System-Wide Benefit Metrics

Presentation to SCT/FET

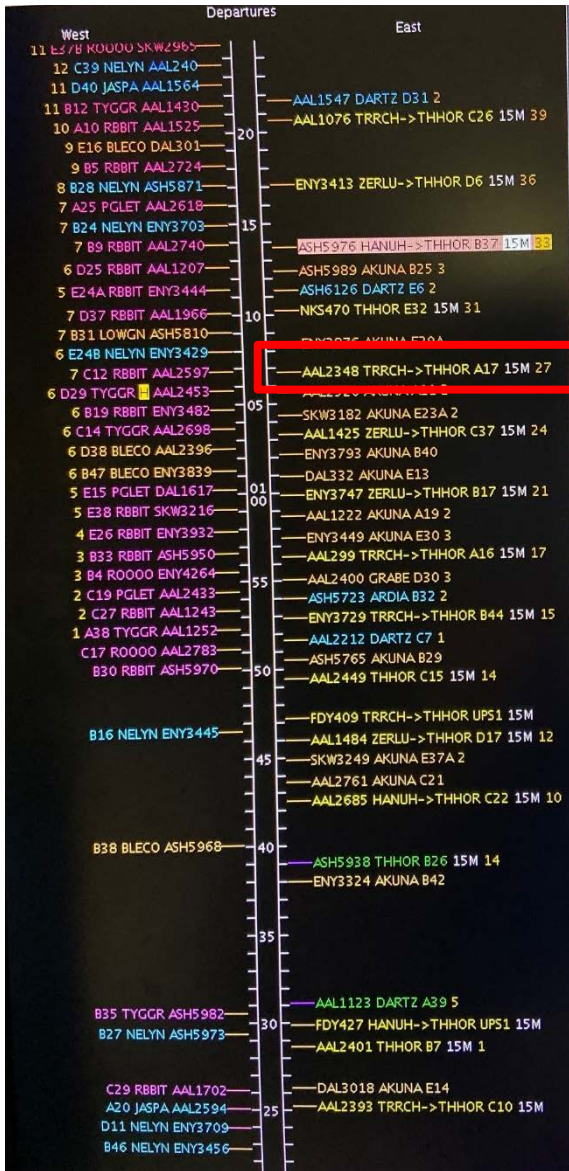February 20th, 2020

Real-Time Metrics

- Motivation
  - Provide data to Flight Operators and ATC to help them to
    - Determine a threshold of cost/benefit decision point
    - Assess tactical and strategic benefits

- Current Limitations
  - Error in predictions are not communicated
  - Off-Times and delay savings predictions are dependent on fluctuations in the input data and scheduling process
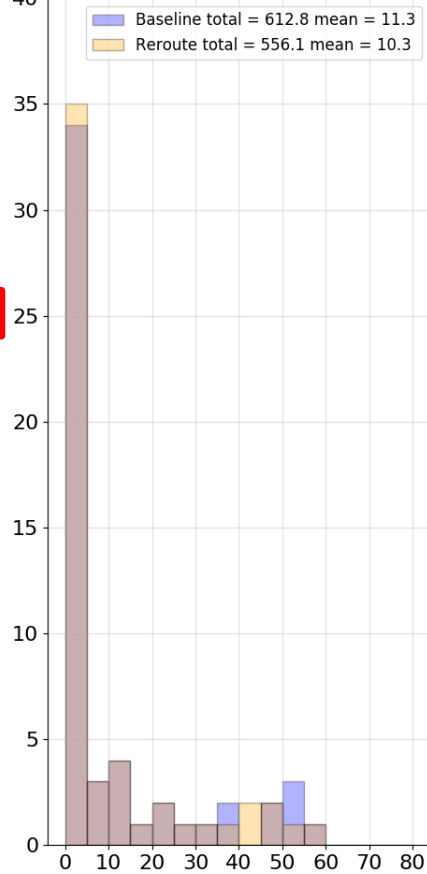 - System identifies delay savings for one flight at the time

- Goals
  - Provide "self-scoring" real-time metric on predicted times and/or delay uncertainties
  - Provide real-time metrics of predictable benefits
    - Identify benefit pool metrics (delay savings for multiple flights)
    - Identify deterministic mechanism to indicate real-time benefits
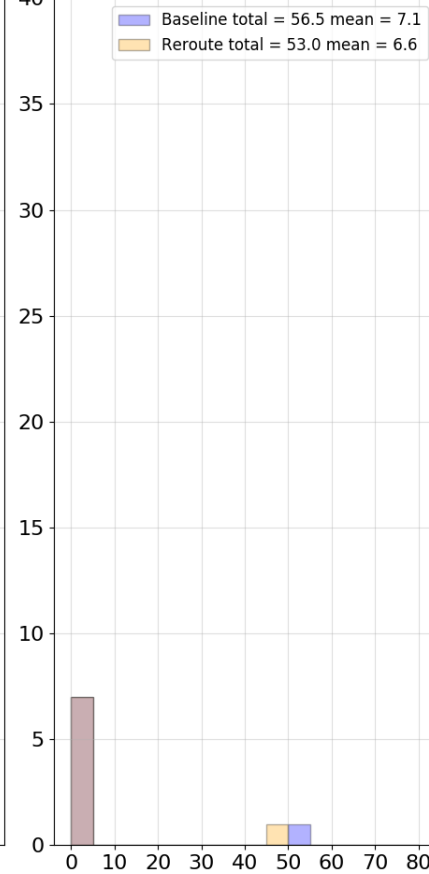
System-wide Benefit Metrics

- Delay metrics by
    - Metroplex
    - Airport
    - Fleet

- Total and average delay

- Constrain calculation to only include flights with UTOT within 60 minutes of current time
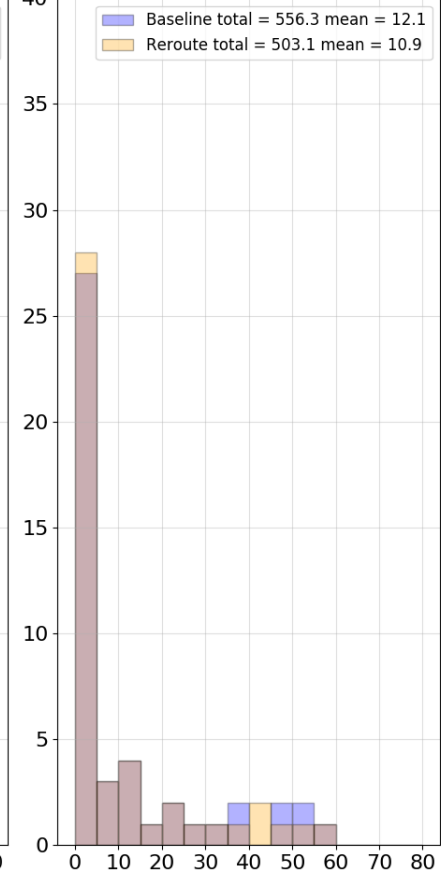
System-Wide Benefit of Single Reroute

Metroplex Delay
- Baseline total = 612.8 mean = 11.3
- Reroute total = 556.1 mean = 10.3

DAL Delay
- Baseline total = 56.5 mean = 7.1
- Reroute total = 53.0 mean = 6.6

DFW Delay
- Baseline total = 556.3 mean = 12.1
- Reroute total = 503.1 mean = 10.9

	D10	DAL	DFW	AAL2348
Total Savings	56.7	3.5	53.2	25.5
Average Savings	1.0	0.5	1.2	

New Metric Fields In The TOS Table

Top routes are indicated for both potential and candidate flights

Flight ID	Rwy	Dest	Route of Flight	Dep Gate	EOBT ▲	Flight Status	ETOT	TMI Info	Eligibility State	Coord State	Num TOS Cand	Top CDR	Top Dep Gate	Top ETOT	Top RTC	Top Total Delay Savings OFF
					22/19:05	Scheduled_Out	22/20:02	15M	Candidate	Not Submitted	2	BOSJ3	NORTH	19:13	+9	-28
					22/19:05	Scheduled_Out	22/19:18		Potential	Not Submitted	0	MIA1S	SOUTH	19:15	+16	-3
					22/19:15	Scheduled_Out	22/19:24		Potential	Not Submitted	0	BWIJ3	NORTH	19:18	+18	-6
					22/19:35	Scheduled_Out	22/19:44		Potential	Not Submitted	0	LGAJ3	NORTH	19:32	+27	-12
					22/19:40	Scheduled_Out	22/19:51		Potential	Not Submitted	0	TPA1S	SOUTH	19:36	+38	-15
					22/19:50	Scheduled_Out	22/21:18	15M Fix...	Candidate	Not Submitted	1	JAX1S	SOUTH	20:55	+20	-23
					22/19:55	Scheduled_Out	22/21:28	15M Fix...	Candidate	Not Submitted	2	FLL1S	SOUTH	20:47	+38	-45
					22/20:00	Scheduled_Out	22/20:09		Potential	Not Submitted	0	BWIJ3	NORTH	19:48	+34	-21
					22/20:00	Scheduled_Out	22/20:10		Potential	Not Submitted	0	MSY1S	SOUTH	19:50	+27	-20
					22/20:03	Scheduled_Out	22/21:49	15M Fix...	Candidate	Not Submitted	1	MCO1S	SOUTH	20:52	+46	-56

TOS Departure - Eligibility State = Candidate; Coord State = Not Submitted; Eligibility State = Potential

Probability of Delay Savings at or above the Relative Trajectory Cost (RTC) threshold

Aggregate delay savings are indicated at the Fleet, Airport and D10 levels

| Top RTC	Top Total Delay Savings OFF	Prob Del Sav ≥ RTC	Aggr Fleet Del Sav	Num Fleet Del Sav	Aggr Airport Del Sav	Num Airport Del Sav	Aggr D10 Del Sav	Num D10 Del Sav
+5	+11	53%	30.2	20	40.9	29	56.5	40
+5	+17	…	…	…	…	…	…	…
+10	+20							
+9	+22							
+13	+29							
+17	+21							
+26	+27							
+16	+35							

Results from 2019-12-16

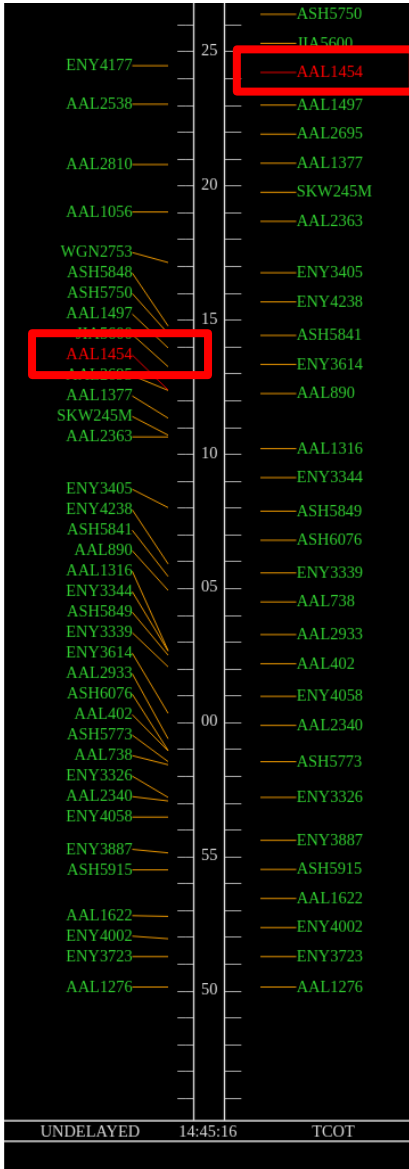# System-Wide Benefit of Single Reroute AAL2565 at 2019-12-16 13:45:42
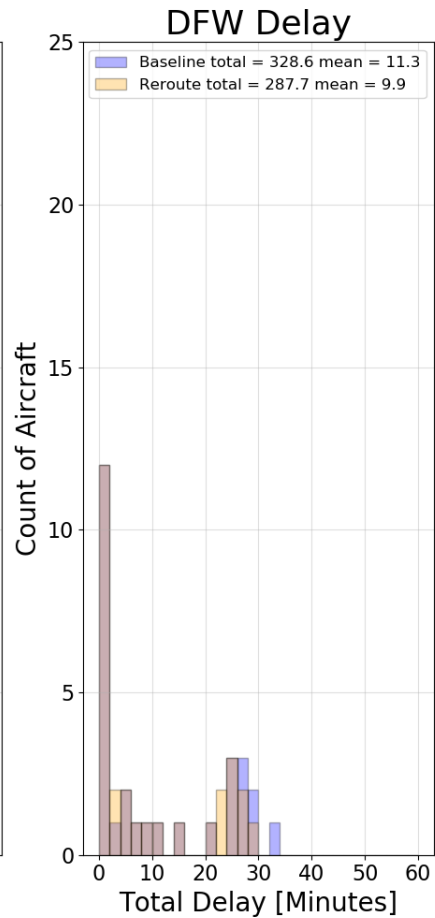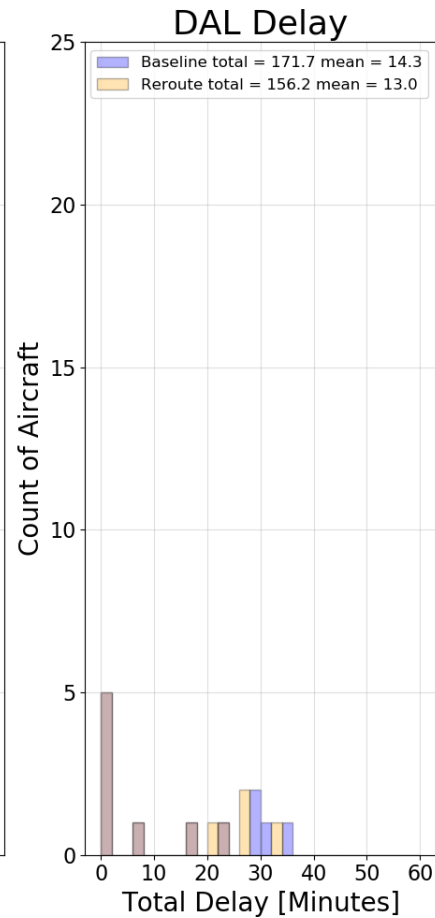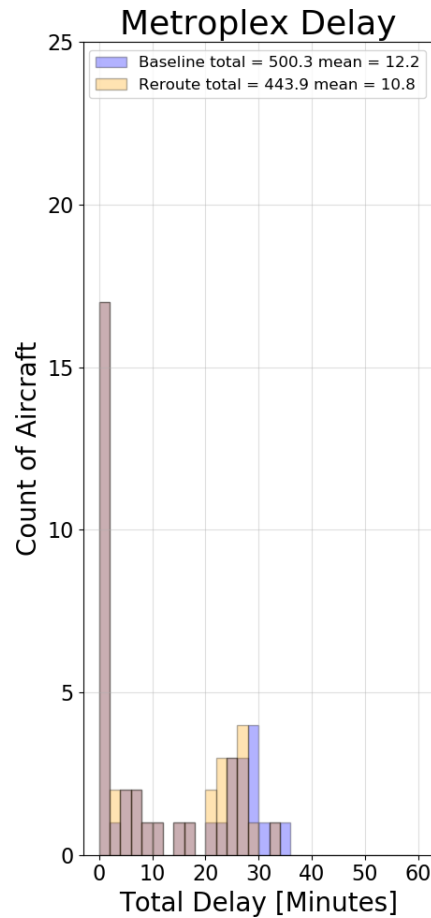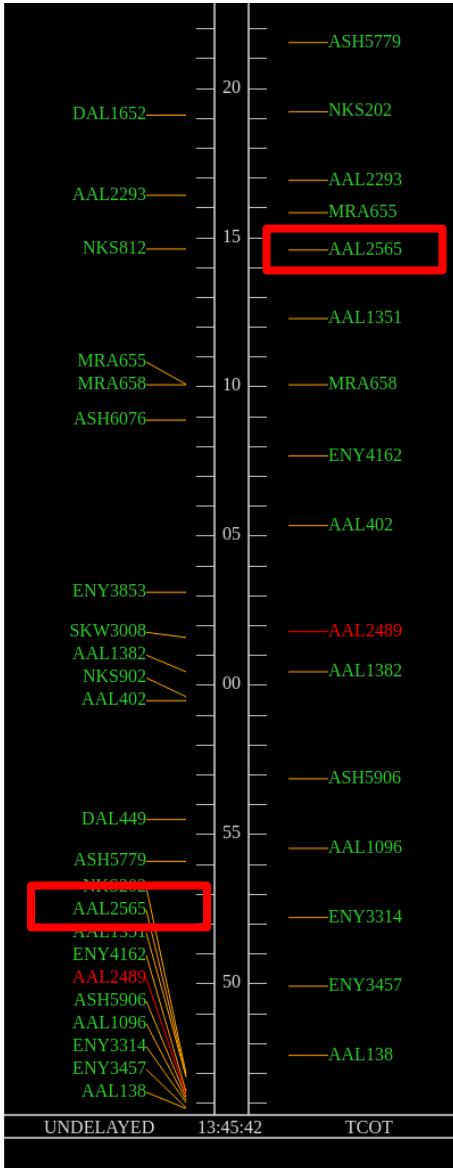
	D10	DAL	DFW	AAL2565
Total Savings	56.4	15.5	40.9	27.7
Average Savings	1.4	1.3	1.4	

System-Wide Benefit of Single Reroute AAL1454 at 2019-12-16 14:45:16
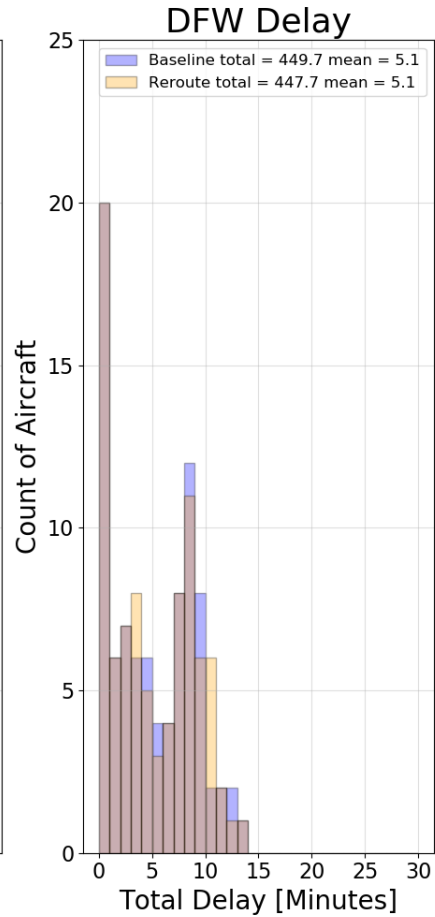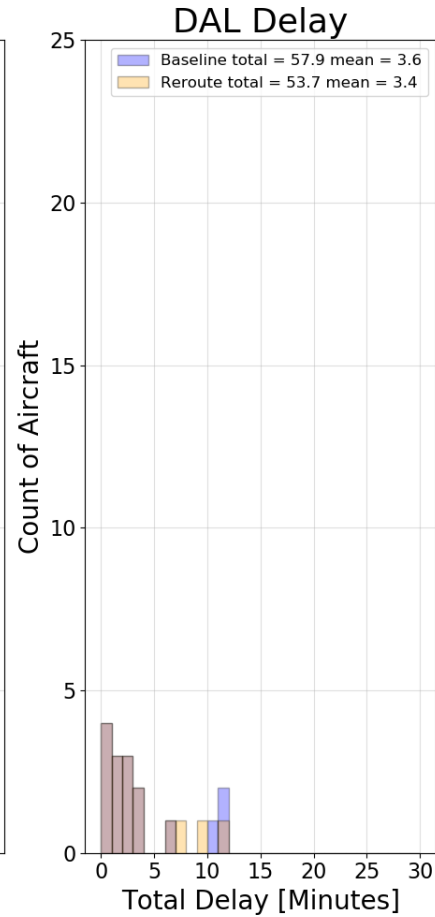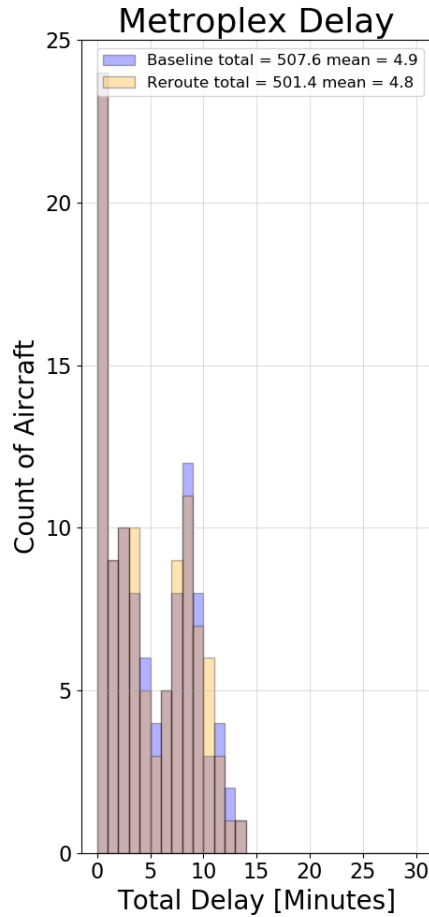

	D10	DAL	DFW	AAL1454
Total Savings	6.2	4.2	2.0	1.2
Average Savings	0.1	0.2	0.0	

Review of Real-Time Self Scoring for ETOT Accuracy and Predicted Delay Accuracy

ETOT Accuracy

- <ATOT – ETOT> measured 30, 25, 20, 15, 10, 5, 0 minutes prior to
  - Actual Off Block Time (AOBT)
  - Actual Take Off Time (ATOT)

- Plot median accuracy and shade between 25th quantile and 75th quantile

- Provide in table format the 25th, 50th, and 75th quantile

DAL ETOT Accuracy

DAL ETOT Accuracy
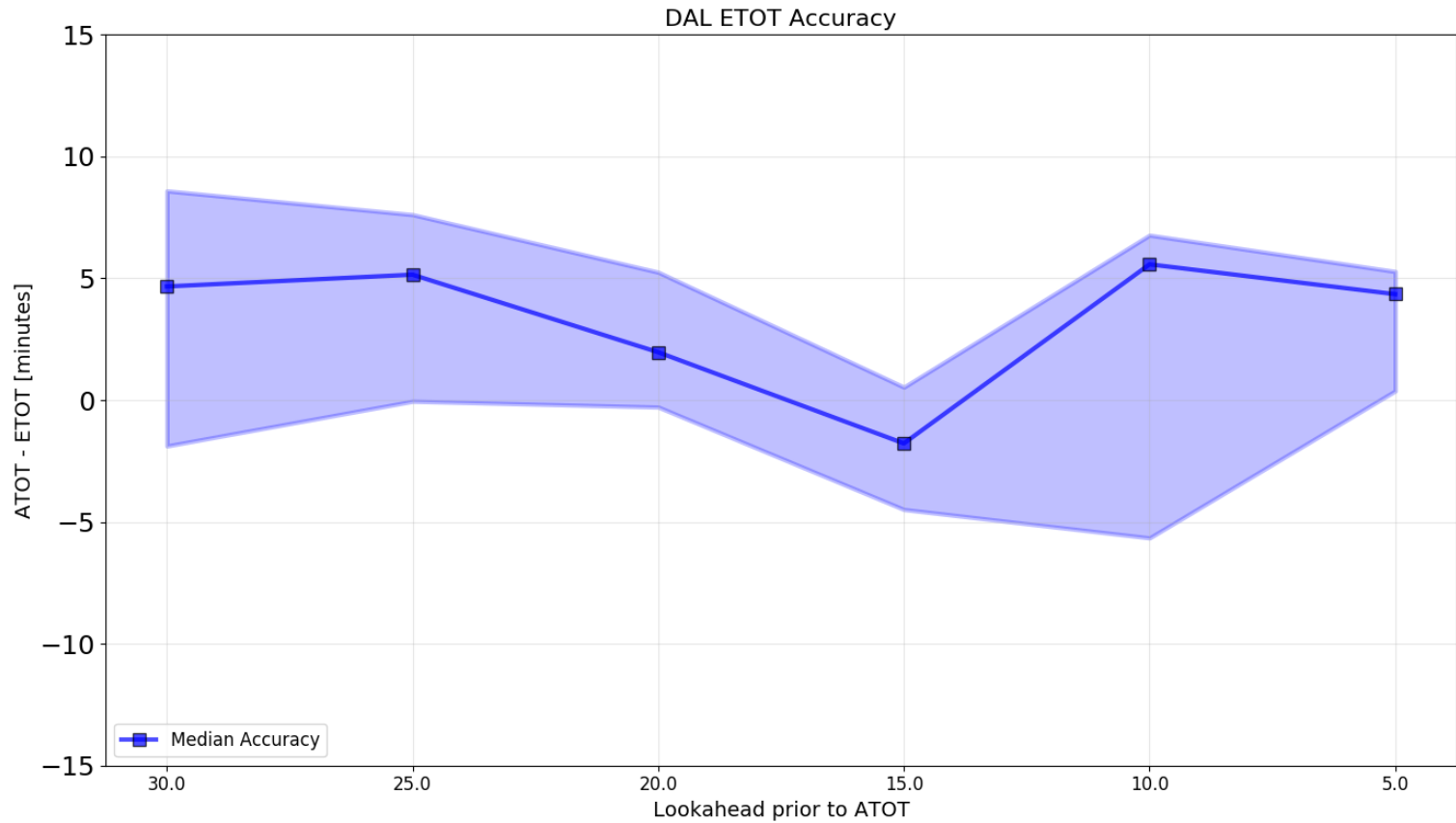
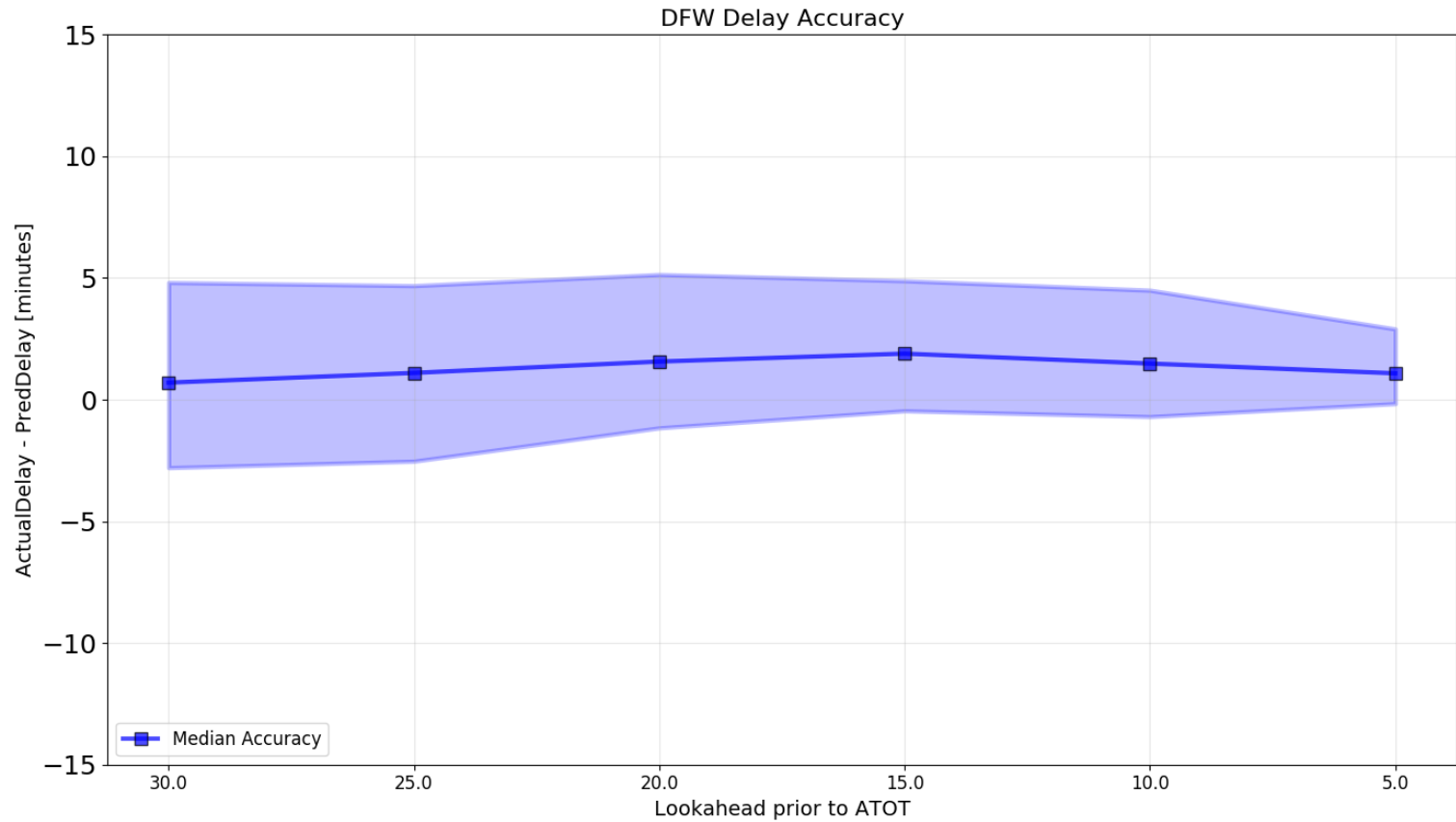|	30	25	20	15	10	5
75 quantile	10.4	8.8	6	6.8	9.2	5.3
median	5.4	4.6	1.6	-1.2	4.8	4.2
25 quantile	-5.7	-2.5	-2.9	-5.1	-7.7	-1.1

DFW ETOT Accuracy

DFW ETOT Accuracy
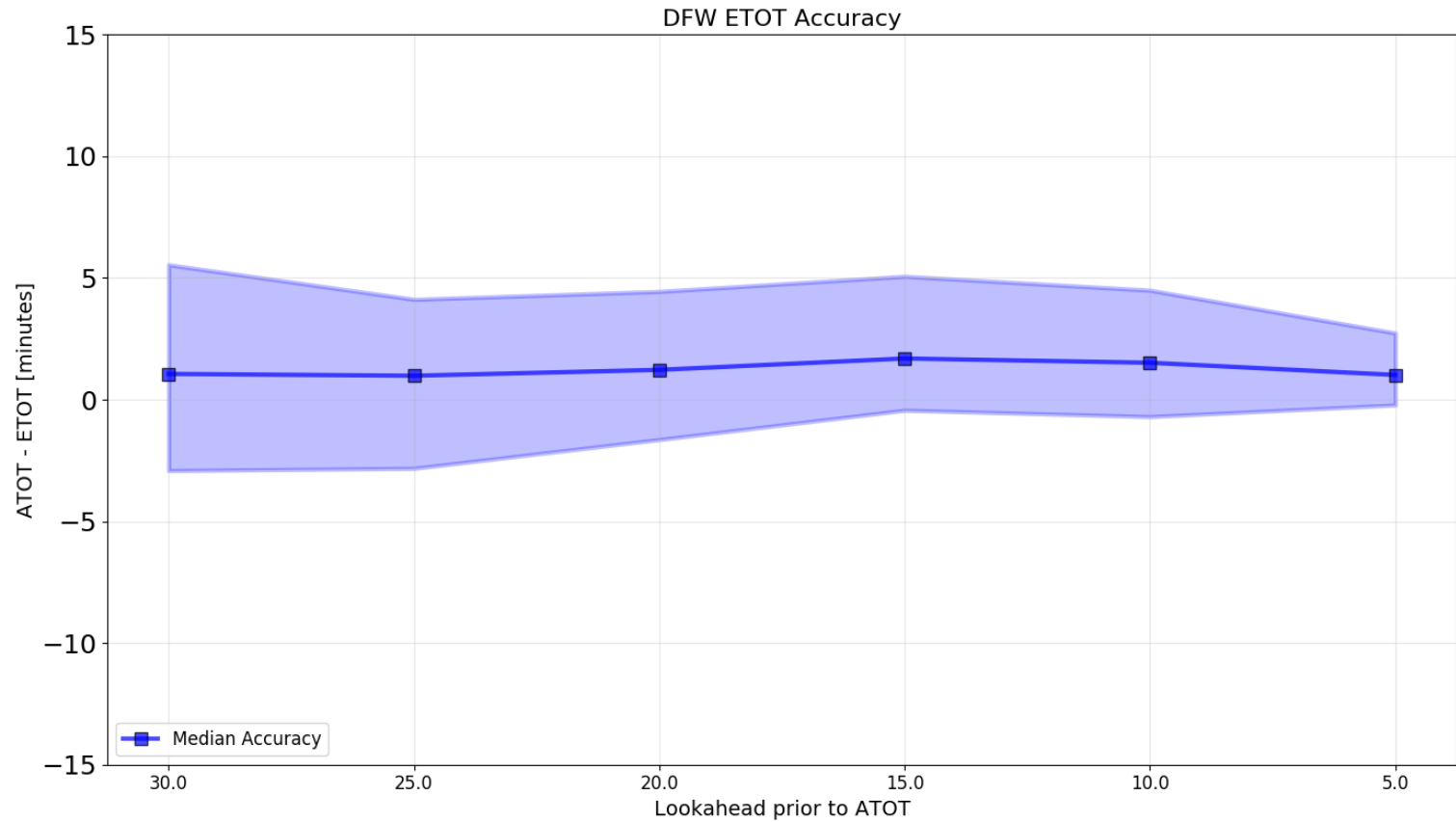
	30	25	20	15	10	5
75 quantile	11	11.4	7.7	7.9	6.8	4.1
median	1.1	1	1.2	1.7	1.5	1
25 quantile	-7.7	-9.9	-10.7	-7.5	-3.4	-2.6

Delay Accuracy

- <ActualDelay – PredictedDelay> measured 30, 25, 20, 15, 10, 5, 0 minutes prior to
  - Actual Off Block Time (AOBT)?
  - Actual Take Off Time (ATOT)?

- ActualDelay measured as ATOT – (AOBT + UTT)

- PredictedDelay measured as
  - ETOT – UTOT prior to push
  - ETOT – (AOBT + UTT) after push

- Plot median accuracy and shade between 25th quantile and 75th quantile

- Provide in table format the 25th, 50th, and 75th quantile

DAL Delay Accuracy

DAL Delay Accuracy
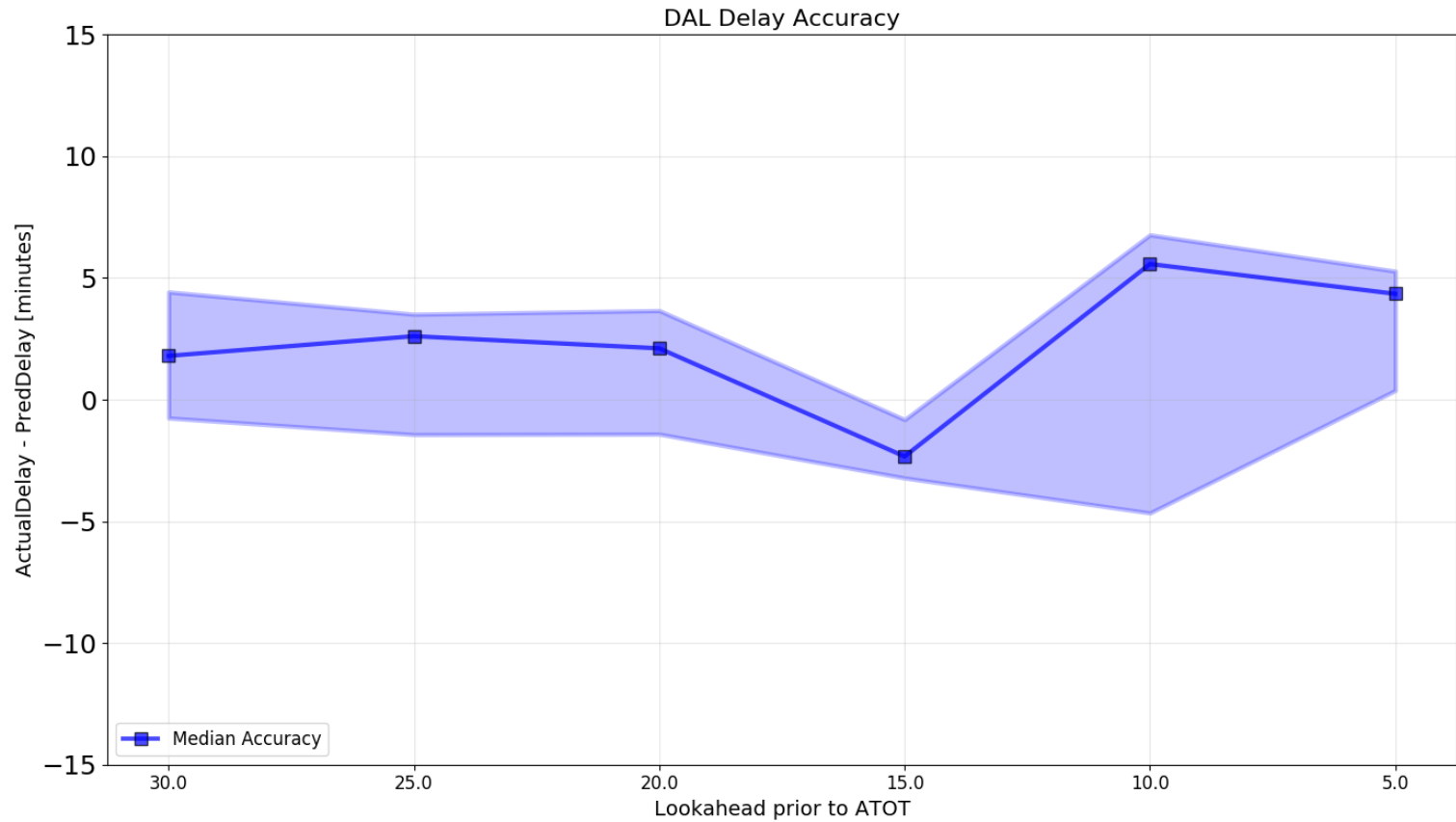
	30	25	20	15	10	5
75 quantile	7.6	7.4	4.4	5.9	9.2	5.3
median	2.1	2.4	-0.5	-1.9	4.8	4.2
25 quantile	-2.8	-2.2	-4.5	-5.6	-8.1	-1.1

DFW Delay Accuracy

DFW Delay Accuracy

ActualDelay - PredDelay [minutes]

Lookahead prior to ATOT

Median Accuracy

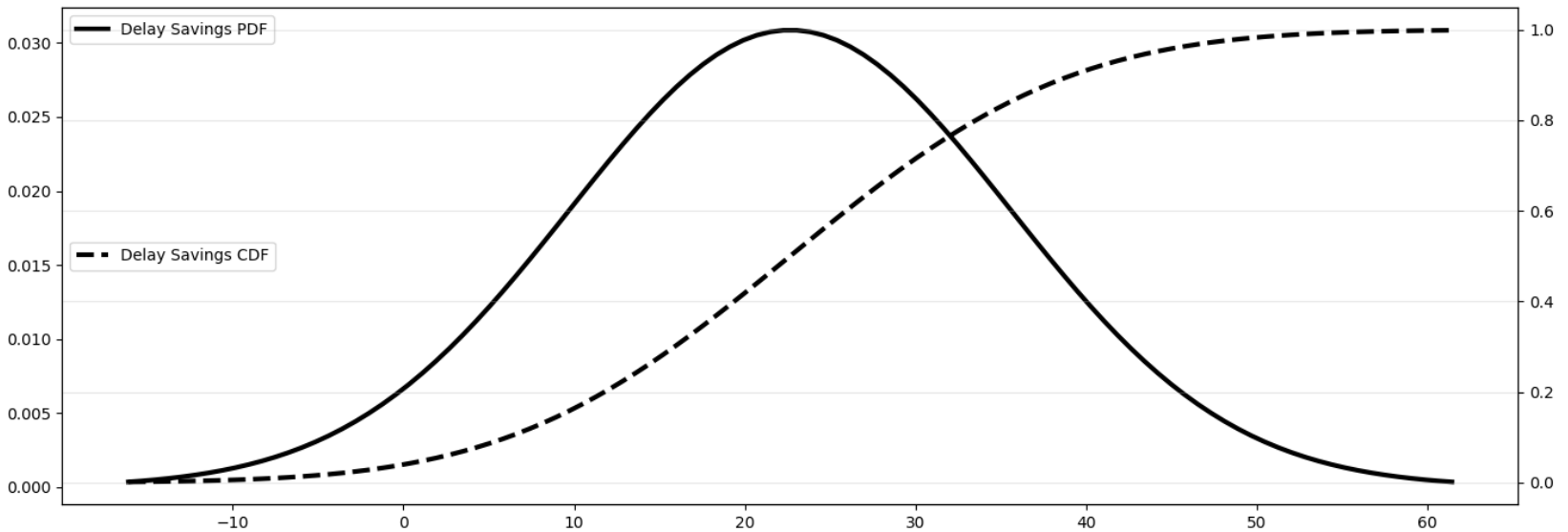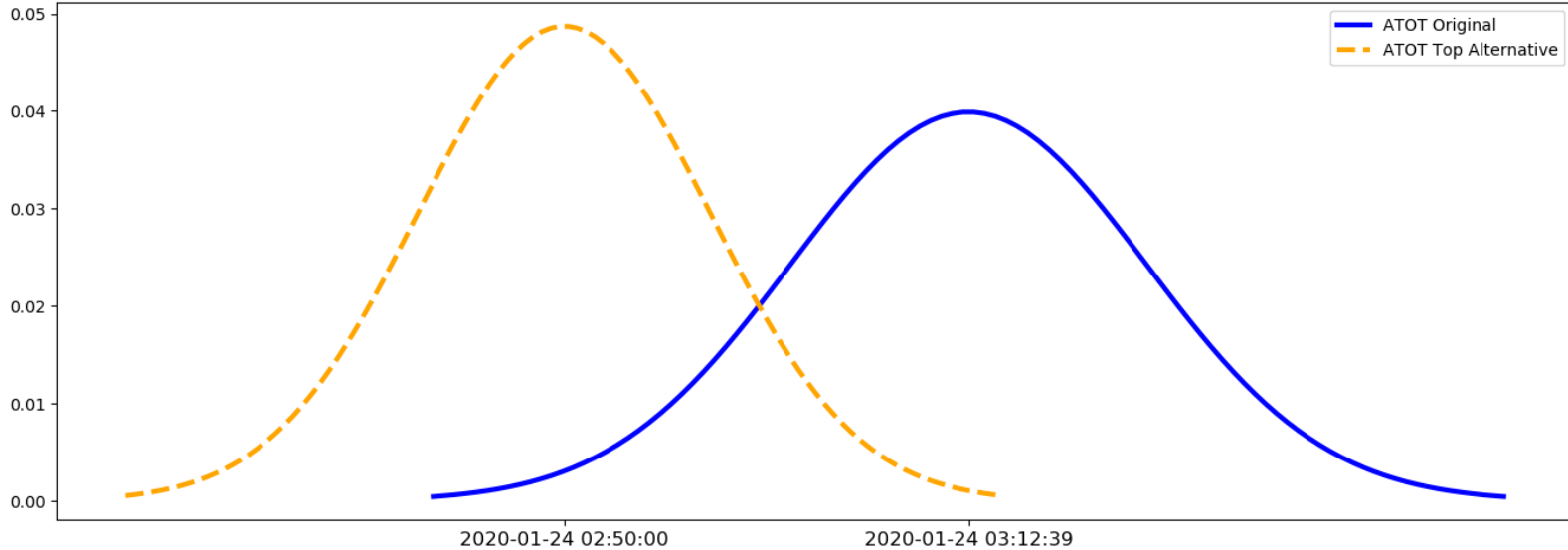|	30	25	20	15	10	5
75 quantile	9.6	9.2	7.8	8.4	7.3	4.2
median	0.7	1.1	1.6	1.9	1.5	1.1
25 quantile	-9.3	-8.7	-8.3	-7.4	-4.3	-2.4

Delay Savings Bounds
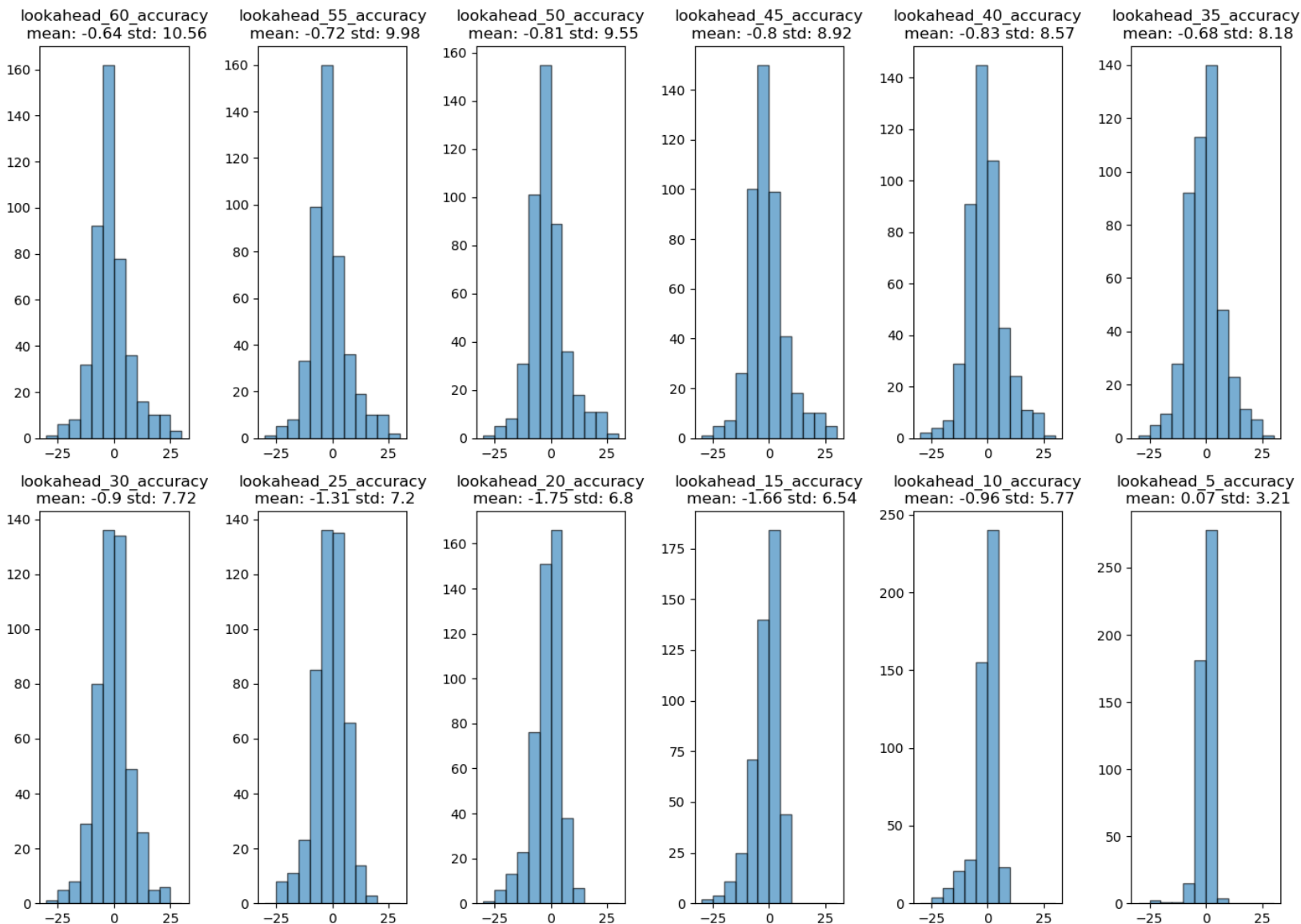
ETOT Accuracy on 2019-12-15

Lookahead 53.5 Minutes: Predicted Delay Savings = 22.65

New Metric Fields In The TOS Table

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Probability of Delay Savings at or above the Relative Trajectory Cost (RTC) threshold

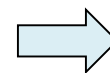Aggregate delay savings are indicated at the Fleet, Airport and D10 levels

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+5	+11	53%	30.2	20	40.9	29	56.5	40
+5	+17	…	…	…	…	…	…	…
+10	+20							
+9	+22							
+13	+29							
+17	+21							
+26	+27							
+16	+35							

Color Alerts Based on Metrics Values

- Users will be able to add color alerts to the new metrics
- The color will be assigned based on a range of values
  - Example: for Probability of Delay Savings at or above RTC
  - Green for values > 60%
  - Yellow for values > 40% and < 59%
  - Red for values < 39%