# Departure Approval Request Compliance Effects on Overhead Stream Insertion

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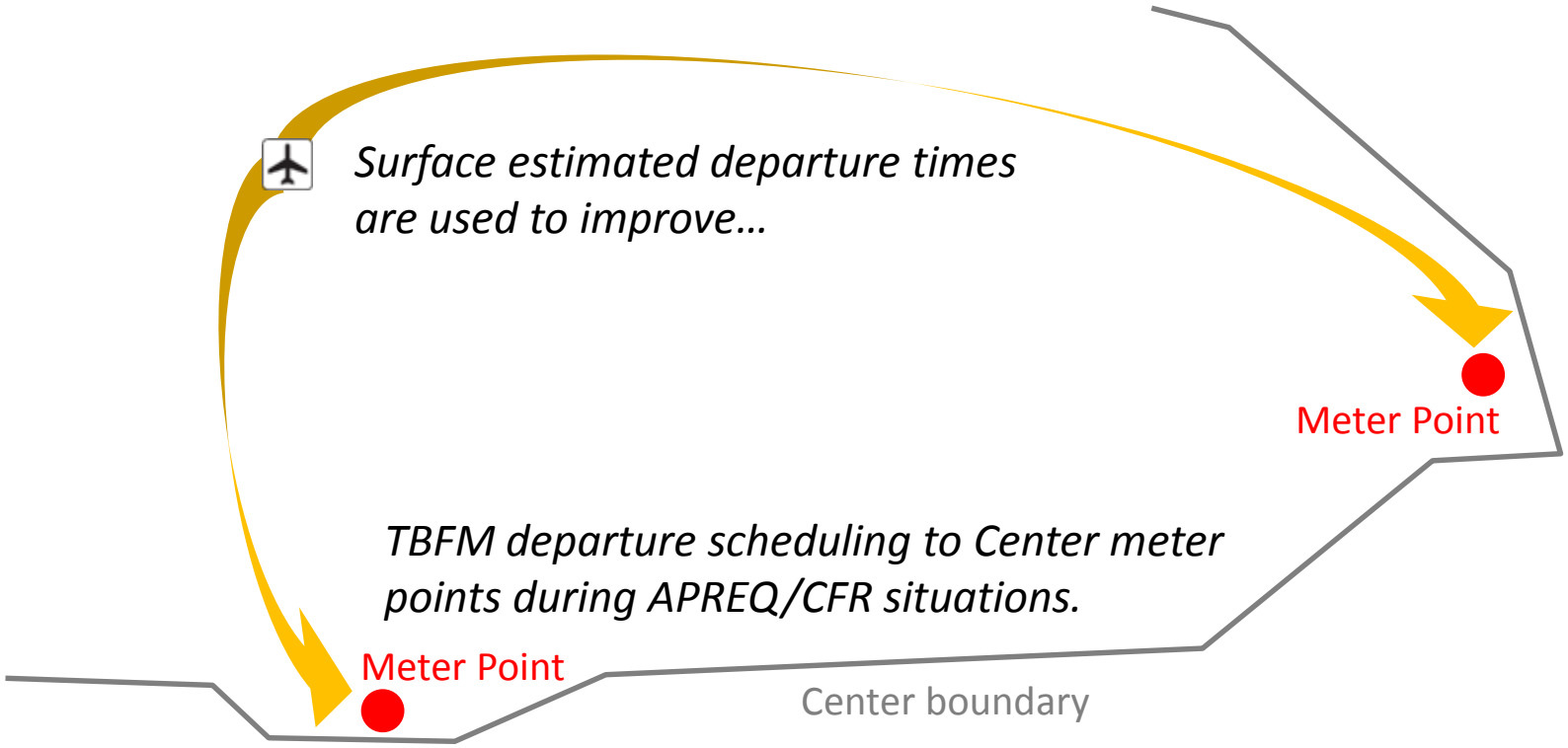
Jeremy Coupe

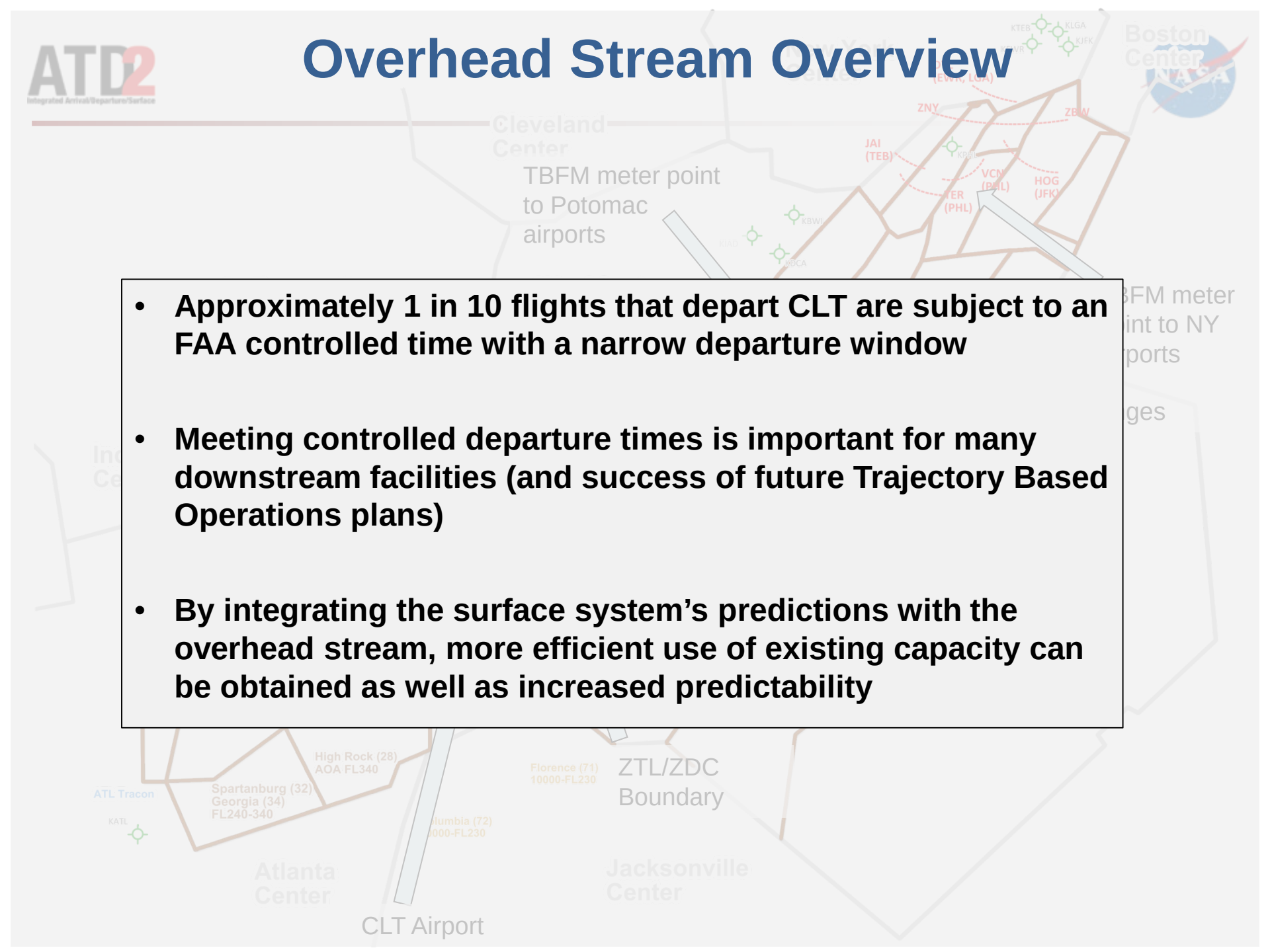
Bob Staudenmeier

5 September 2019

# ATD-2 and Stream Insertion

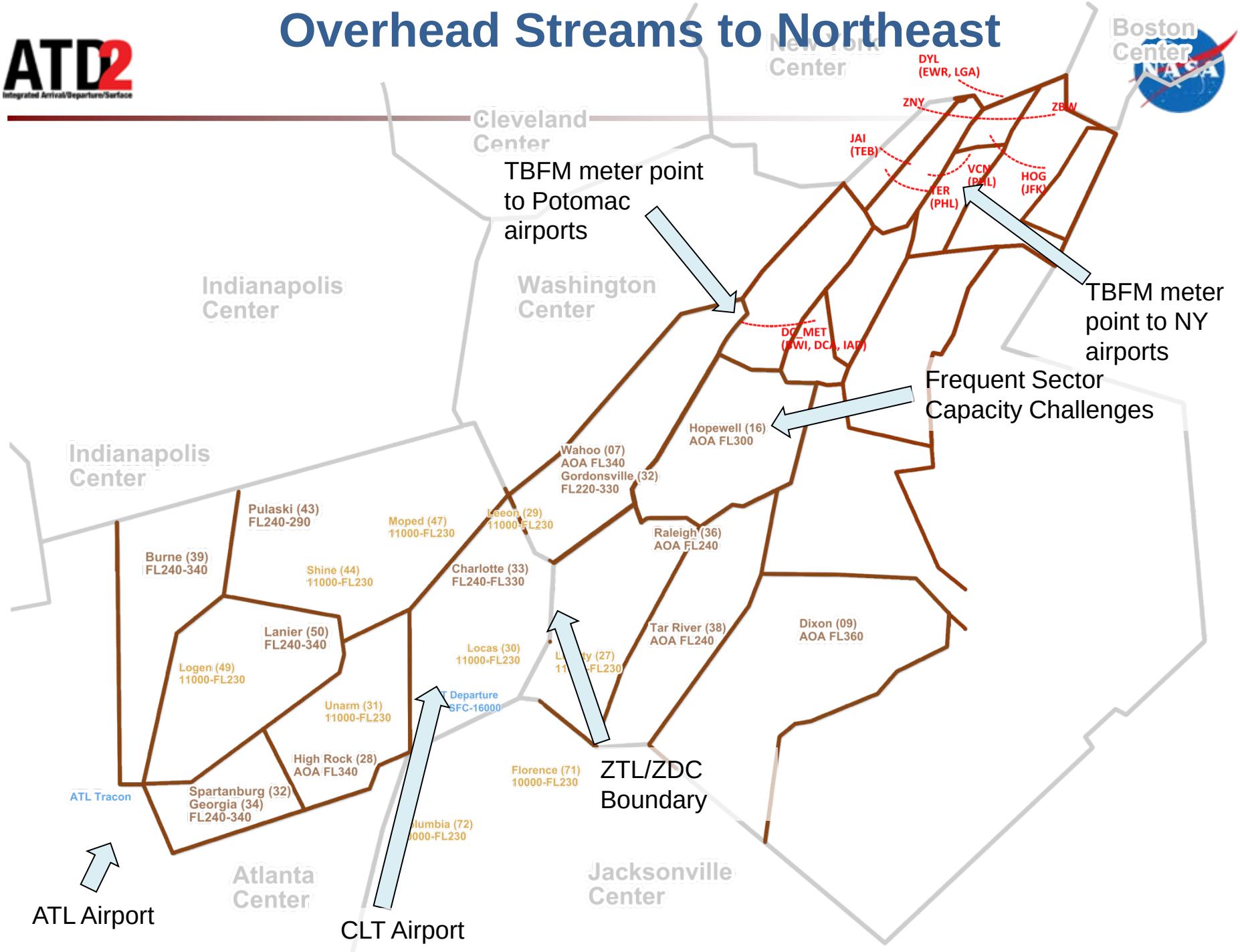


# Overhead Stream Overview

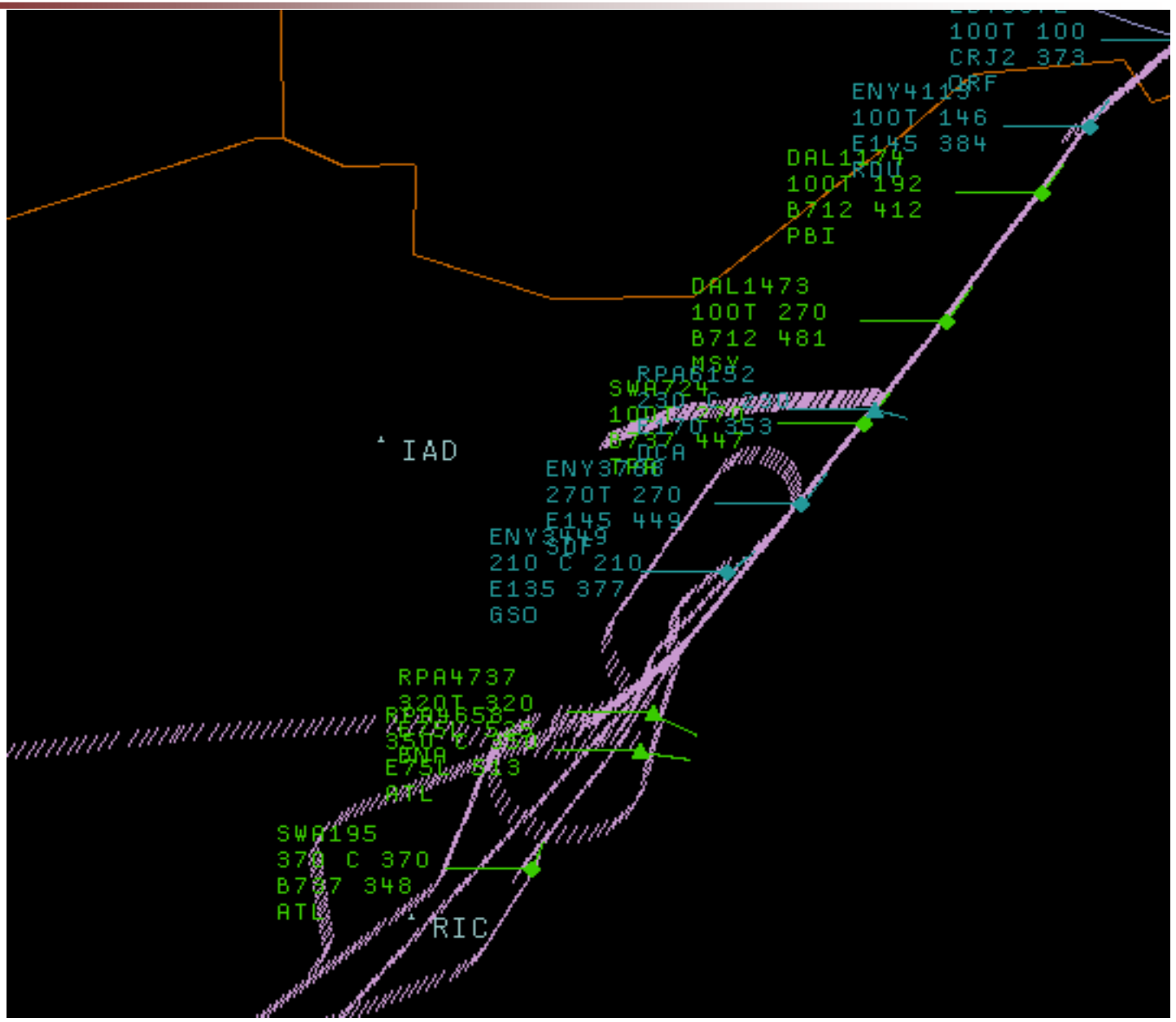



- **Approximately 1 in 10 flights that depart CLT are subject to an FAA controlled time with a narrow departure window**
- **Meeting controlled departure times is important for many downstream facilities (and success of future Trajectory Based Operations plans)**
- **By integrating the surface system's predictions with the overhead stream, more efficient use of existing capacity can be obtained as well as increased predictability**

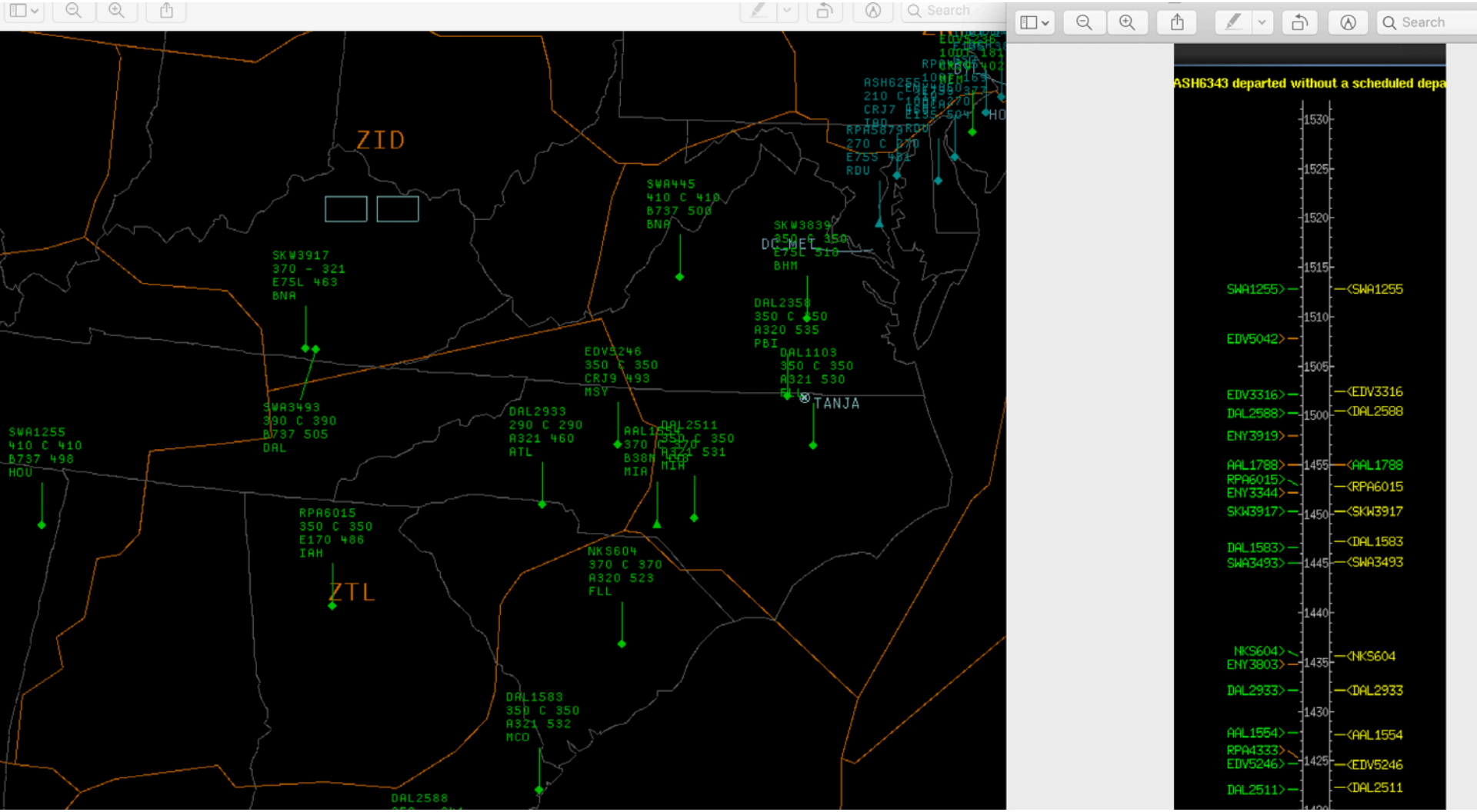
# Overhead Streams to Northeast



# Vectoring to Merge Flows



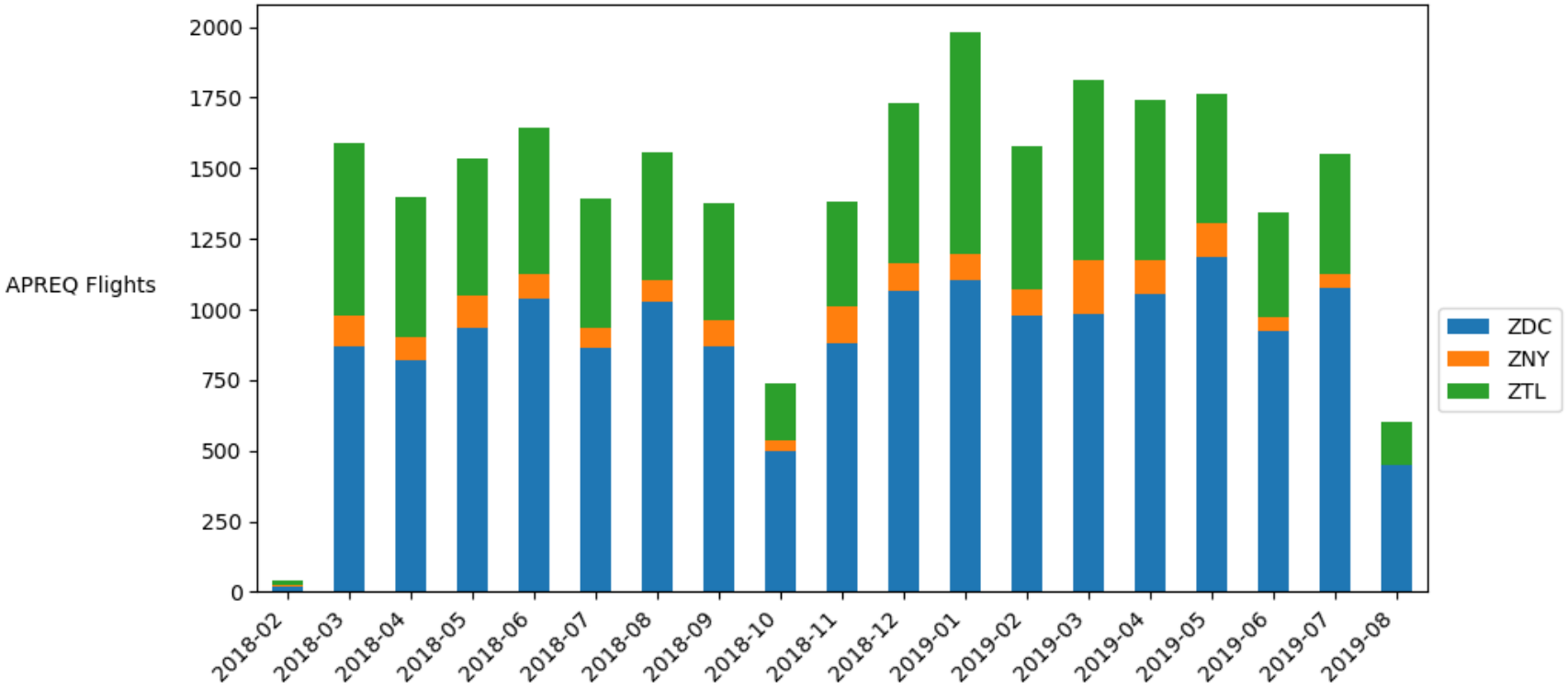
# Smooth Stream Insertion



# Stream Insertion Analysis

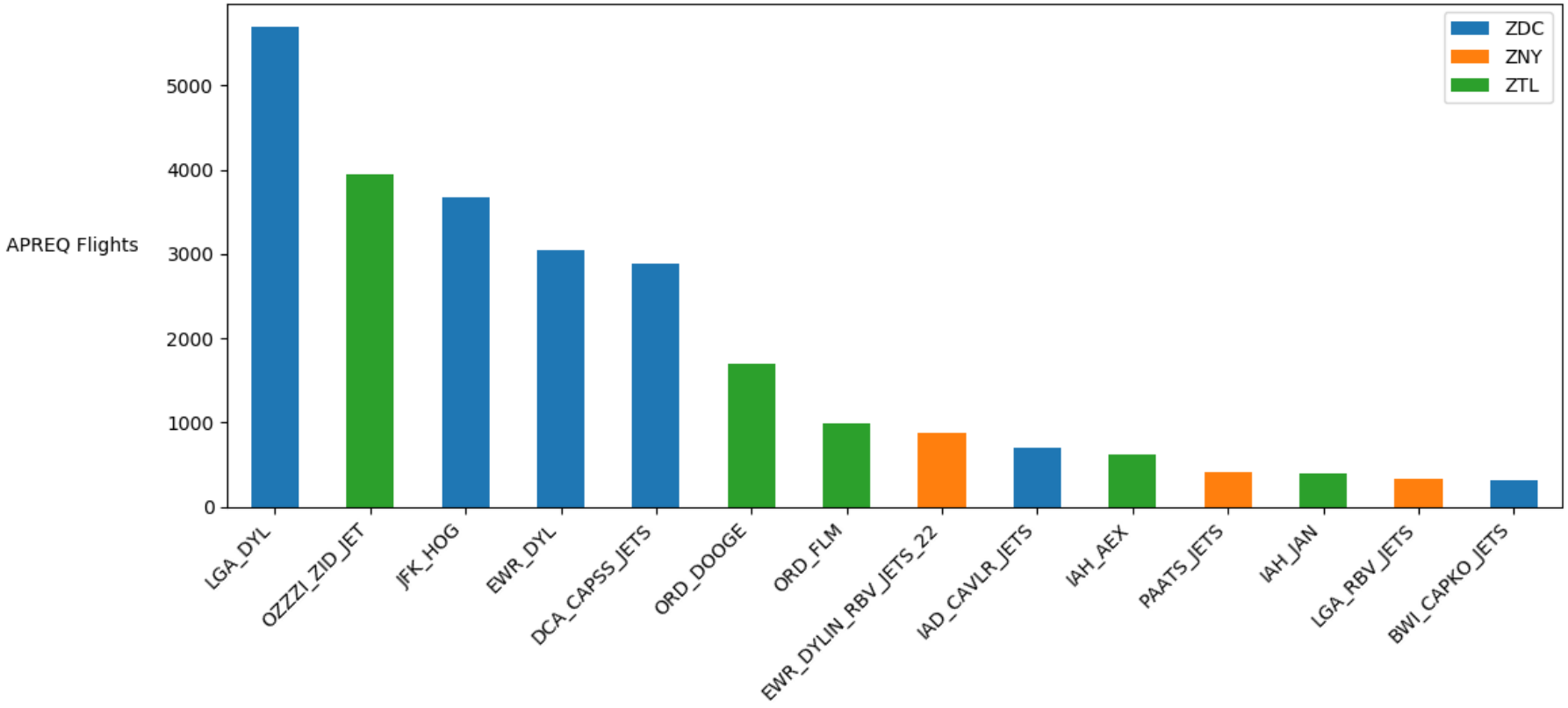
- TBFM schedule data merged with flight_summary data
  - CLT APREQs with TBFM schedule data and departure_runway_actual_time

26,752 Flights



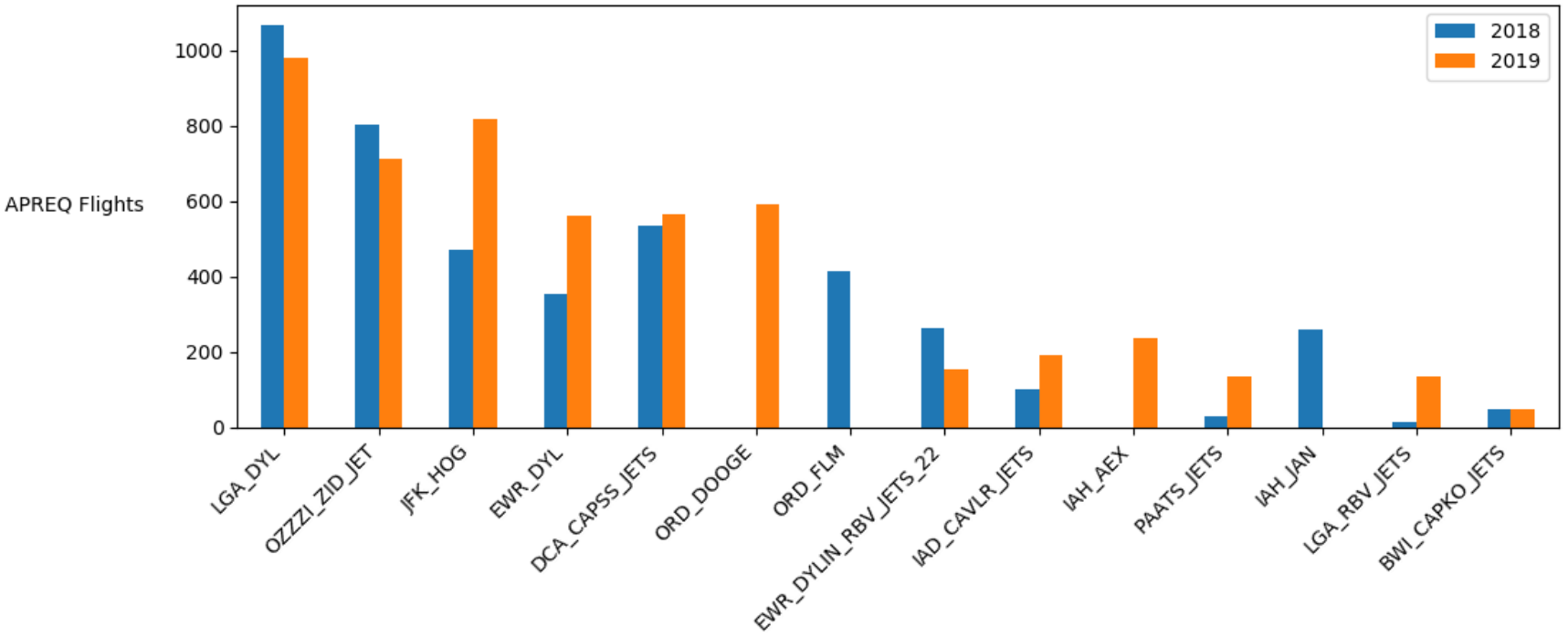
# Stream Classes

Most utilized:



# Stream Classes

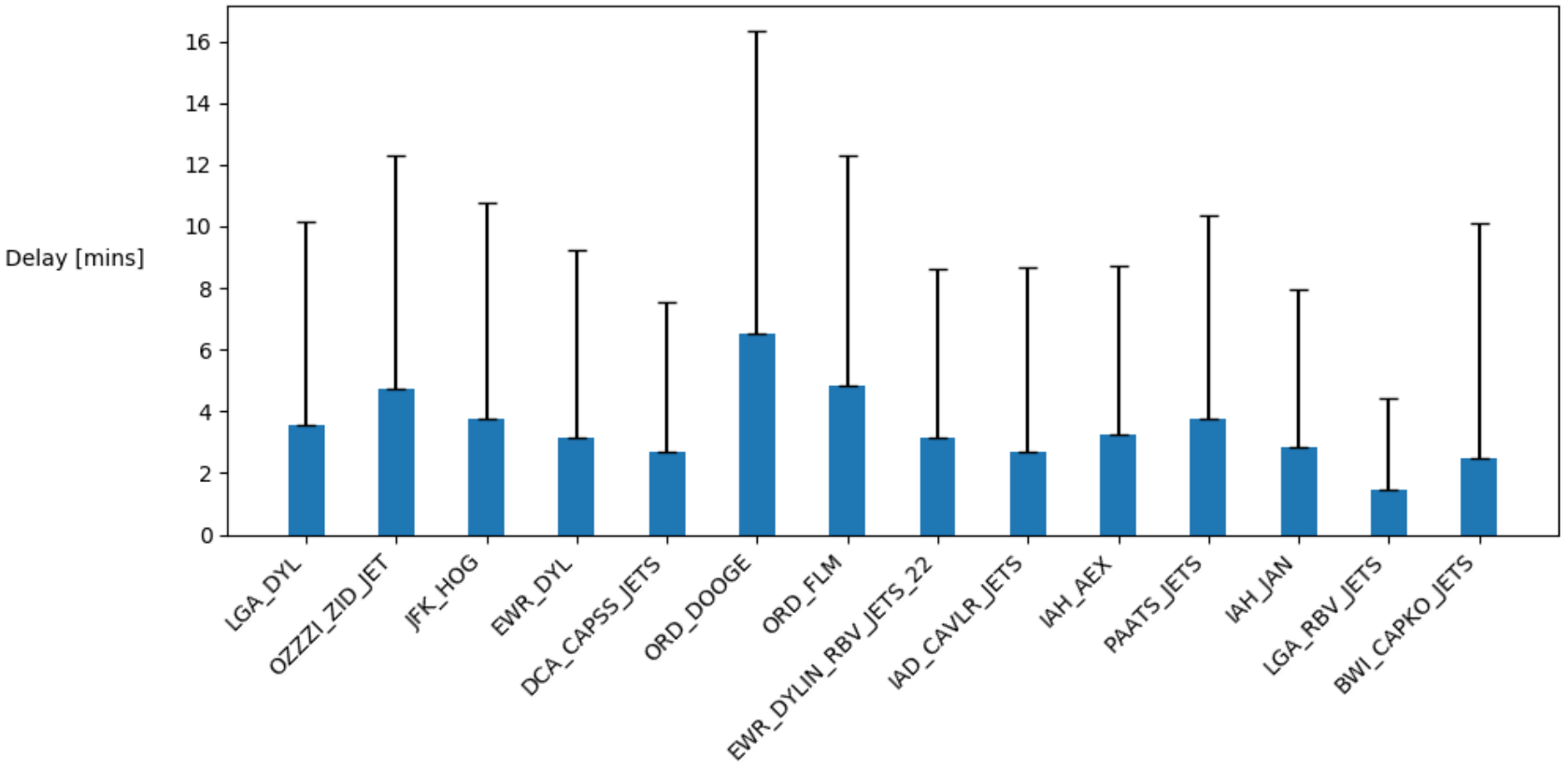
Year-over-year stream-class utilization changes:




CLT Apreqs: Mar-May 2018 vs. Mar-May 2019

# Delays by Stream Class

Average delay by stream class for CLT Apreqs:




Error bars: 1 std. dev.

# Stream-Insertion Metrics

- Lead & Trail Match

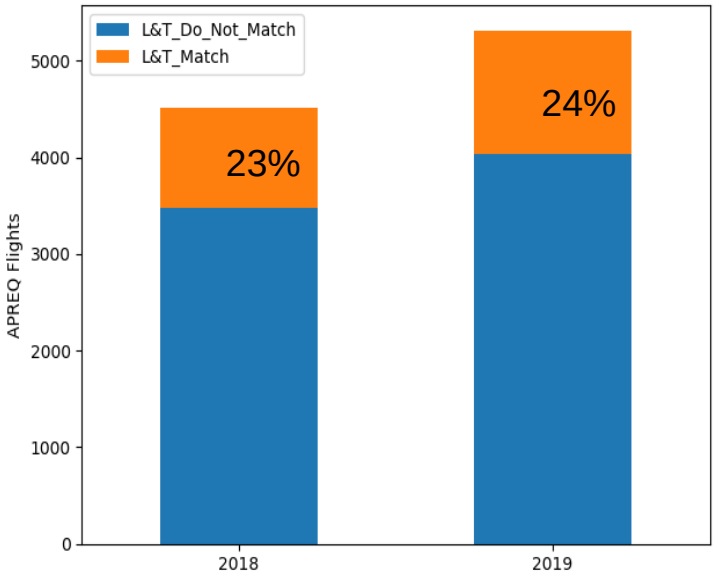
  Lead and trail upon departure scheduling match lead and trail upon schedule-point crossing

- Sequence Holds

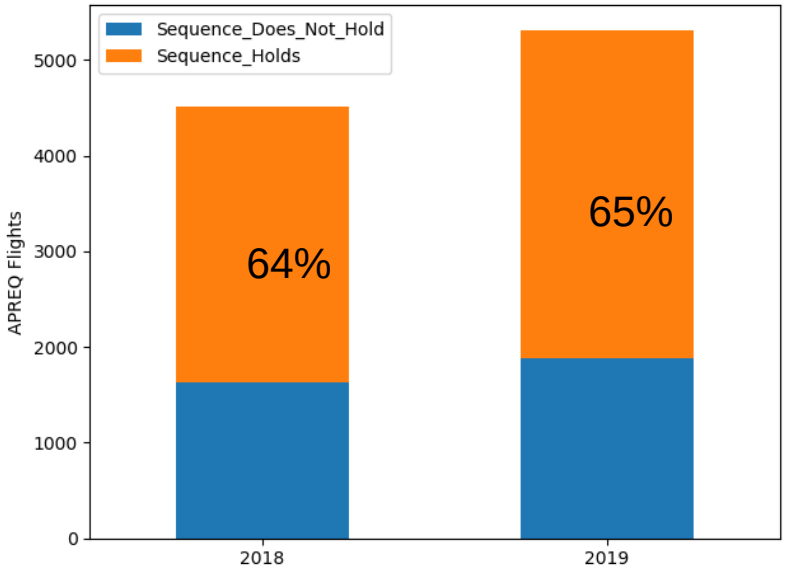
  Upon schedule-point crossing, lead at departure scheduling is still ahead and trail at departure scheduling is still behind (other aircraft may have merged)

# 2018 vs. 2019 Comparison

## Lead & Trail Match

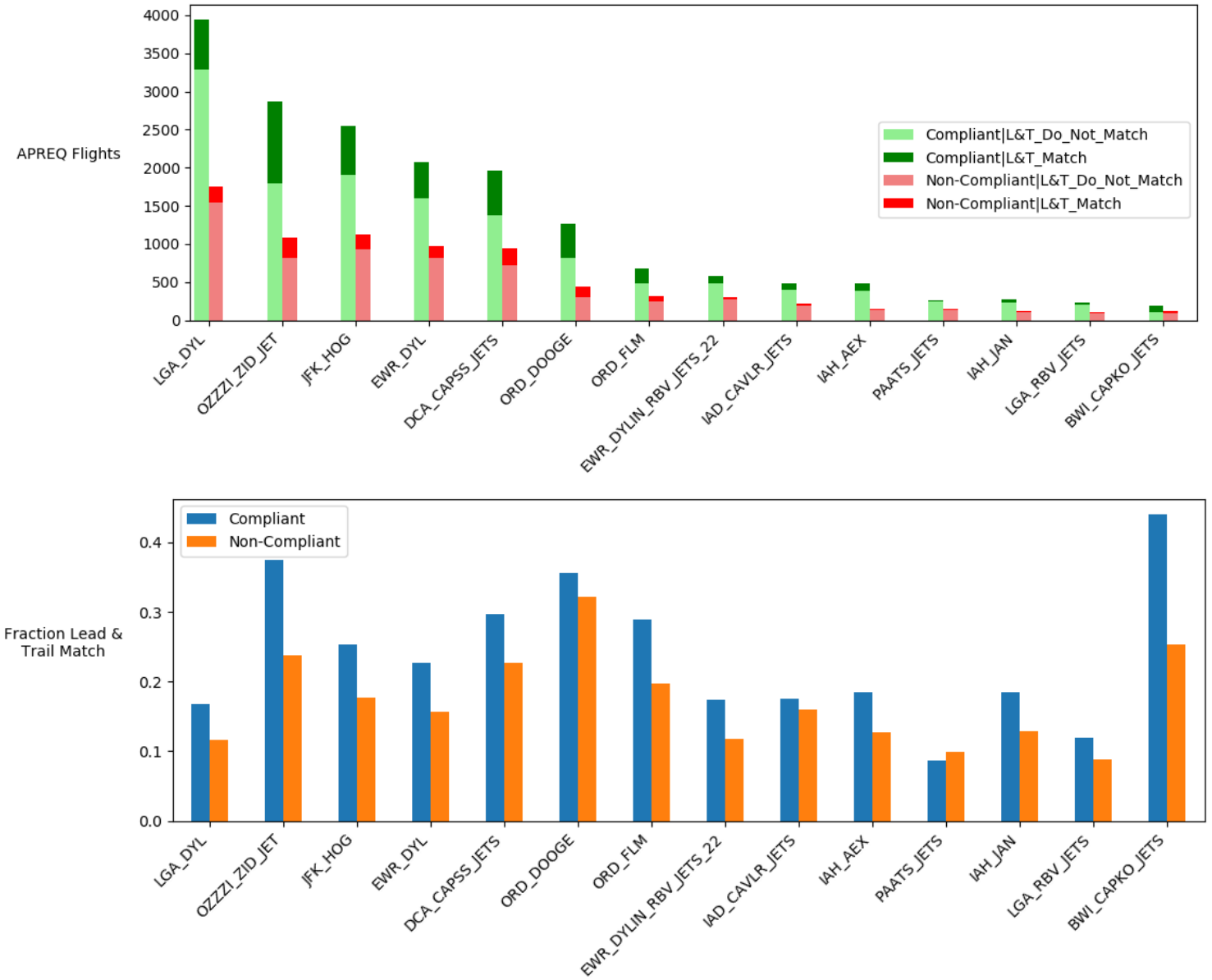



## Sequence Holds

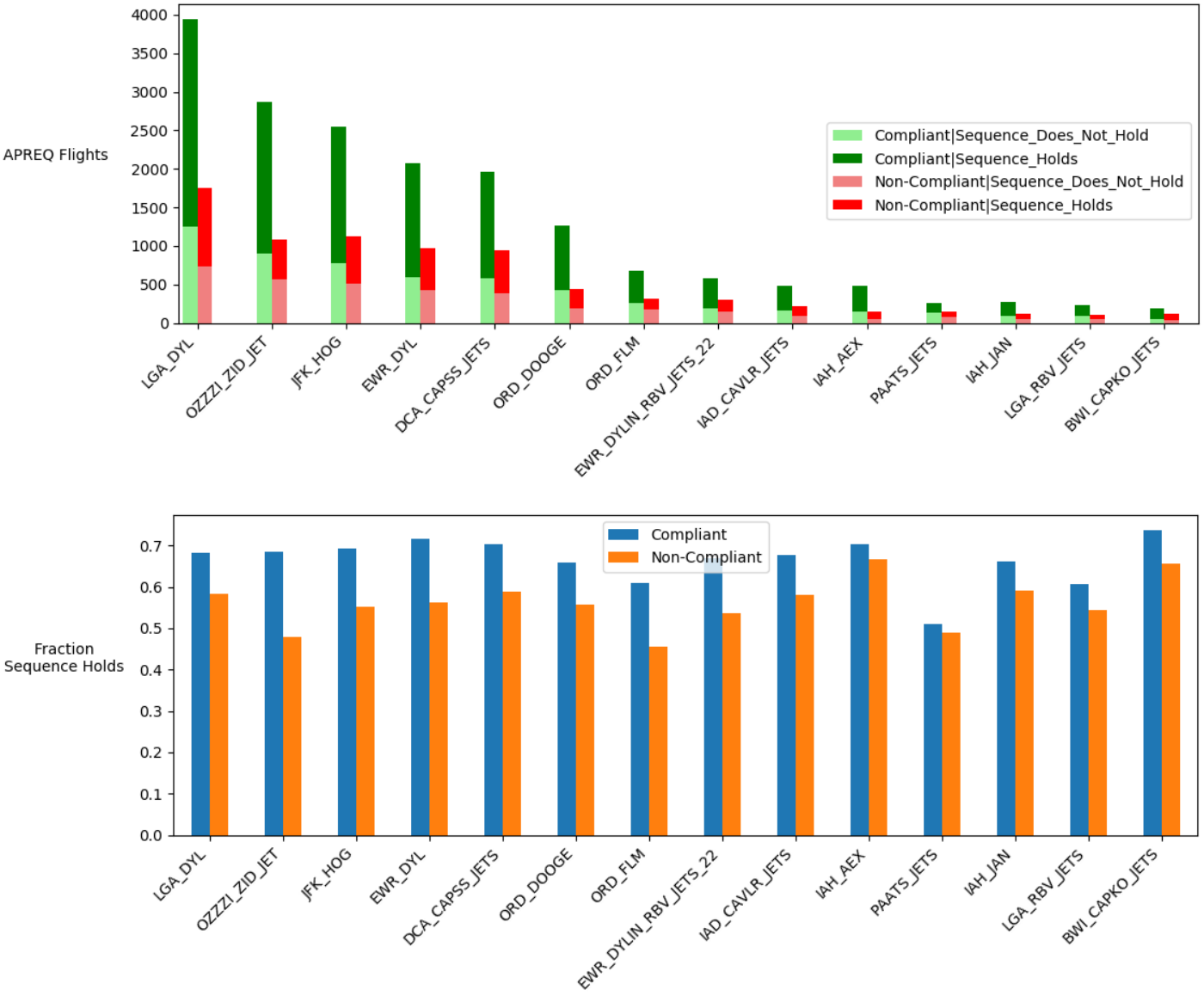



CLT Apreqs: Mar-May 2018 vs. Mar-May 2019

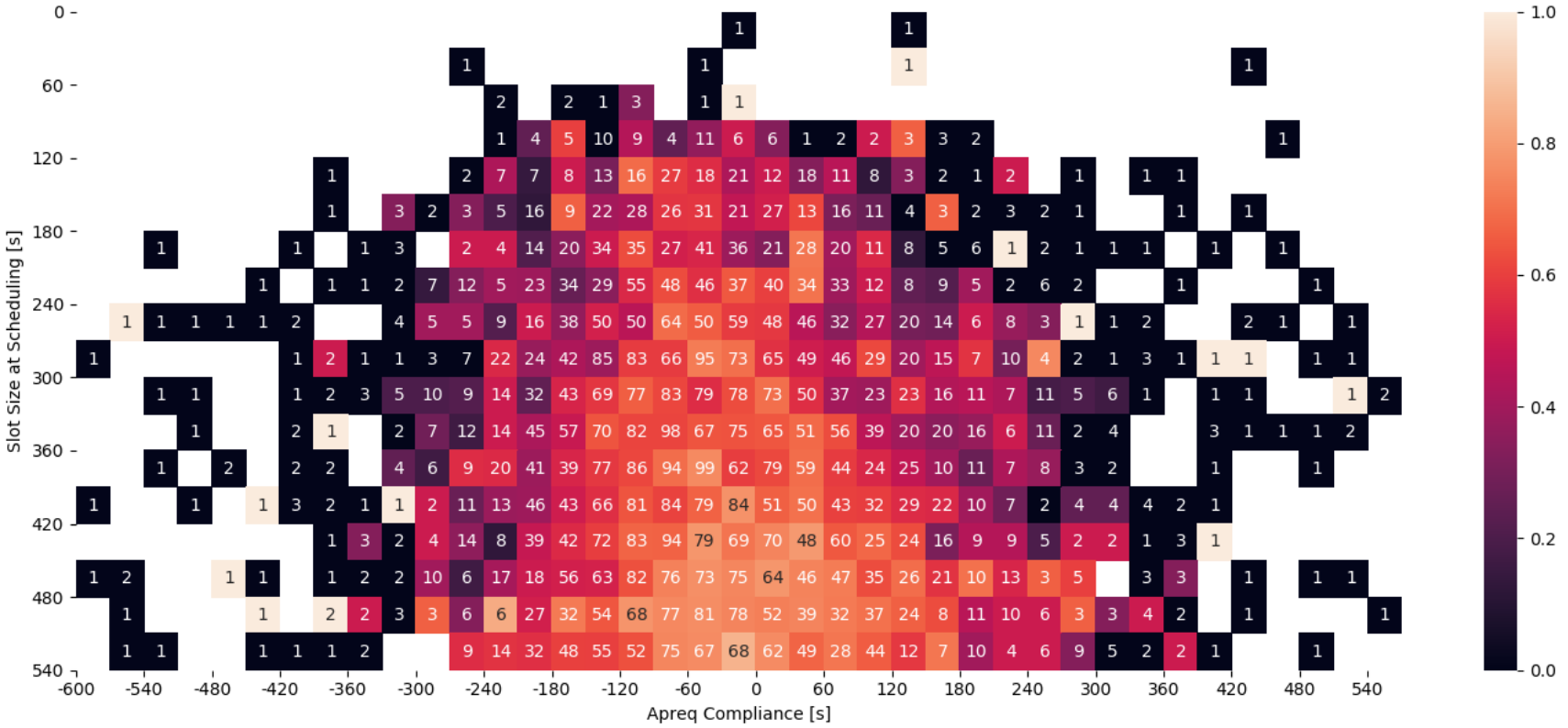
# ‘Lead & Trail Match’ by Stream Class



# ‘Sequence Holds’ by Stream Class

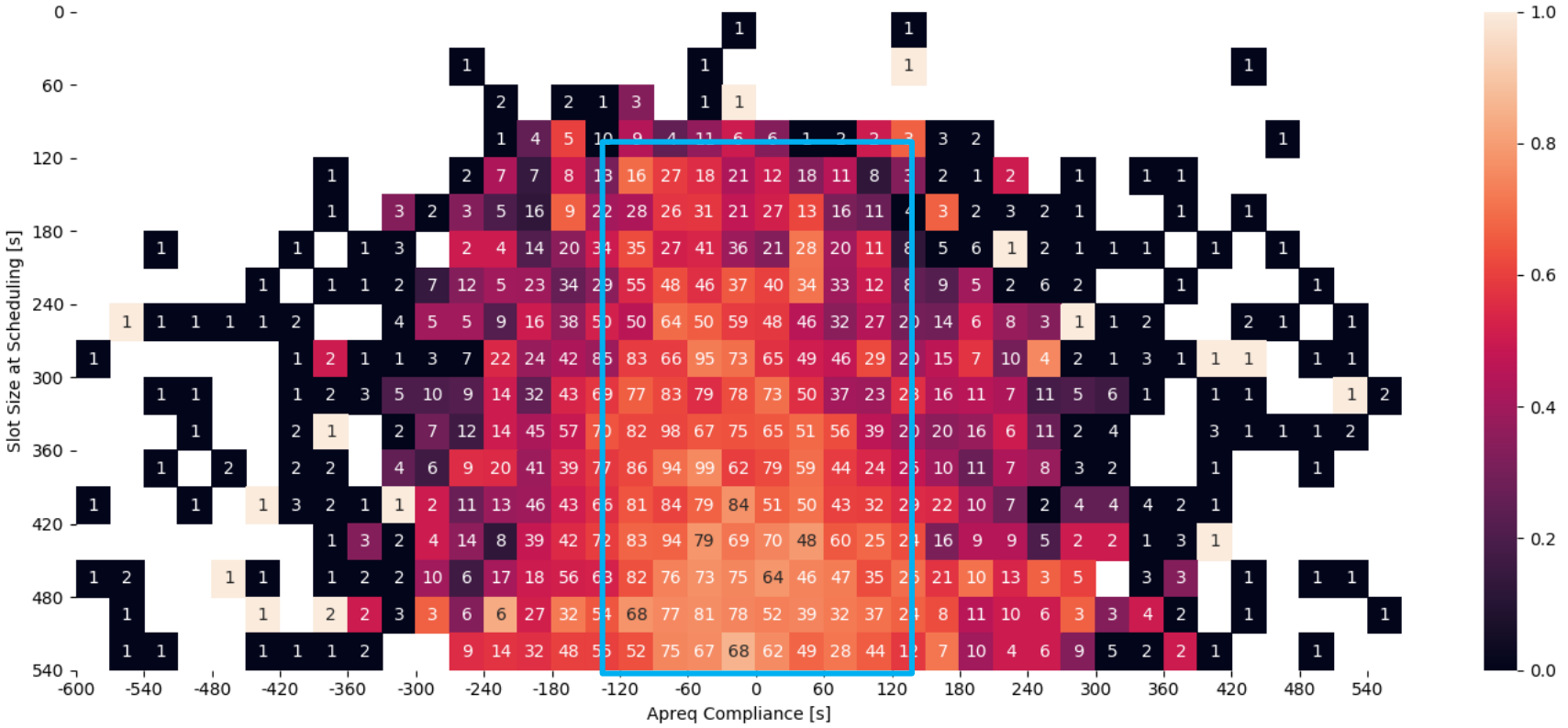


# ‘Sequence Holds’ by Slot Size & Compliance




- Top stream classes
- Colors show fraction for which sequence holds
- Numbers show sample size (23,735 CLT Apreqs)

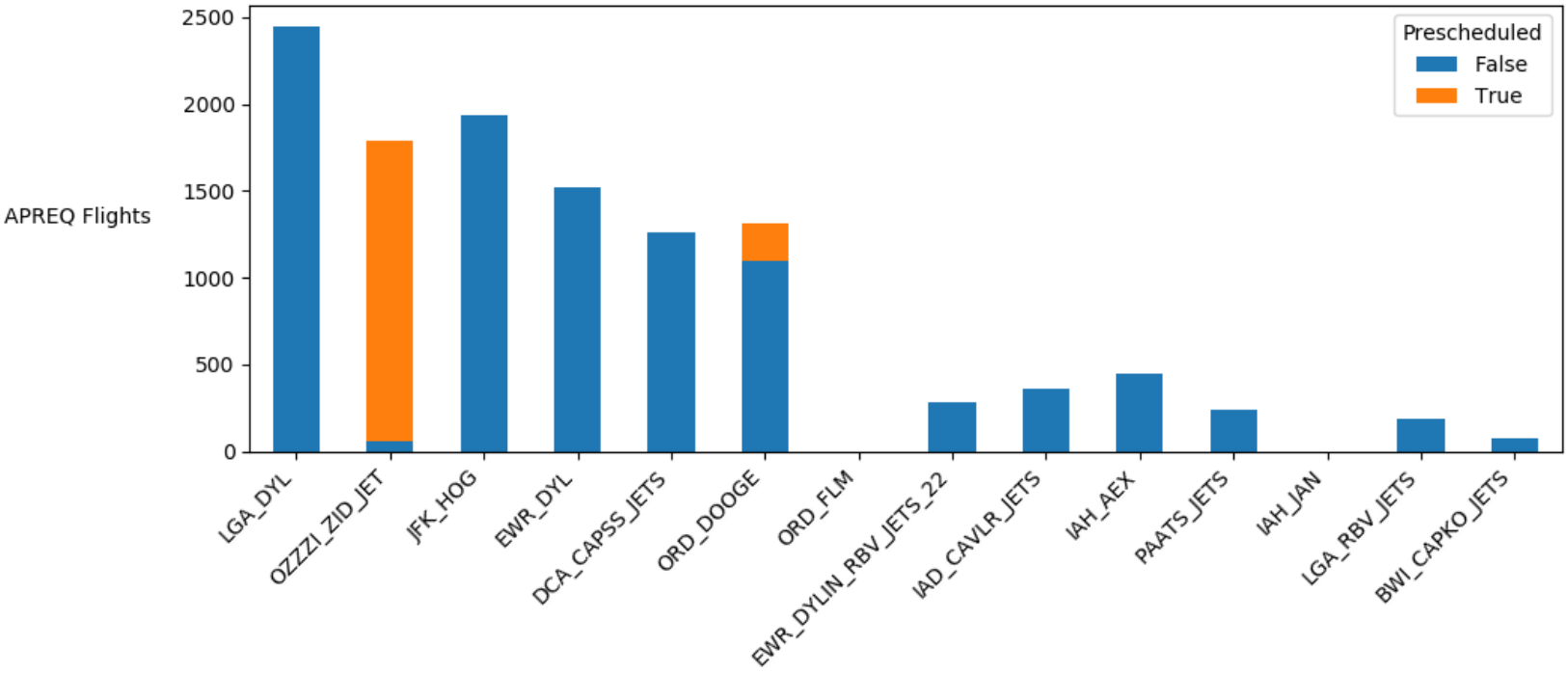
# ‘Sequence Holds’ by Slot Size & Compliance




- Top stream classes
- Colors show fraction for which sequence holds
- Numbers show sample size (23,735 CLT Apreqs)

# Prescheduled Apreqs by Stream Class

Stream classes with prescheduling:




2019 CLT Apreqs

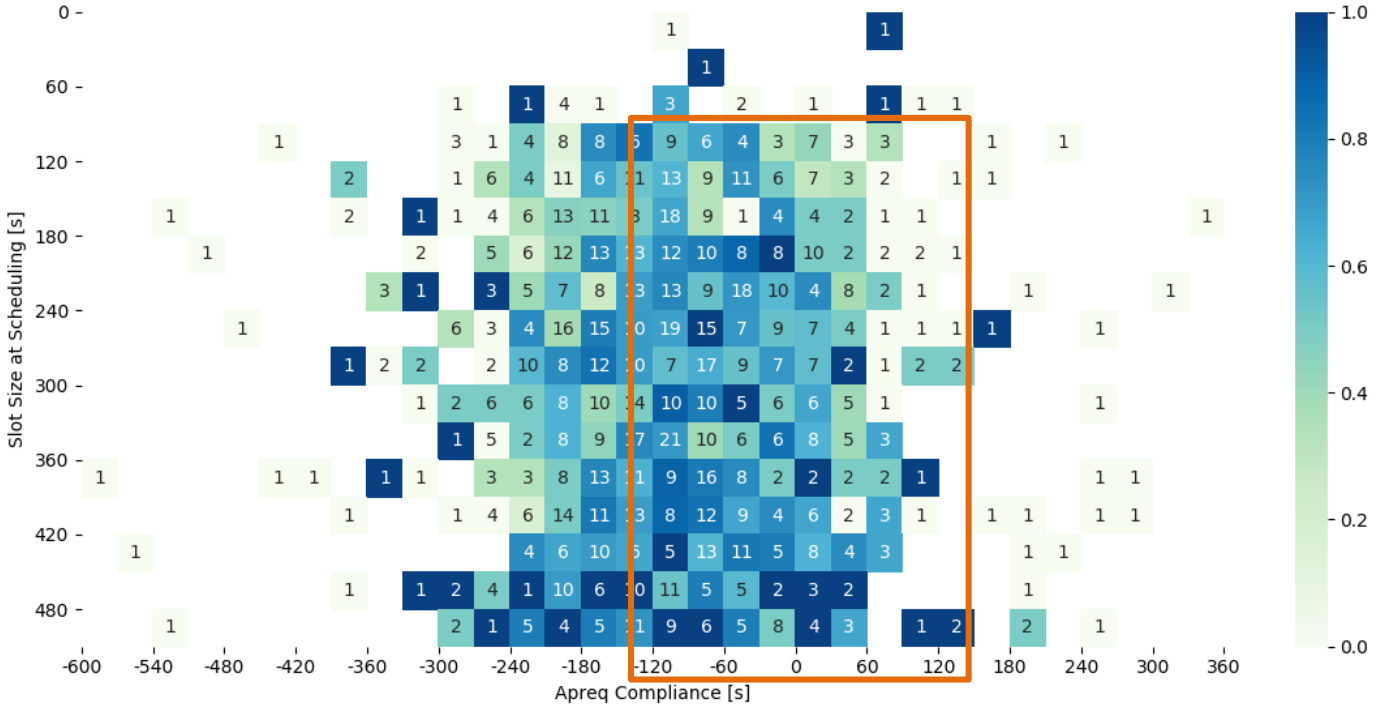
# Apreq Prescheduling

| | Compliance | Lead & Trail Match | Sequence Holds |
|---|---|---|---|
| Prescheduled | 75% | 34% | 63% |
| Not Prescheduled | 69% | 22% | 63% |

- 2,428 *prescheduled* CLT Apreq flights

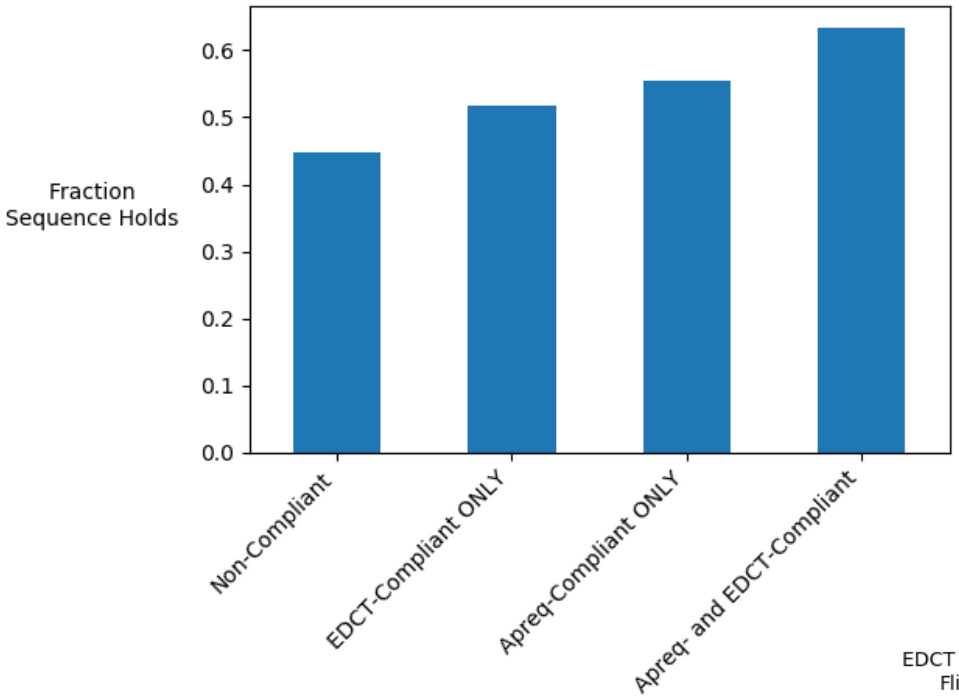
# ‘Sequence Holds’ by Slot Size & Compliance

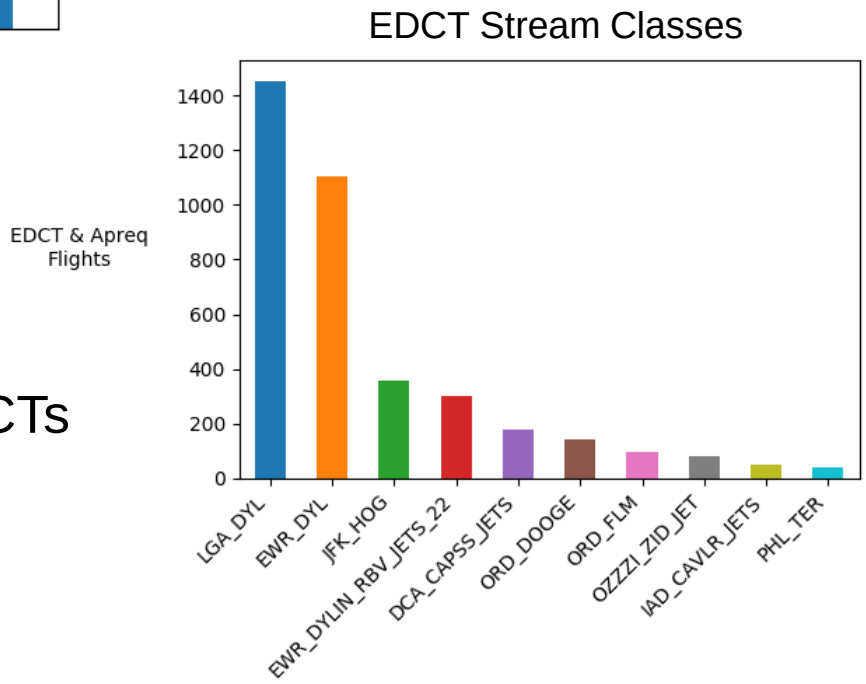
- Prescheduled flights




- Colors show fraction of sequence-hold’s
- Numbers show sample size (2,297 *prescheduled* CLT Apreqs)

# ‘Sequence Holds’ by Apreq and EDCT Compliance




- 4,061CLT Apreq flights with EDCTs

# Summary

- Stream-class specific analysis combines TBFM and surface data
- Apreq compliance consistently improves stream insertion
  - Variation with slot size
  - Variation with stream class and specific flow characteristics
- ‘Sequence Holds’ insensitive to prescheduling (also insensitive to airport configuration)