

# Innovative and low-cost technique to identify airport taxi congestion points

9<sup>th</sup> SESAR Innovation Days



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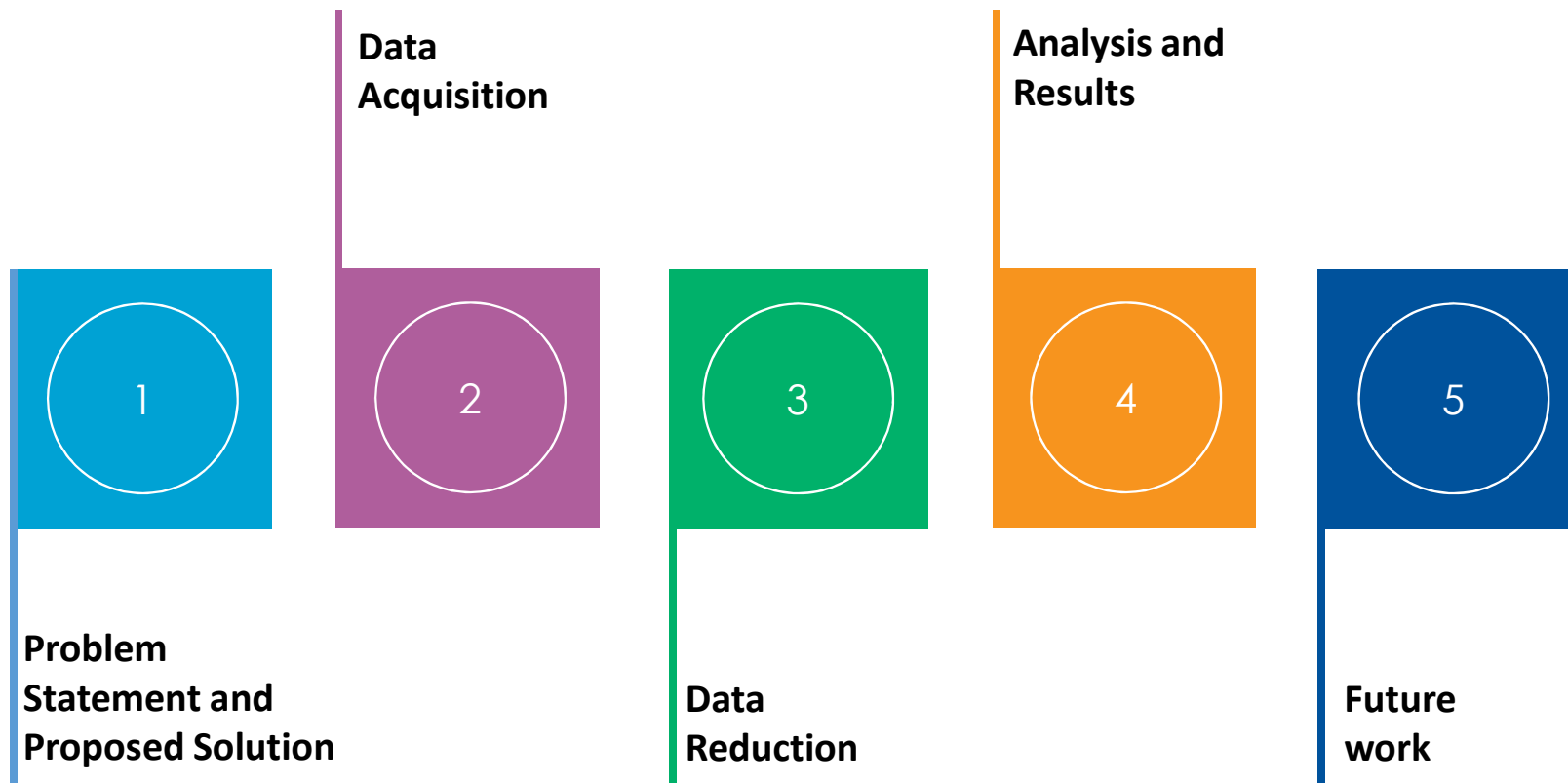


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2 – 6 December 2019, Athens, Greece





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1

# Problem Statement

- ENAIRE was interested in knowing the points of taxi congestion at the Malaga Costa del Sol airport to increase the operational taxi-in/taxi-out efficiency.
- How to perform a post operational analysis of taxiway movement at an airport without surface surveillance?



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1

# Proposed Solution

- Find means to:
  - Save the motion data of the aircraft on the ground
  - Keep datapoints to a manageable level for interactive analysis
  - Determine the taxiway intersections that cause congestion
  - Visualize the results in an easy to understand manner
  - Keep cost of solution accessible to medium/small airports
- Solution - Use ADS-B data and freeware/COTS products to acquire, save, analyse, and present the data and results



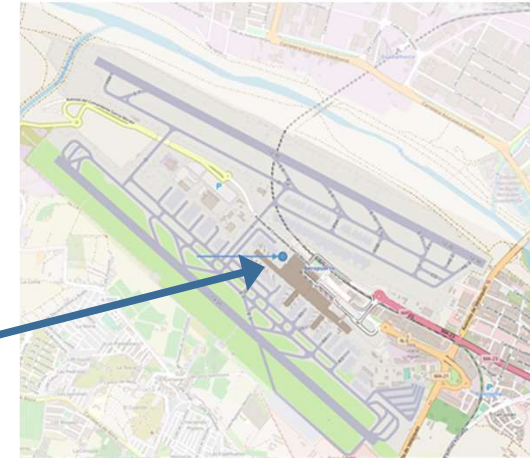
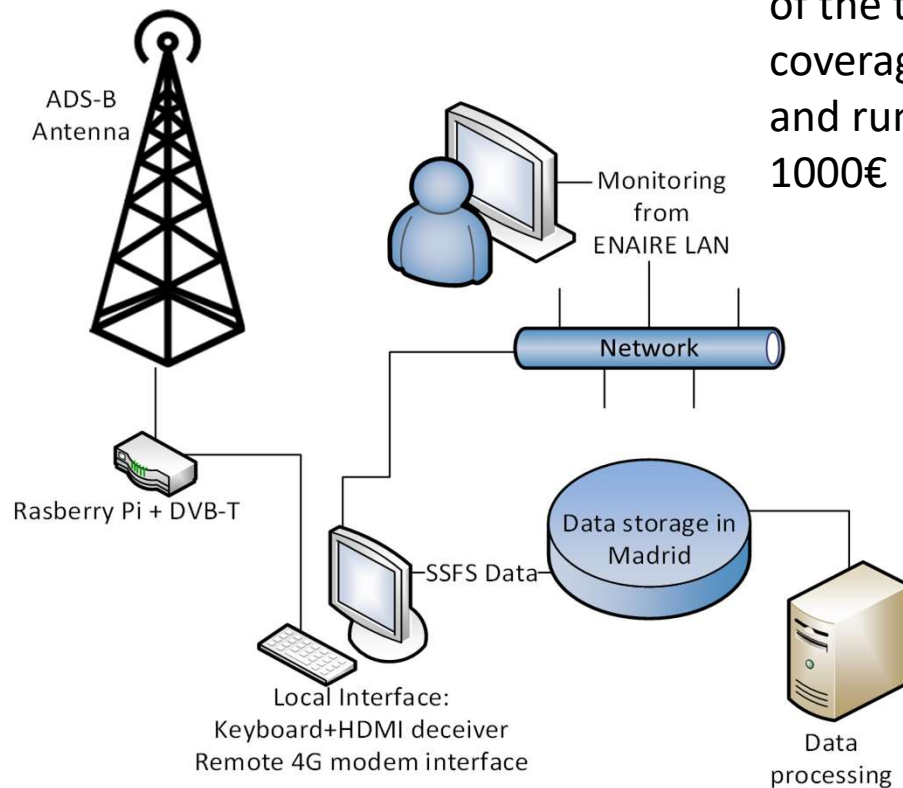
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2

# Data Acquisition

5 ADS-B antennas installed on top of the tower provide full coverage of the airport taxiways and runways at a total cost of 10000€



Data is locally decoded into CSV files, then stored remotely daily

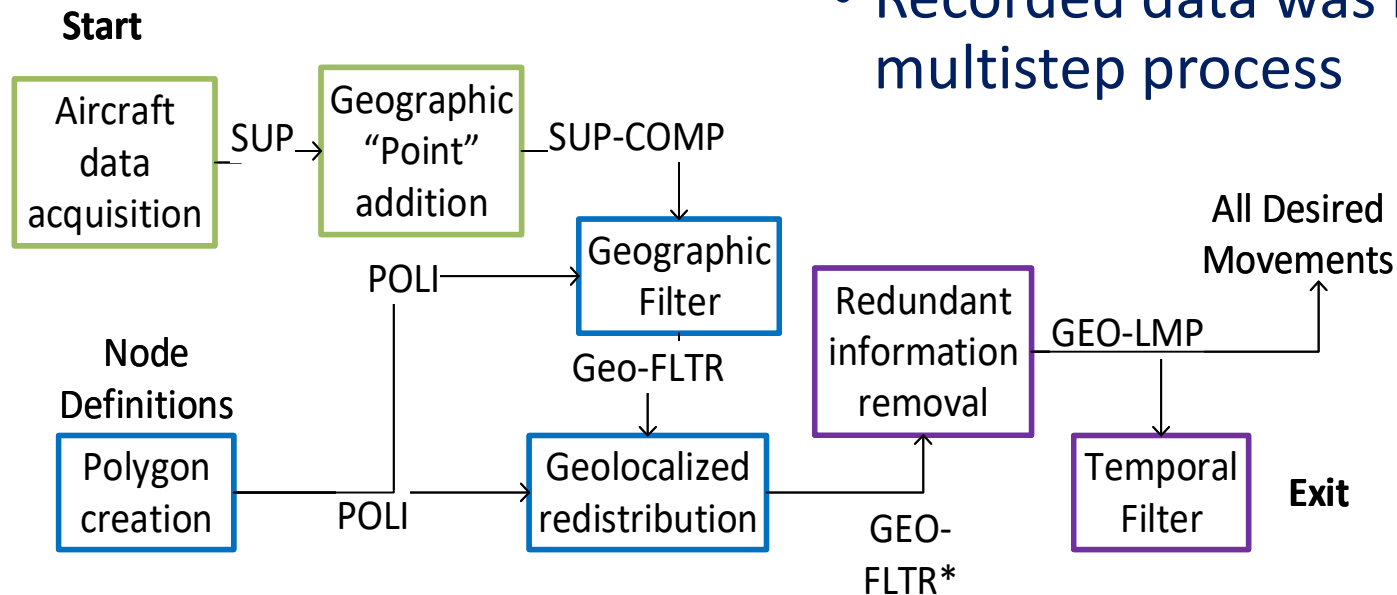


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## Data Reduction

- At 1,5Gb/day, data needs to be reduced in order to be easily analysed

- Recorded data was reduced in multistep process

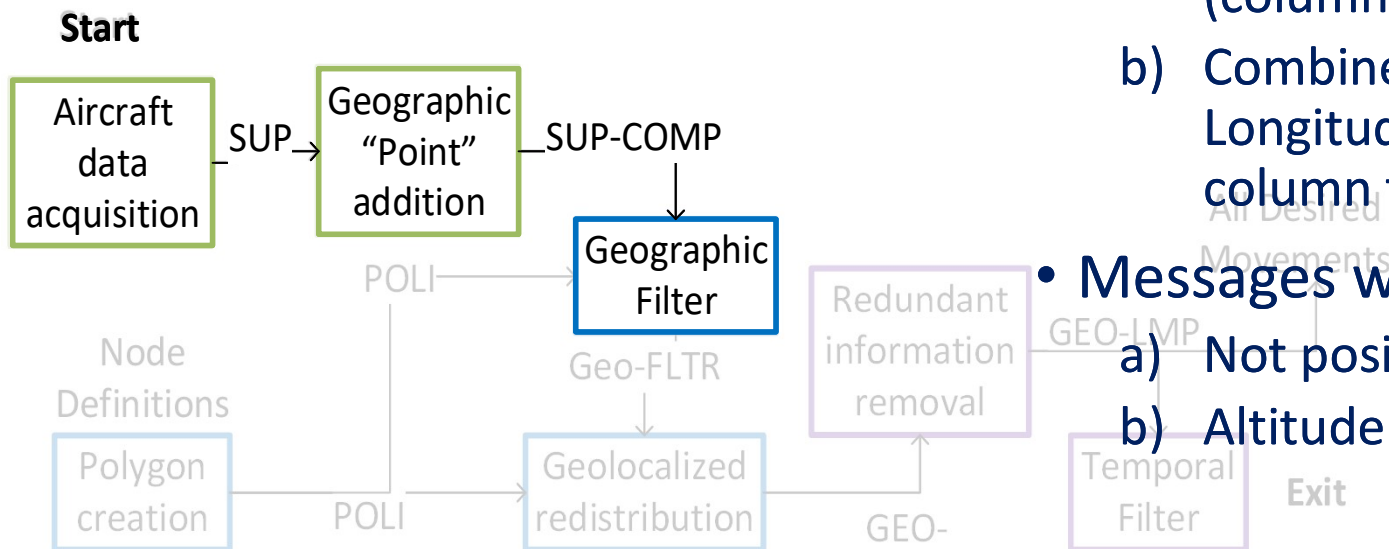


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# Data Reduction

## 1. Landing and surface movement data only

- Messages were reduced by:
  - a) Saving only 6 of the 22 fields (columns)
  - b) Combine the Latitude and Longitude columns into a column titled “Point”
- Messages were deleted where:
  - a) Not position related messages
  - b) Altitude was above 300ft



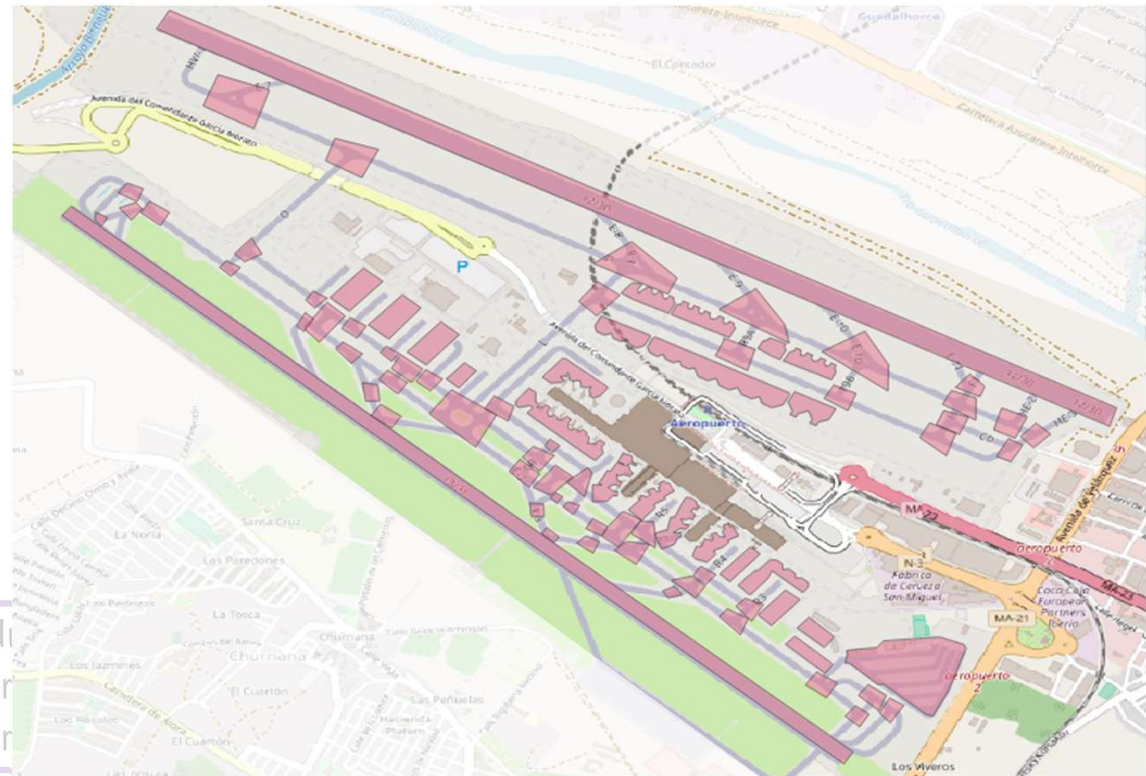
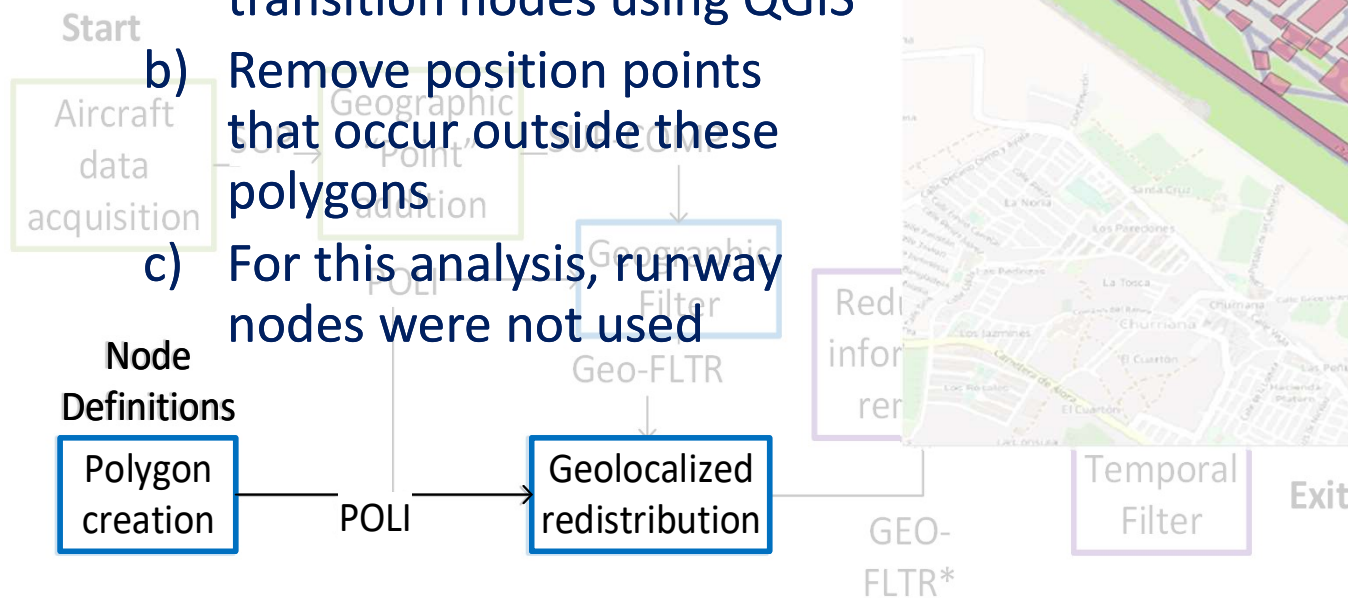
This first set of steps reduces the dataset size by 96,2%

3

# Data Reduction

## 2. Only save “change” data

- Define taxi movement transition nodes using QGIS
- Remove position points that occur outside these polygons
- For this analysis, runway nodes were not used

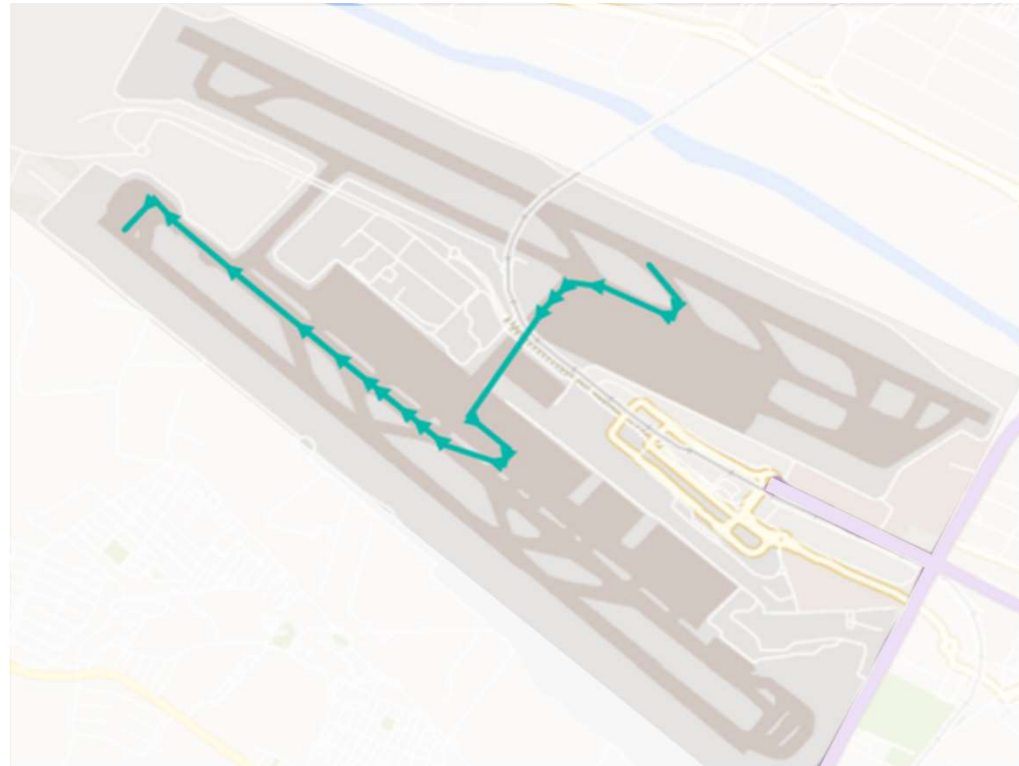




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## Data Reduction

- Second step reduces dataset size again by 99,4%
- Even with so much data reduction, tracing the taxi path of a single aircraft is clear.
- Resulting dataset is nearly **4 orders of magnitude smaller** than original recorded dataset



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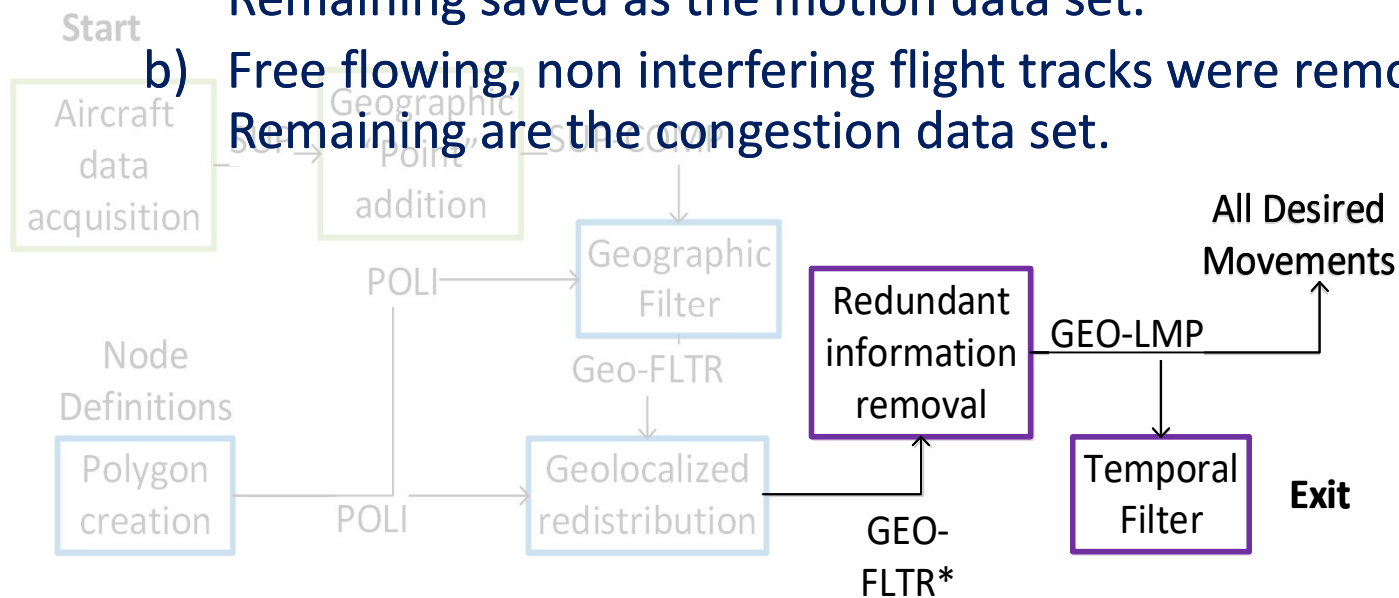
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## Data Reduction

### 3. Non-congestion causing movements were removed

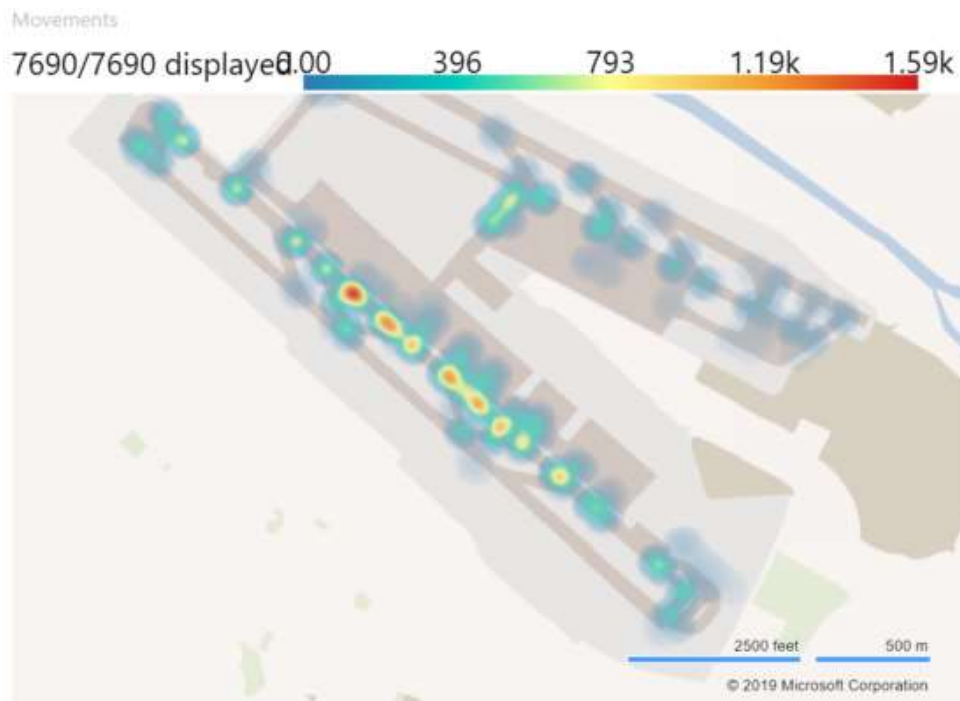
a) Position messages differing by less than a second were removed.  
Remaining saved as the motion data set.

b) Free flowing, non interfering flight tracks were removed.  
Remaining are the congestion data set.



4

## Analysis and Results



- Using QGIS or other visualization program (Power BI) the distribution of the traffic through the nodes can be seen.
- 8 highest traffic level nodes are intersections between most used rapid runway exit nodes and the road intersection nodes.

4

## Analysis and Results



- Looking at the congestion heat map, the runway 31 entry node has the most congestion.
- However, congestion isn't regularly distributed

4

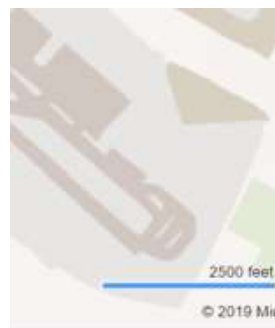
## Analysis and Results



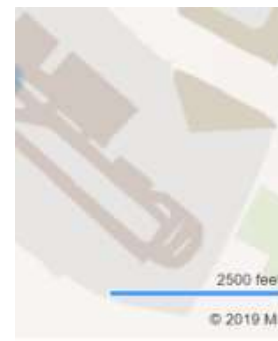
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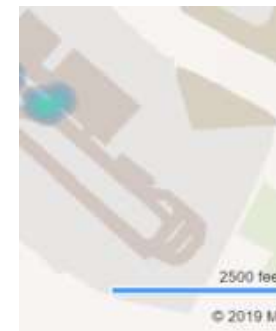
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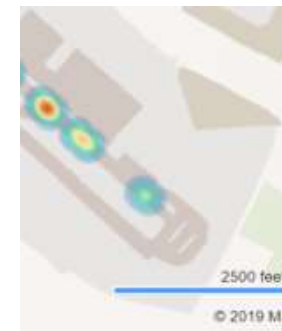
Wednesday



Thursday



Friday



Saturday



Sunday

- Runway 31 entry node congestion is concentrated on Sunday, July 29th.
- Operations on that day show the airport in single runway mode and was using runway 31 for departures.



5

## Future Work

- More data needs to be collected before any operational changes can be suggested to smooth congestion (at least a year)
- Further investigations include:
  - runway occupancy time analysis,
  - rapid exitway prediction, a
  - queue times at departure runway holdings.
- Tenerife airport is using the same system to investigate how runway occupancy times relate to weather and visibility conditions.



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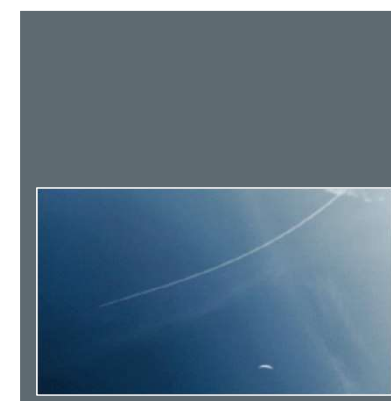
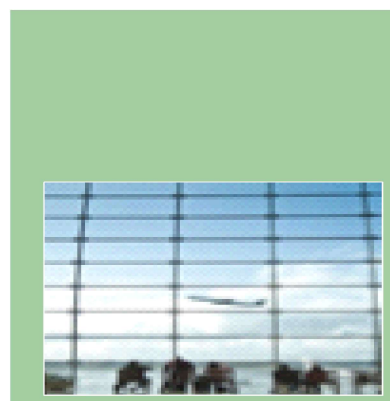
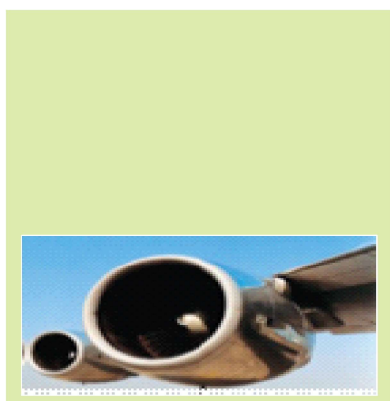
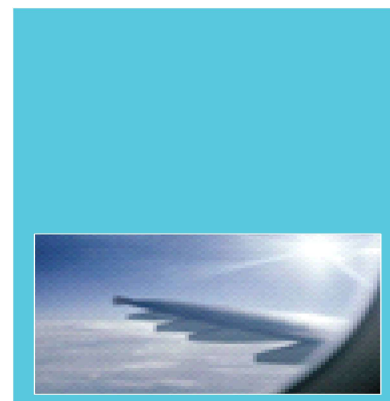
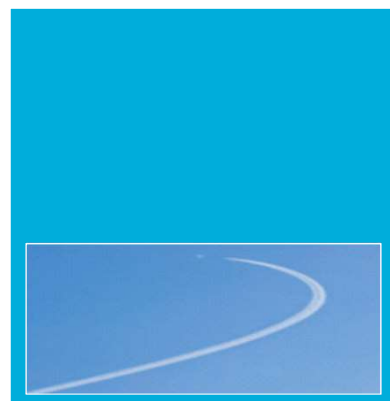
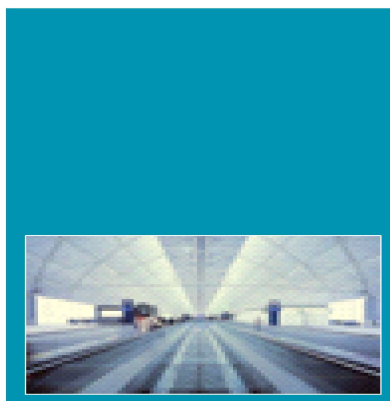


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