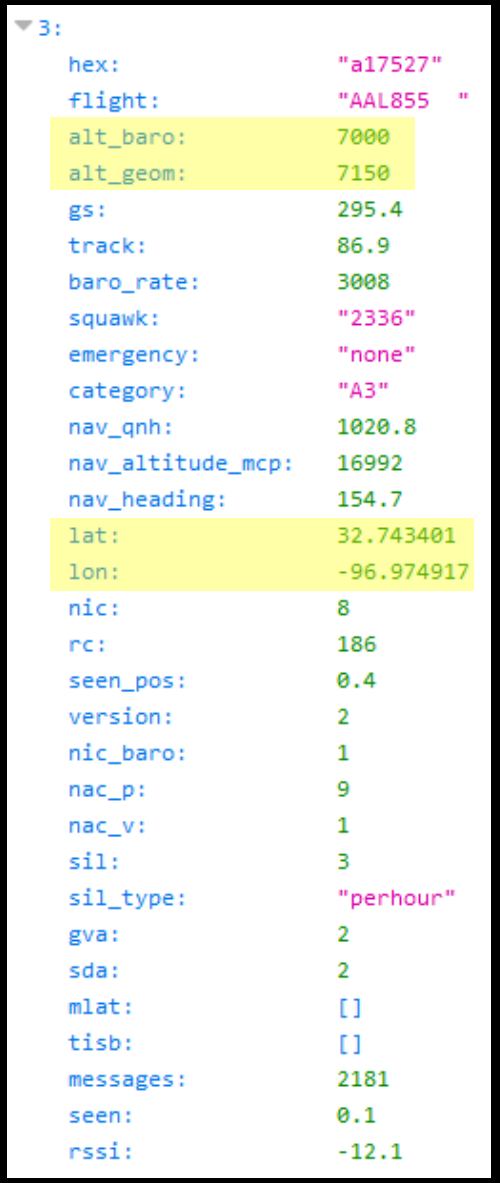


FlightAware ADS-B Stats Page

	12/8/2019	12/7/2019	12/6/2019	12/5/2019	12/4/2019	12/3/2019	12/2/2019
ADS-B	10,023	208,366	236,776	207,836	219,641	217,687	258,769
MLAT	60	1,471	2,065	2,138	1,748	1,716	1,690
Other	2,829	59,925	77,993	76,954	73,471	72,945	75,545
Total	12,912	269,762	316,834	286,928	294,860	292,348	336,004

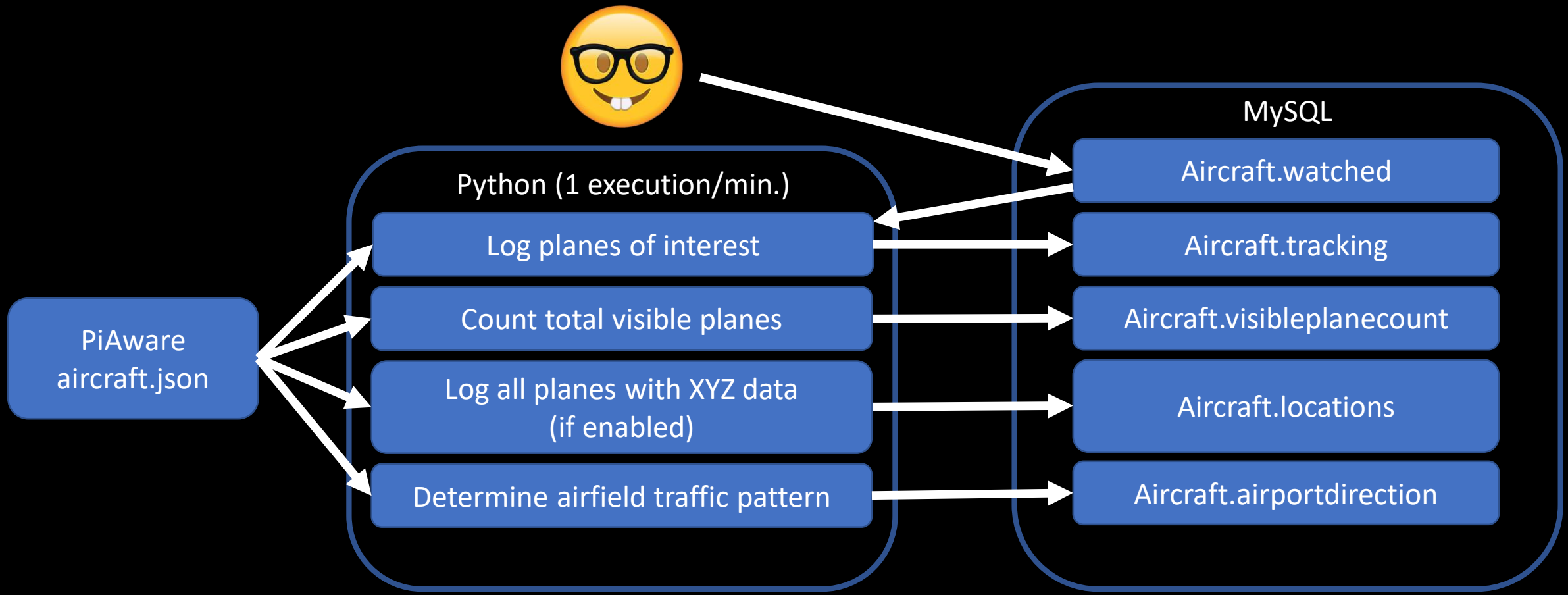
Extensibility of PiAware Framework

- Stock information output is useful, but there's much more potential
- PiAware software continuously outputs information to a JSON file to provide the information seen on the Skyview page
- Stock PiAware distribution runs on Raspbian, a lightweight Linux distribution based on Debian
  - Allows for installation of additional useful components (Python, SSH, Samba, MySQL)



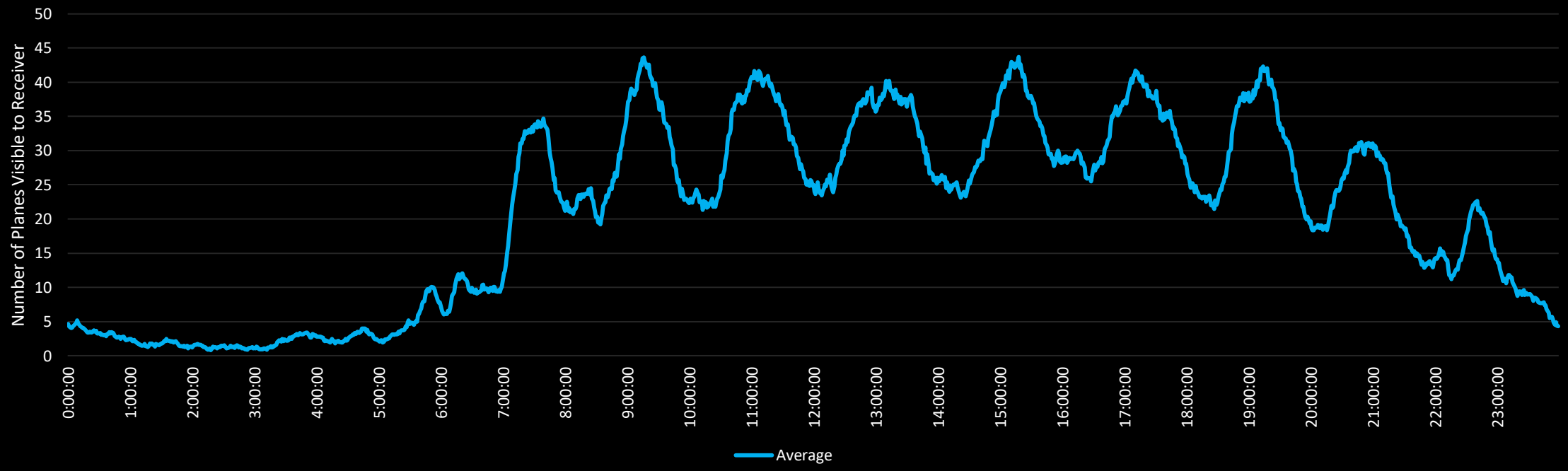
Logging Process

- Series of Python scripts read Skyview JSON once per minute (cron) and insert relevant data into MySQL database



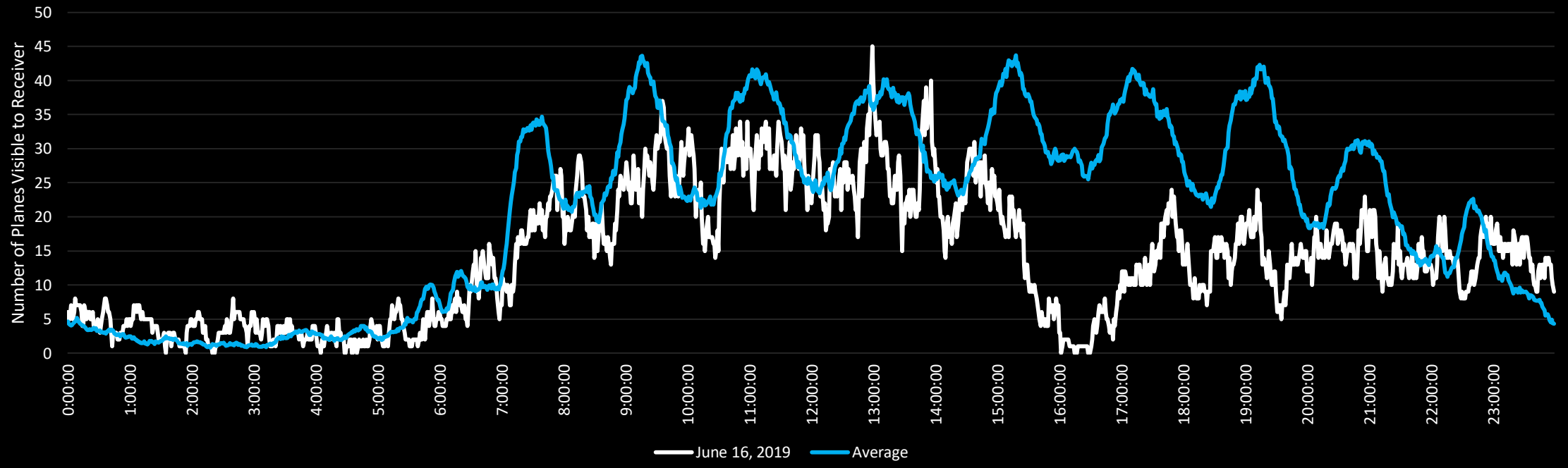
Applications – Overall Airport Activity

- Clear banking pattern evident



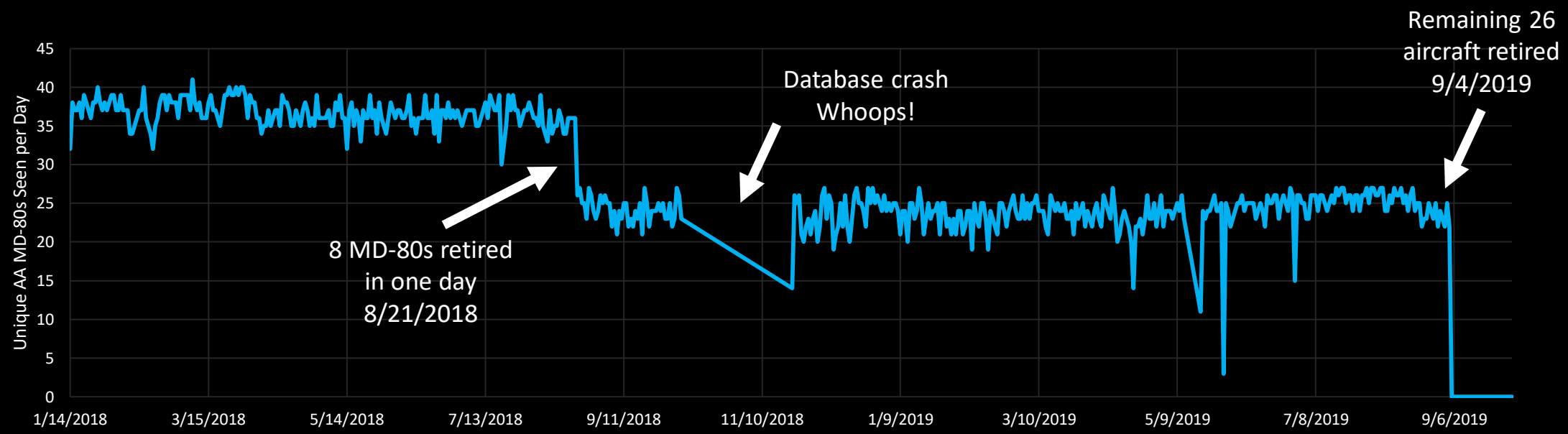
Applications – Overall Airport Activity

- Clear banking pattern evident
- 6/16/2019 – 2.42 inches of rain recorded at DFW Airport

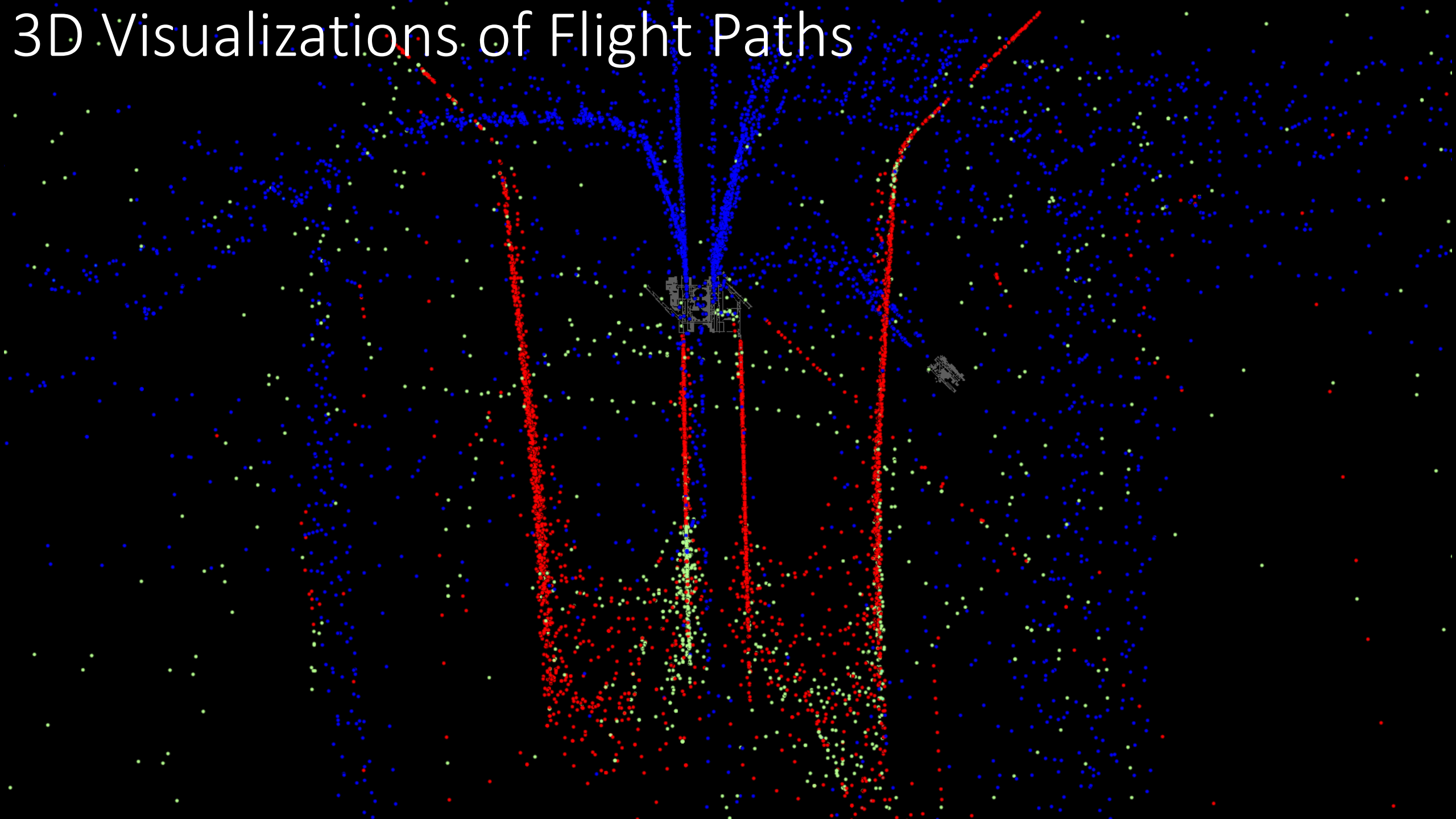


Applications – Tracking Interesting Planes

- Retirements of American's MD-80 fleet over time



3D Visualizations of Flight Paths



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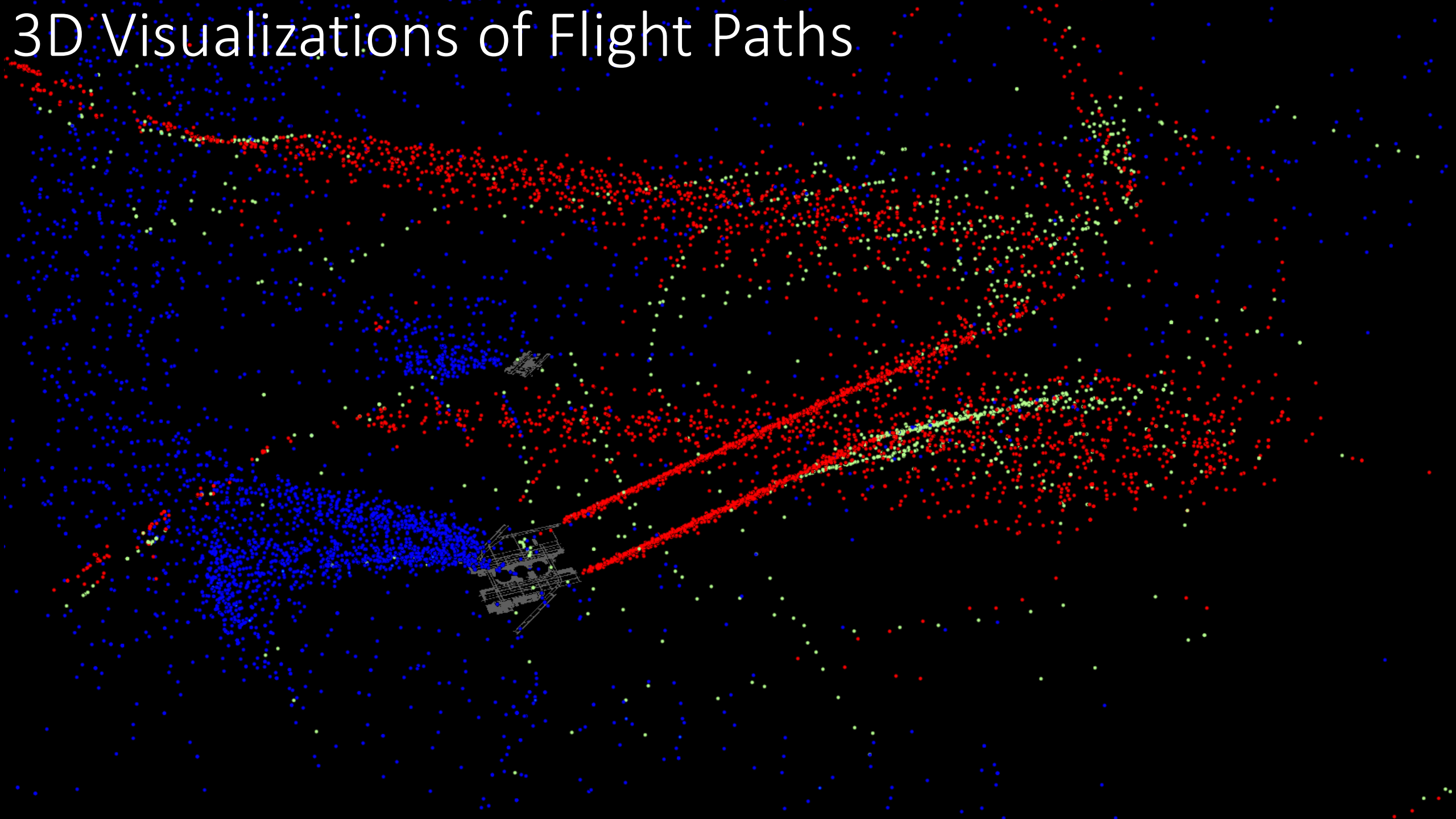

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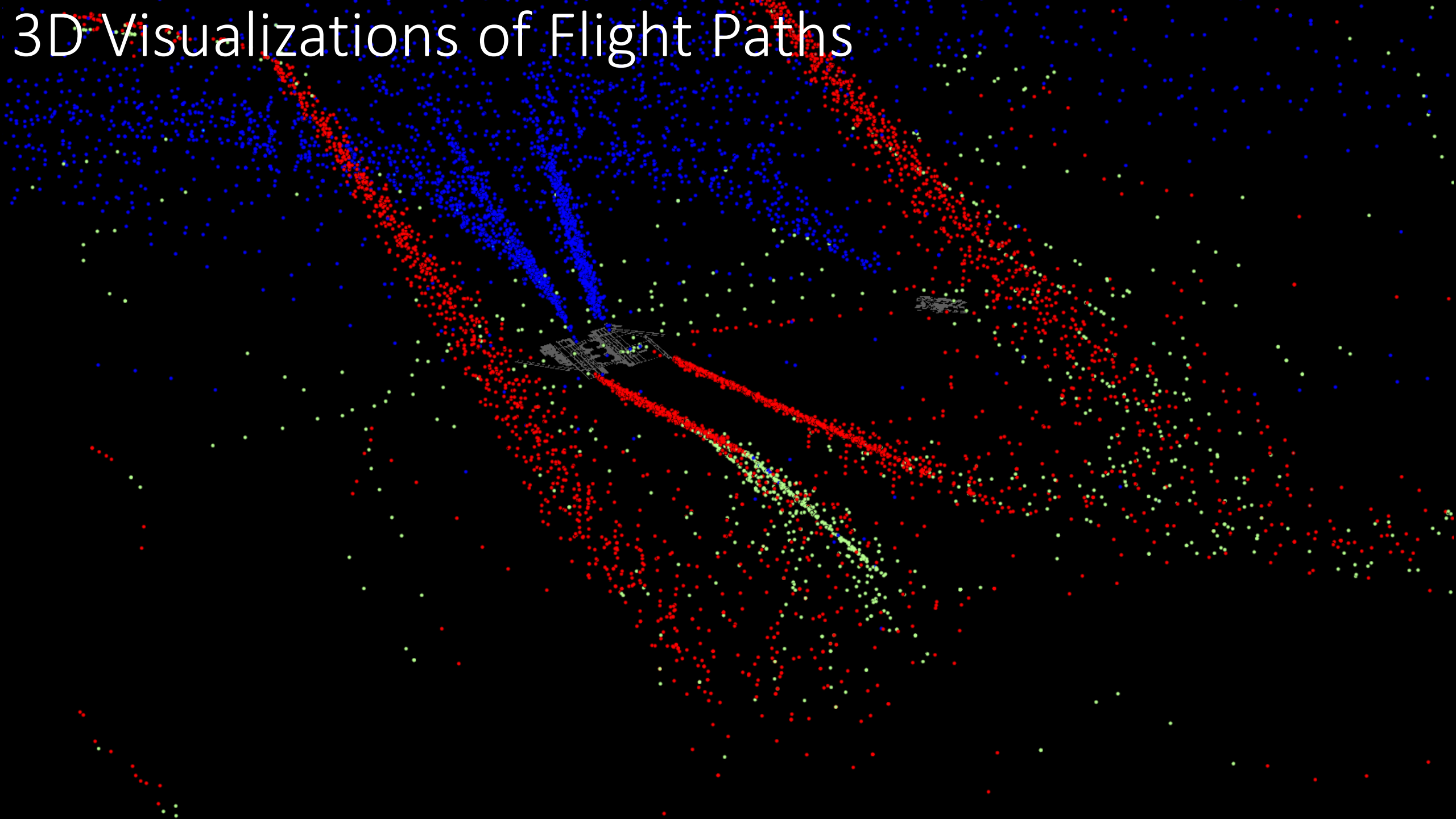
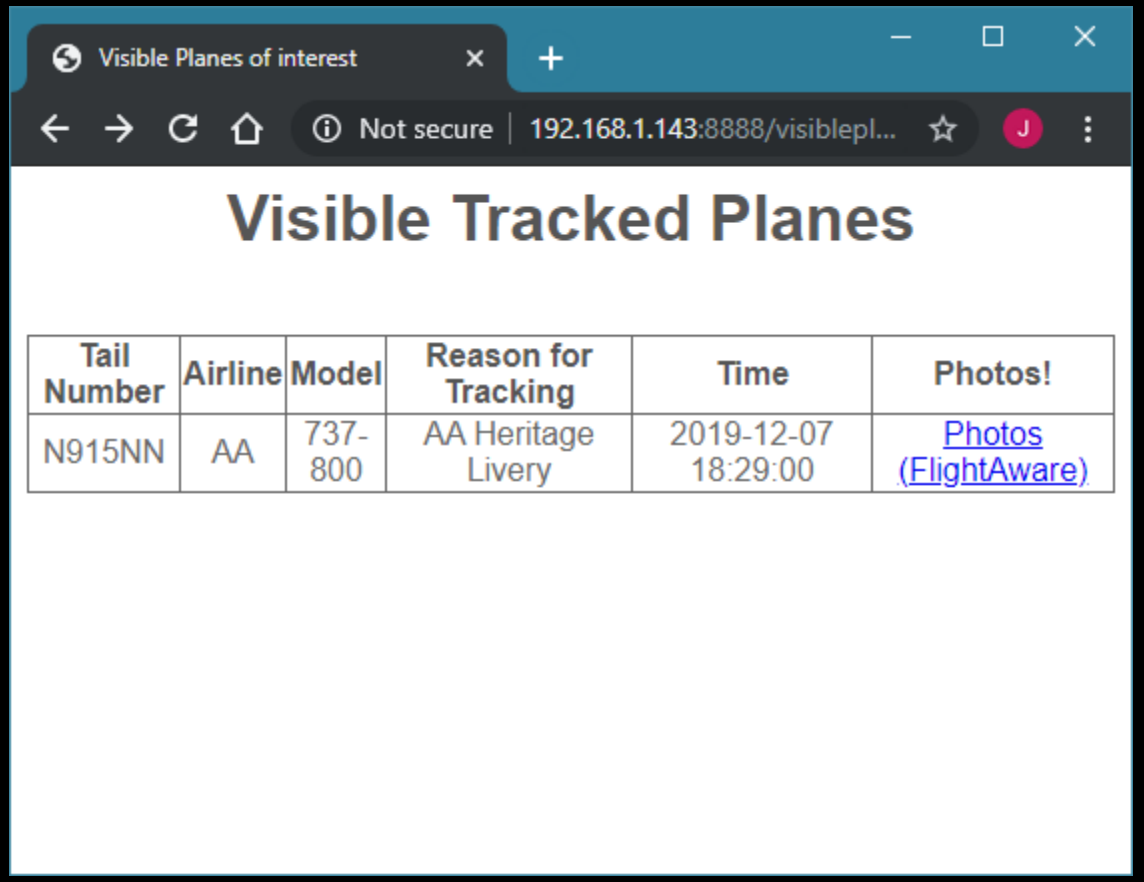


PHP – Reading from MySQL



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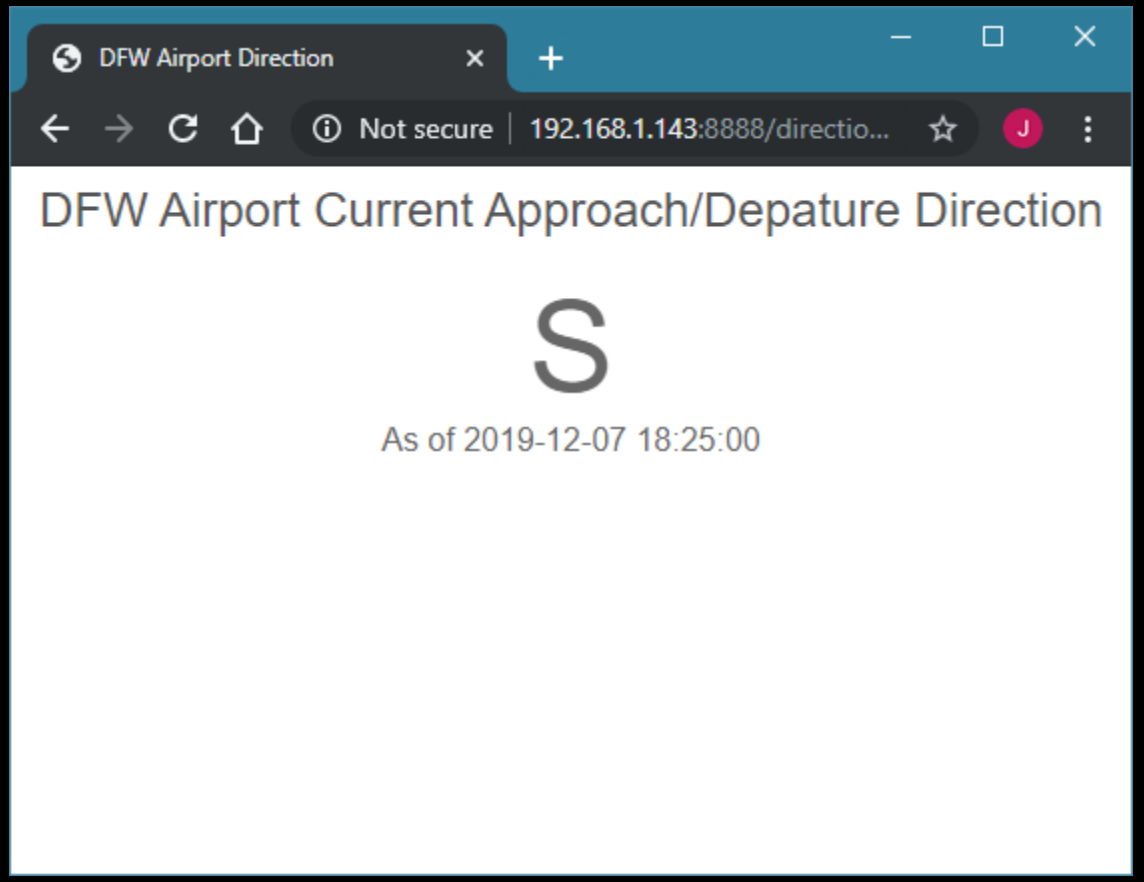

What’s Next

- More web products
- Better antenna and location
- Potentially modifying Skyview JSON on a live basis and exposing it as a GeoJSON or another service to be consumed in my own online applications
- Continuously logging all aircraft movements
  - Better data infrastructure needed

Endorsements

- FlightAware/PiAware
  - Useful software package that recognizes that its users value extensibility
- Raspberry Pi
  - Handles continuous radio decoding tasks, data submission, and my additional overhead smoothly
- ArcGIS Personal Use license
  - Opportunity to practice and get exposure to newer versions of ESRI software (Pro)

Questions?

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