

# Assessing Global Airfields: Infrastructural Viability for Military Operations



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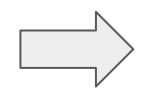
## PROBLEM STATEMENT

### Context

To prepare for the future fight, the Air Force has prioritized implementation of the **ACE concept**

What is ACE?

Agile  
Combat  
Employment



A **proactive** and **reactive** operational scheme of maneuver executed within threat timelines to increase survivability while generating combat power.

An important aspect of ACE involves conducting operations **outside of established airbases**. Using public data for **preliminary airfield assessments** will allow us to expand operations to more airfields, as well as **save the time** and **resources** needed for successful ACE operations.

How can we efficiently tell an airfield we've never used before is viable for military operations?

### Data

No centralized, publicly available database regarding global airport infrastructure

Through **combination** of several **publicly available** sources, we accumulated a database of **Flight Traffic Records** and **Aircraft Characteristics**

Flight Traffic Data (BTS)

| ORIGIN | DEST | AIRCRAFT   | AIR TIME | PAYLOAD  |
|--------|------|------------|----------|----------|
| ORD    | JAX  | Boeing 777 | 120 min  | 2000 lbs |

Aircraft Characteristics (Skybrary)

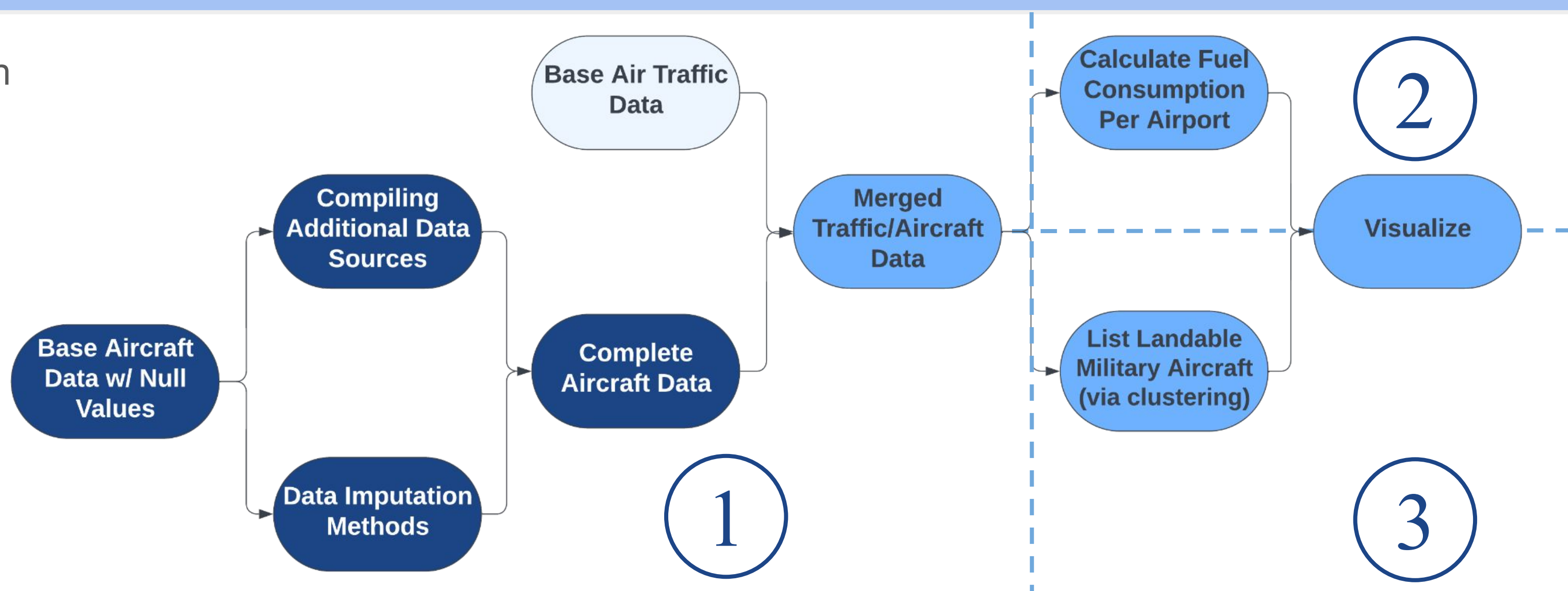
| AIRCRAFT   | DIMENSIONS  | MAX TAKEOFF WEIGHT (MTOW) | CRUISE SPEED | APPROX. FUEL BURN RATE |
|------------|-------------|---------------------------|--------------|------------------------|
| Boeing 777 | 73x65x19 ft | 545,000 kg                | 590 kts      | 8.5 gal/hr             |

## METHODOLOGY

### Workflow

With the following assumptions, we can use our available data to preliminarily assess airport infrastructure:

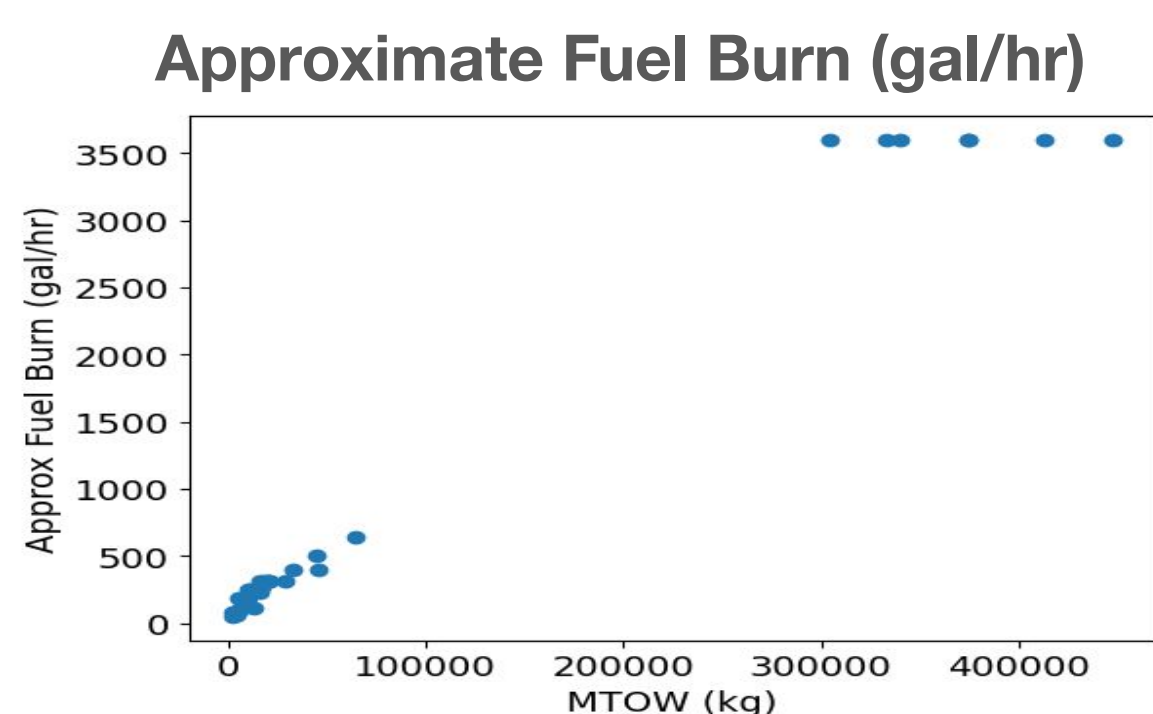
1. Airfields with **many fuel-intensive flights typically have larger fuel storage capacities**
2. Airfields that can land large aircraft can handle similar or smaller ones



### 1. Data Manipulation

Aircraft attributes (e.g. body type, aircraft dimensions) were imputed through various means such as **KNN imputation**

In order to ensure accurate fuel burn estimations, we used a **splines model** due to the piecewise nature of fuel burn



### 2. Fuel Estimation

We can use fuel consumption estimates as a proxy for fuel storage capacity:

#### Complex Estimation

More accurate, requires more granular data

$$\text{Base fuel burned}_{Flight} = \text{Aircraft Burn Rate} * \text{Distance}$$

$$\text{Payload burn}_{Flight} = \text{Distance} * \text{Payload} * \text{Payload Multiplier}$$

$$\text{Fuel Estimation} = \sum_{Flights} \text{Base fuel burned}_{Flight} * \text{Payload burn}_{Flight}$$

#### Simple Estimation

Less accurate, feasible with less granular data

$$\text{Fuel Estimation} = \sum_{Flights} \text{Cruise Speed} * \text{Distance} * \text{Aircraft Size}$$

Compute simple estimation for all airfields and complex estimation for airfields where granular data exist

### 3. Aircraft Similarity

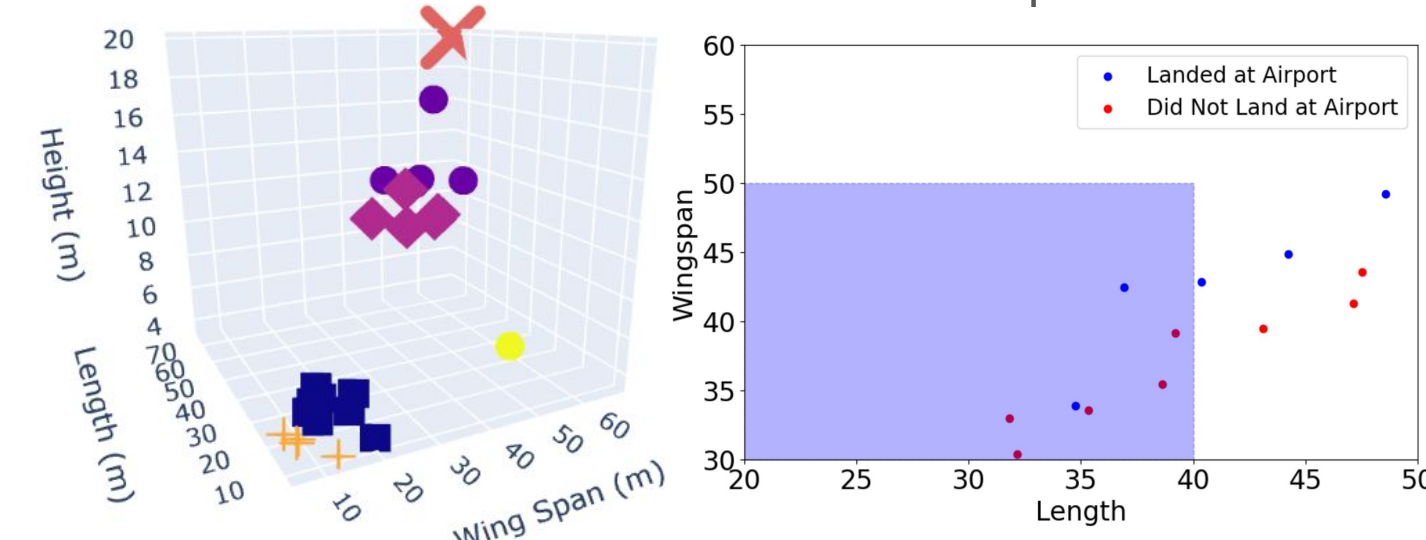
Knowing **what planes have landed** before allow us to **predict what planes can land** in the future

#### Clustering

1. Hierarchical Clustering
2. K-Nearest Neighbors

#### Bounding Box

Any plane that is **smaller than** the largest previously landed plane can land



With our current data, we recommend a **combination** of clustering and bounding box approach

## BUSINESS IMPACT

### Results



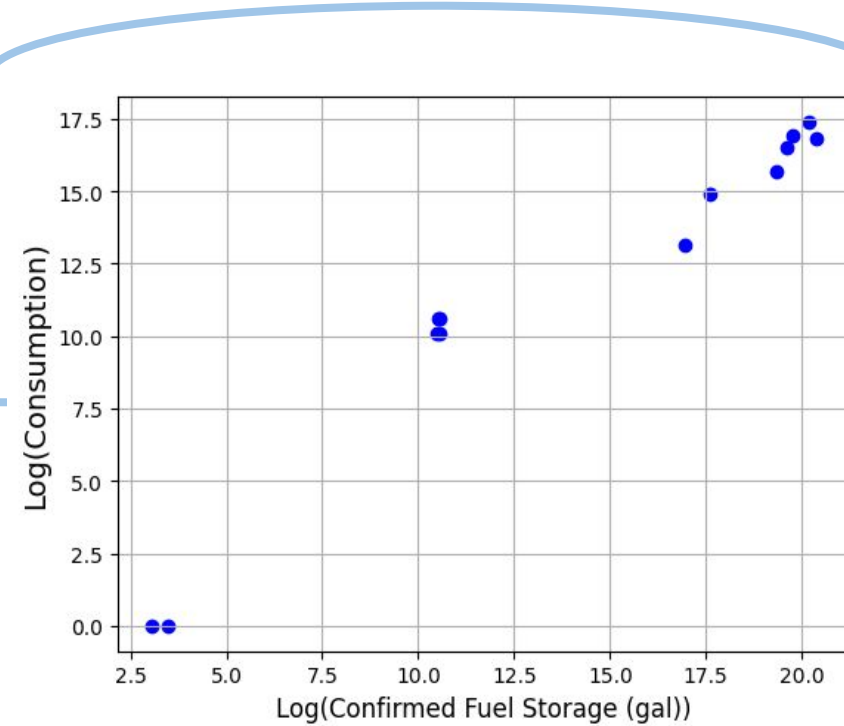
Efficient  
Airfield  
Assessment



Accurate Fuel  
Storage  
Estimation

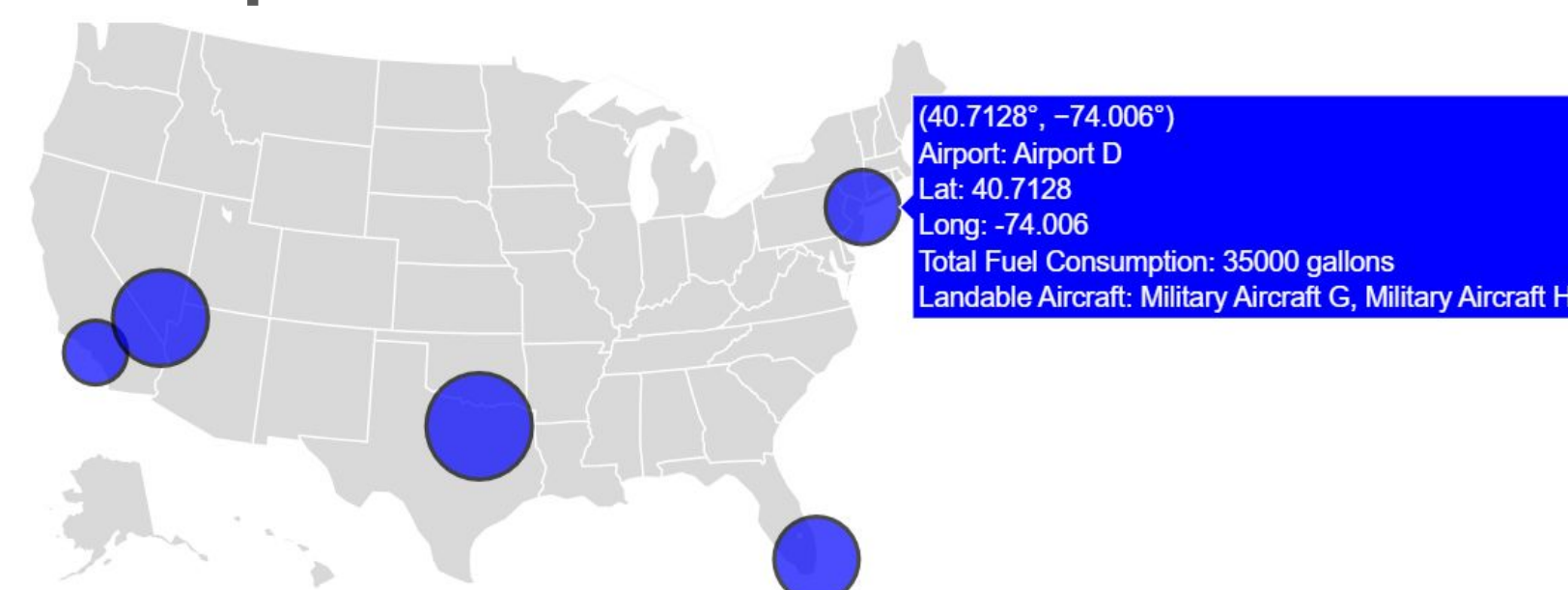


Manpower  
and Time  
Savings



By harnessing available data and applying analytics, our process enables mission planners to efficiently assess **200%** more airfields for a given mission

### Example of Potential Use



Circles mark potential airfields for a specified mission. Circle size corresponds to fuel consumption. Hovering over circle shows airfield details including total fuel consumption and landable aircraft.