Analyzing Double Delays at Newark Liberty International Airport (EWR)

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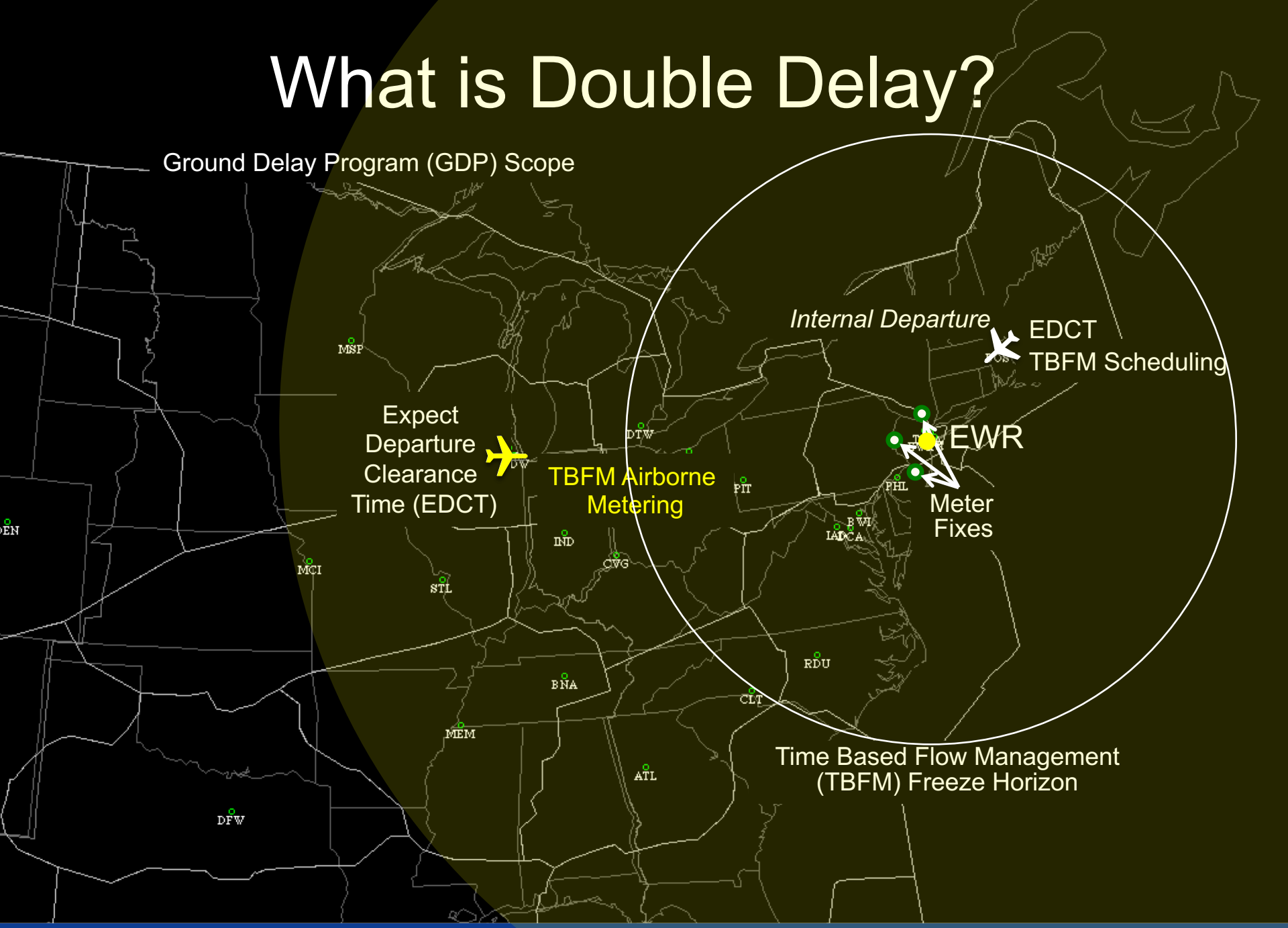
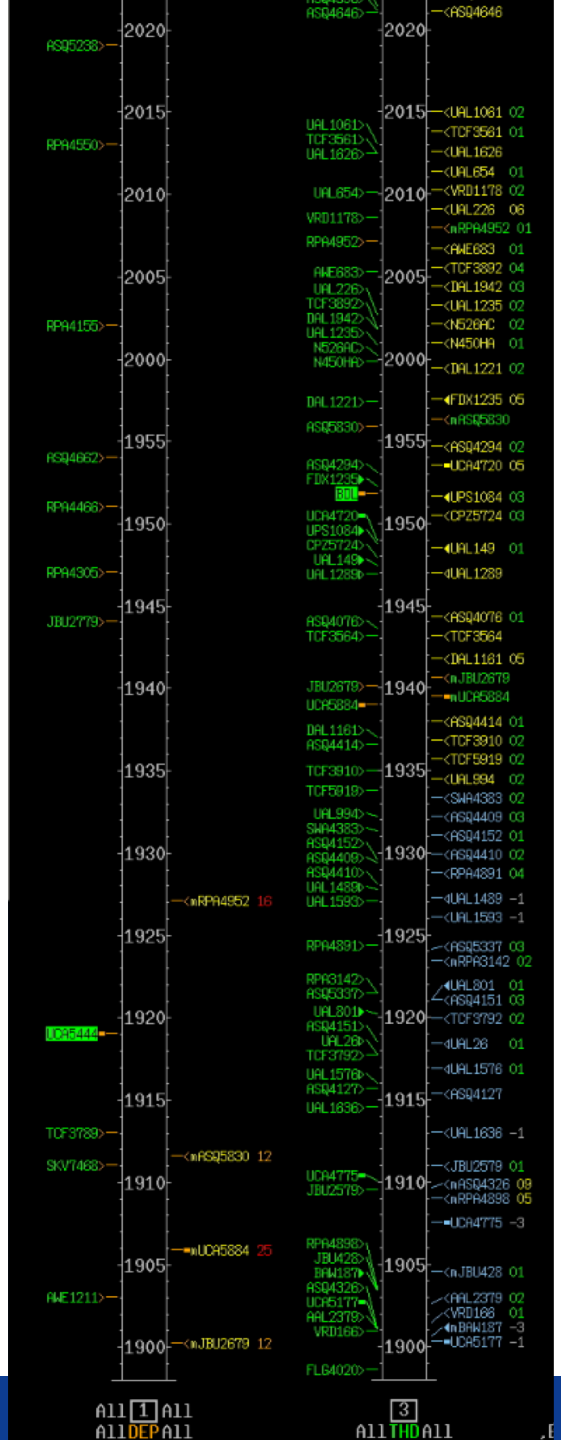
What is Double Delay?





What is Double Delay?

- Gaps may not exist in arrival stream for internal departures
  - Delayed on the ground until gap available
- Internal departures may receive high TBFM scheduling delays after high GDP delays
- Perceived in-equitability

Motivation

- Do internal departures receive ‘double delays’ at EWR?
- If so, how widespread is the problem?
- What are the underlying drivers of ‘double delays?’

- Can a concept be developed that will reduce the occurrence of ‘double delay?’
  - Integrated Demand Management

Quantifying Double Delay

Based on Multi-TMI data from Volpe National Transportation Systems Center

- **June – Aug 2010**
- Traffic Management Advisor (TMA)

EWR Arrivals

	Avg. GDP Delay Internal and External Departures Ground	**Avg. TMA Scheduling Delay** Internal Departures Ground	**Avg. TMA Airborne Metering Delay** External Departures Airborne
GDP, TMA active	46.7 min	10.0 min	3.2 min

How widespread is the problem?

- Double delay:
  - GDP delay > 15 minutes
  - TMA Scheduling delay > 5 minutes

- Using this definition:
  - 42% of EWR internal departures under TMA scheduling and GDP are classed as double delayed

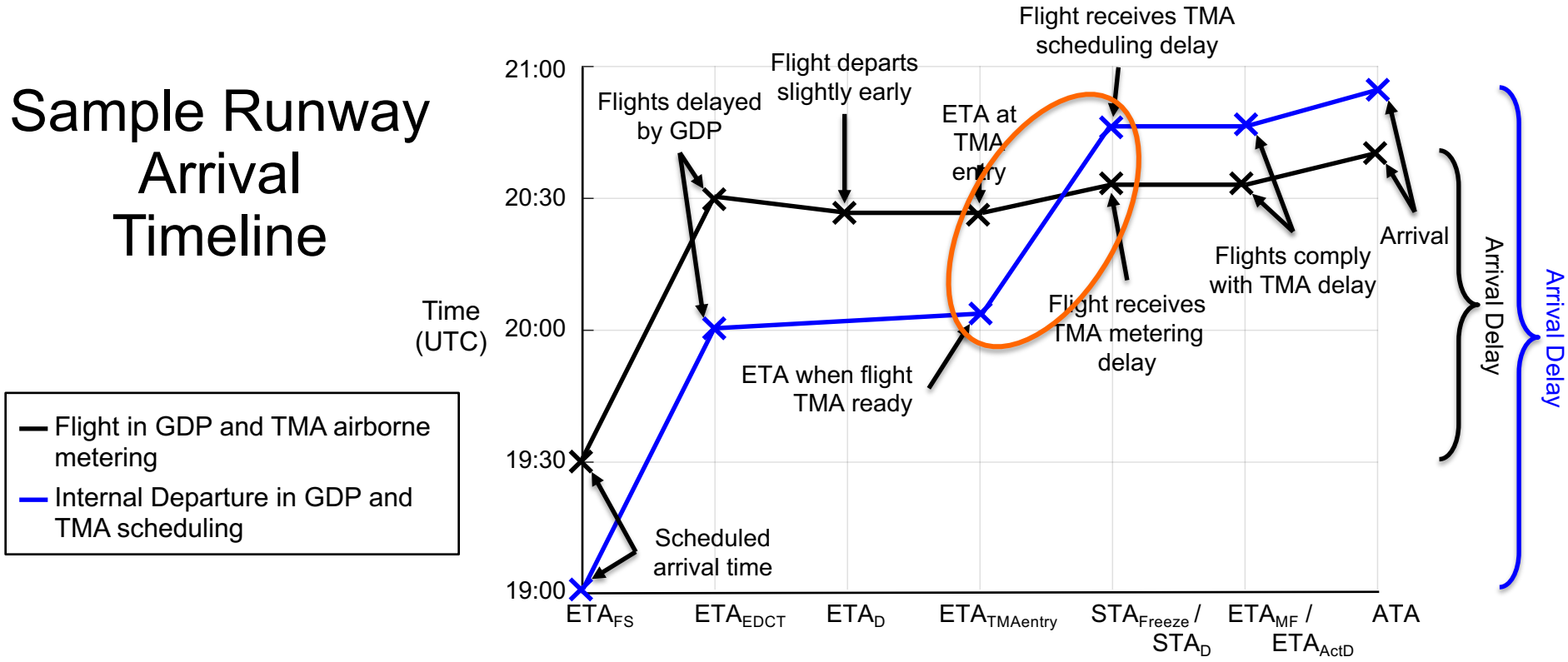
Based on Multi-TMI data, June-Aug 2010, from Volpe National Transportation Systems Center

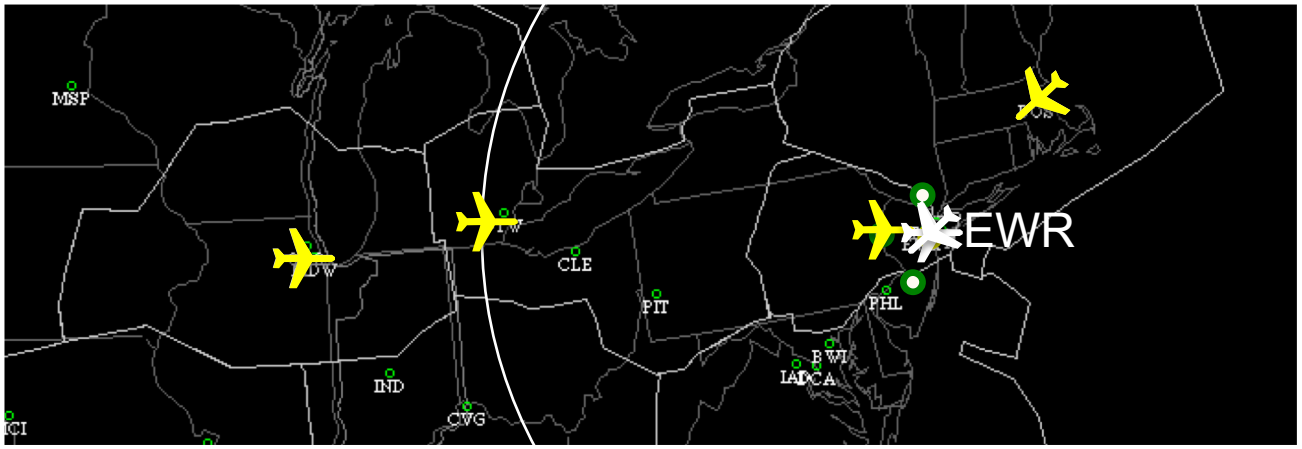
Analysis Approach

- Supervised machine learning
  - Feature identification
    - Analyze key days with high number of double delays
    - Identify features impacting double delays
  - Build classifier of occurrence of double delay
  - Extract drivers

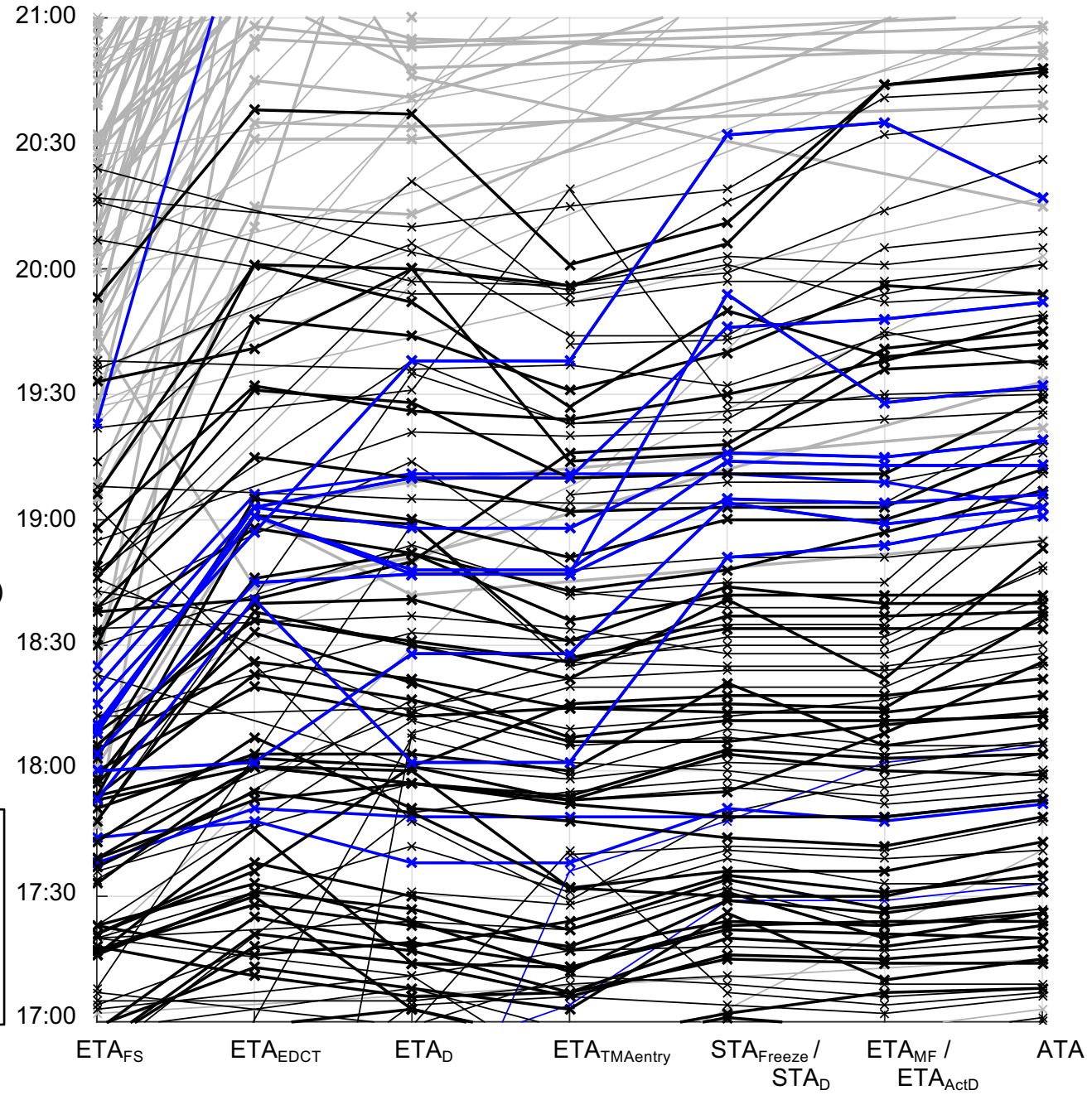
- Volpe Multi-TMI database
  - June-August 2010

Sample Runway Arrival Timeline

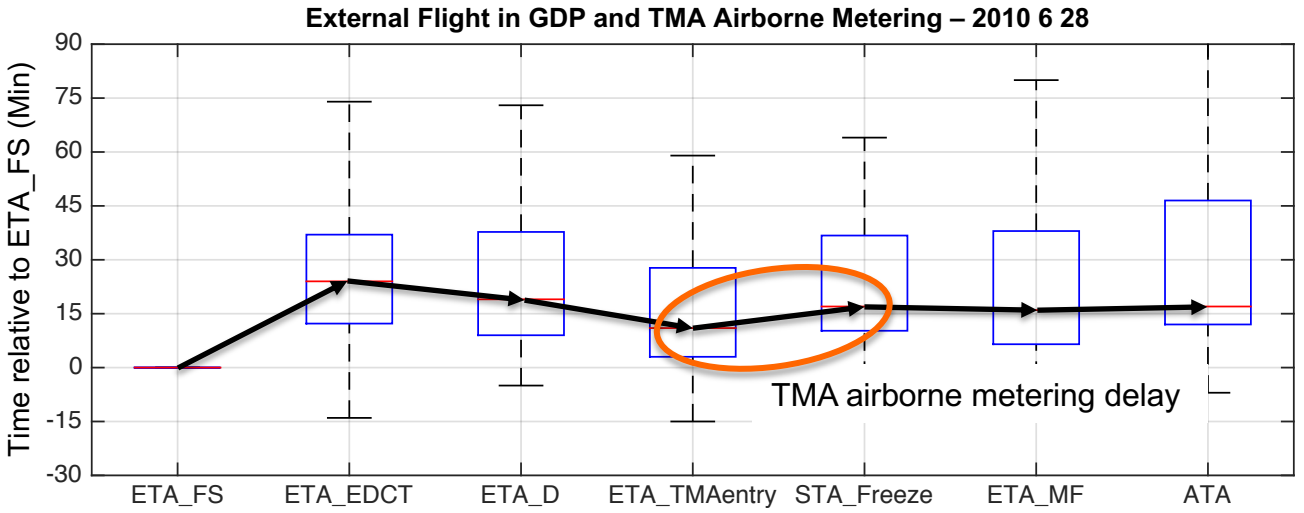


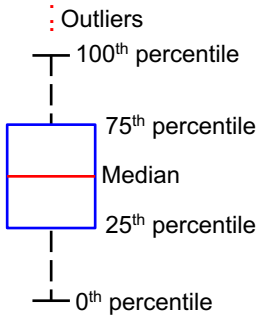


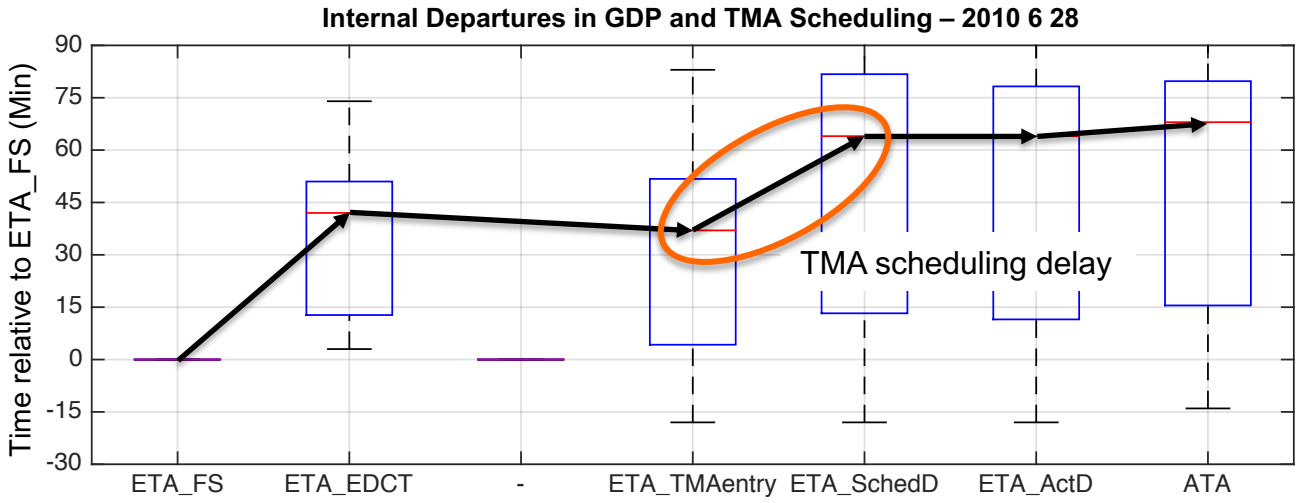
EWR Arrivals Sample Timeline June 28, 2010



EWR Arrivals Aggregate Timeline June 28, 2010







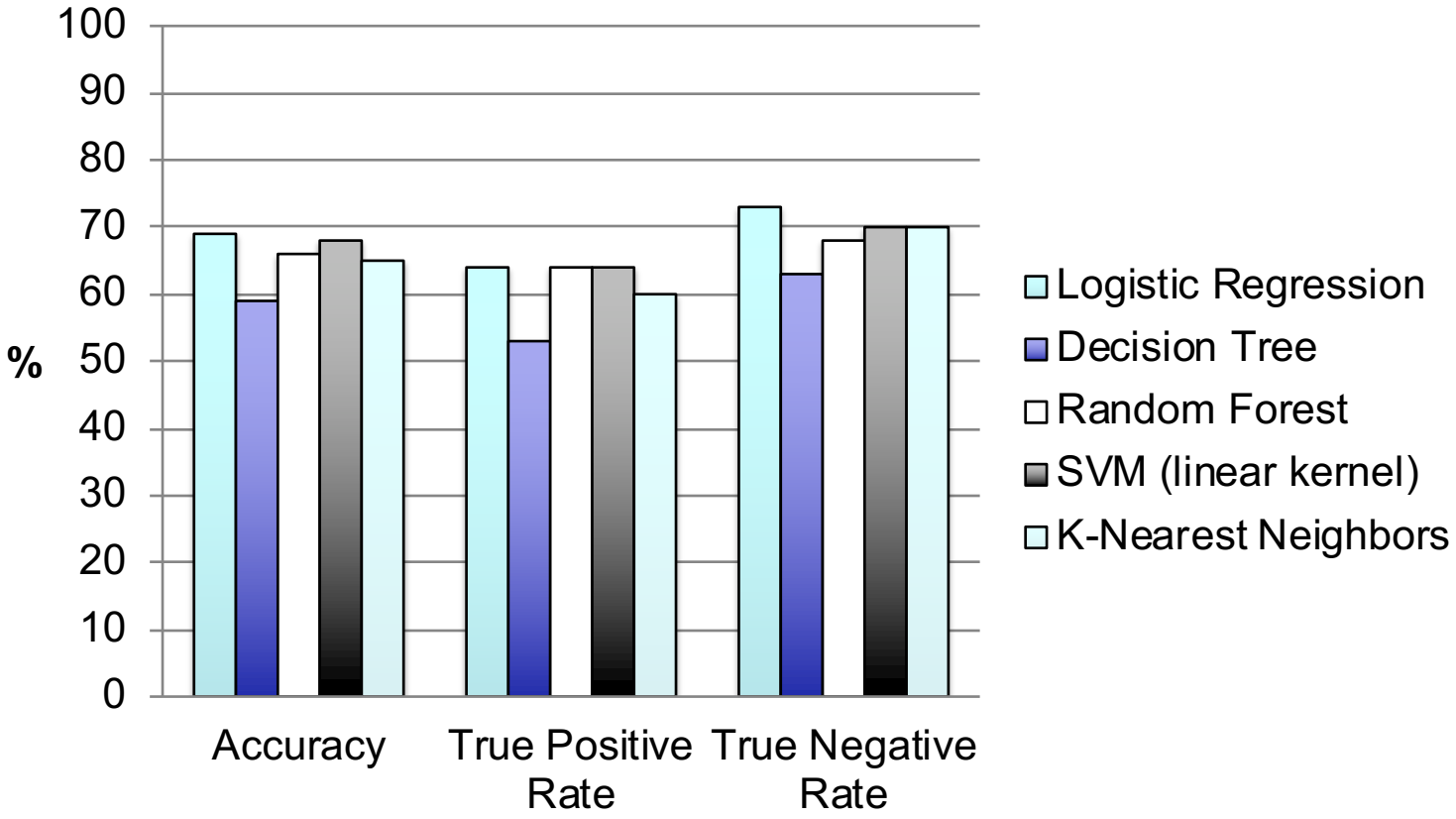
Feature Set

Features that may affect occurrence of double delays:

- Flights departing before EDCT
- Shorter en route times used by GDP and TMA
- High ratio of demand to capacity
- Large differences in the arrival demand defined by EDCTs and entering TMA
- Large differences in rates used for GDP and TMA
- Large virtual TMA runway arrival queue
- Maximum airborne metering delays

Double Delay Classification

EWR arrivals, June – August 2010, with 10 fold-cross validation, 310 observations



Logistic Regression: Drivers

Double Delay Classifier, EWR arrivals

Feature	t-Statistic	Estimate	% Inc. Odds	Std. Dev.
Virtual TMA Runway Arrival Queue Size	5.39	0.44	55.0%	1.9 ac
Ratio of Demand to Capacity	2.80	1.44	320.6%	0.27
Departing before EDCT	2.63	0.03	3.1%	13 min
Diff. in rates used by GDP and TMA	2.57	0.03	3.3%	11 ac/hr
Diff. en route times used by GDP and TMA	2.28	0.04	4.1%	7.5 min

Features that are collinear or statistically insignificant excluded

Conclusions

- For EWR in 2010, double delay impact 42% of internal departures under GDP and TMA scheduling
- Supervised machine learning used to extract drivers of double delay:
  - Large virtual TMA runway arrival queue
  - High ratio of demand to capacity
  - Flights departing before EDCT
  - Differences in rates used for by GDP and TMA
  - Shorter en route times used by GDP and TMA
- 1st step towards developing a concept that mitigates double delays