Service Analysis for Weather Information

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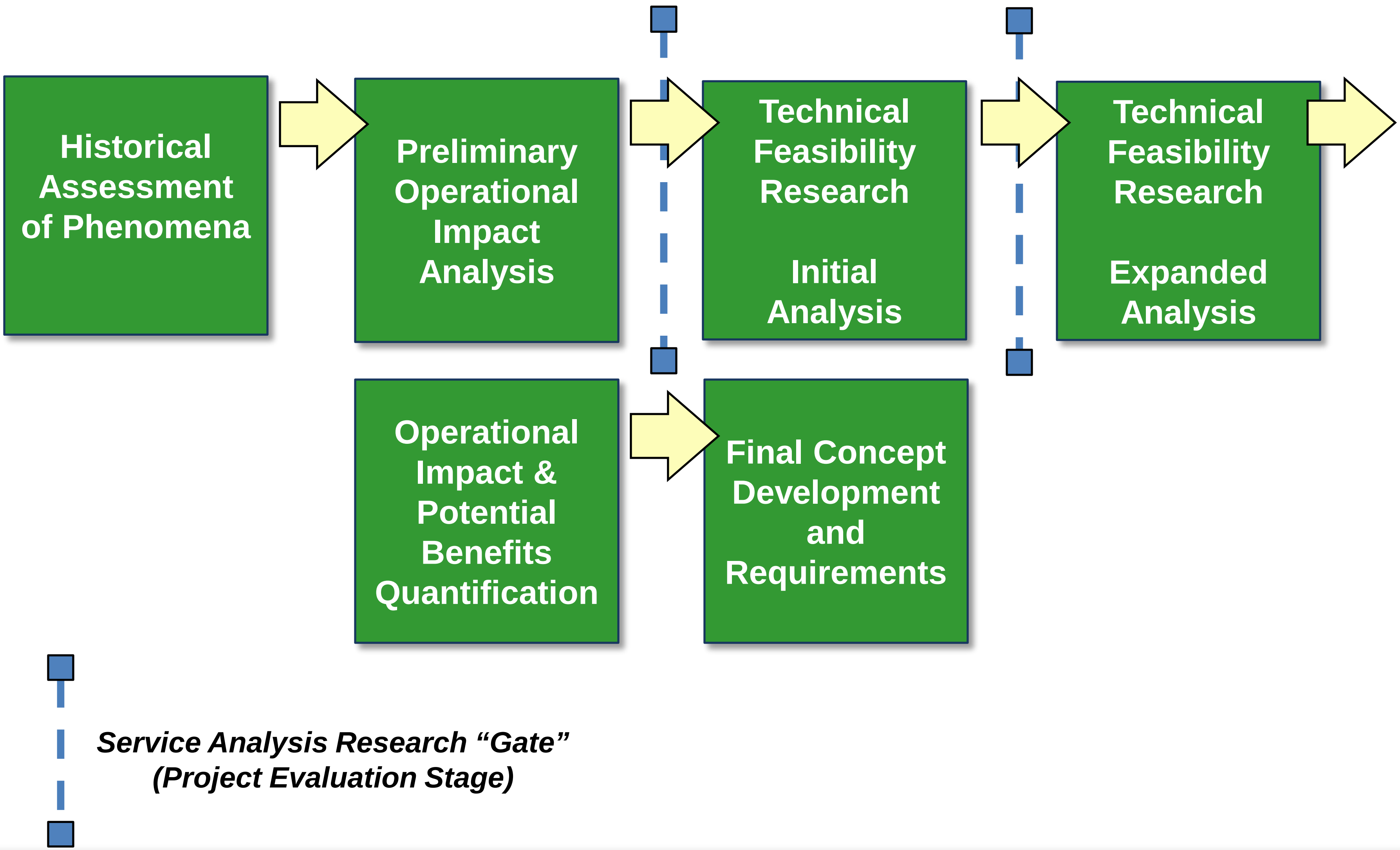
Outline

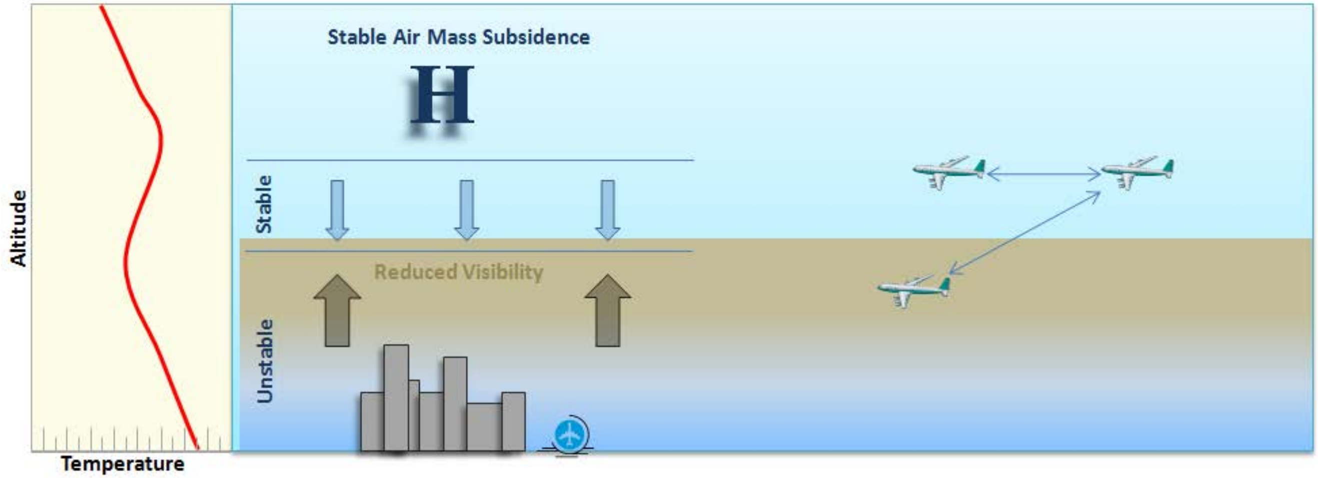
- Weather Service Analysis Research Road Map
- Weather Service Analysis - Haze
- Weather Service Analysis – Terminal Convection Time Of Wind Return (TOWR)
- Summary

Weather Service Analysis Research Road Map

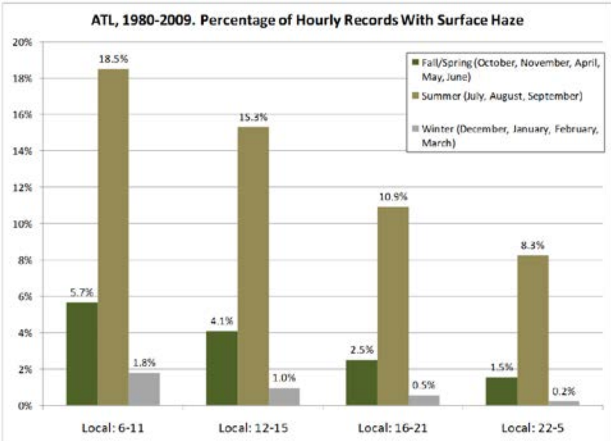


Haze Service Analysis Background

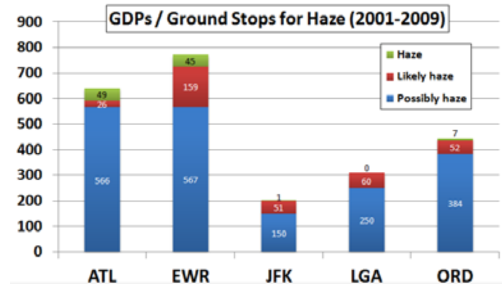
- Visibility through a haze layer – especially at shallow angles (slant range), often reduces normal visibility (7-10SM) to less than 3SM.
- Aircrafts penetrating through this layer would have difficulty seeing the runway or the airplane in front of them resulting in an Instrument Landing System (ILS) approach.
  - Aircrafts must increase spacing from ~3M to 4-6M for IFR conditions *(JO 7110.65T, Section 5-5-4)*
  - Resulting separation reduces capacity and may impact NAS operations
  - Airports with E/W runway configurations are more susceptible due to sun angle refraction, however this is not always the case (CLT as example for final approach turns)

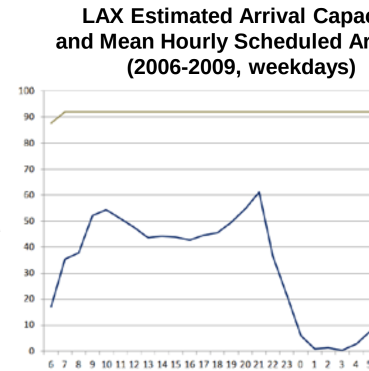


Haze Service Analysis Results

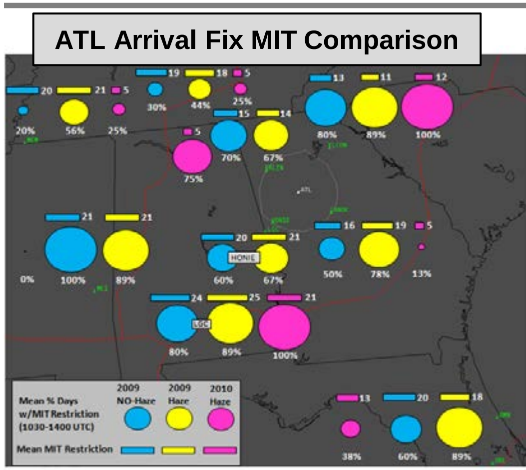


Haze is a frequently occurring phenomena at many Core NAS airports





Several airports issue TMIs for haze, but often due to haze aloft (not at surface - difficult to observe); Other airports (LAX) can often handle haze-related capacity constraint



Previously significant haze impact at ATL "vanished" in 2010 (TBFM / TMA changes, airline schedule "de-peaking")

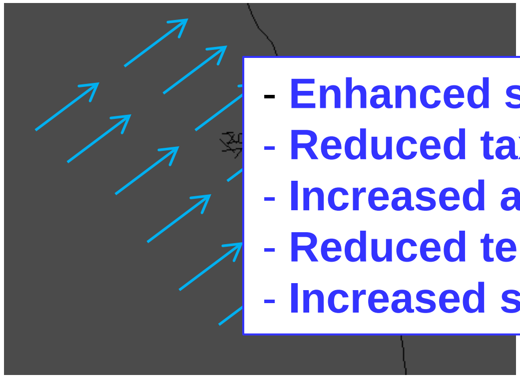
Summary of Service Analysis Results

- Surface haze is frequent weather phenomena at many core airports - but most manage capacity constraint with minor impacts
- At airports where haze impacts more significant (e.g., EWR), concern is "haze aloft" – difficult to observe and predict
- Haze impacts at ATL (airport where users noted "haze issues") currently masked by schedule / operations changes
- Haze Service Analysis – halted and tabled after Phase 1
  - Phase 1 report documents all haze service analysis findings

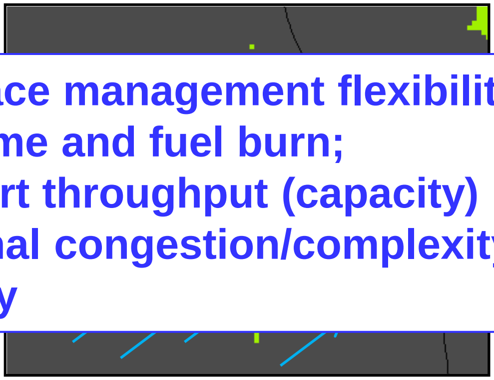
TOWR: Time Of Wind Return in Airport Terminals

- Critical need to know when synoptic wind regime will become re-established (“return”) after transient, storm-induced wind-shift subsides
  - Need for proactive surface management often highest during these impact events
  - One of today’s solution: Asking nearby Towers “Have your winds returned yet?”

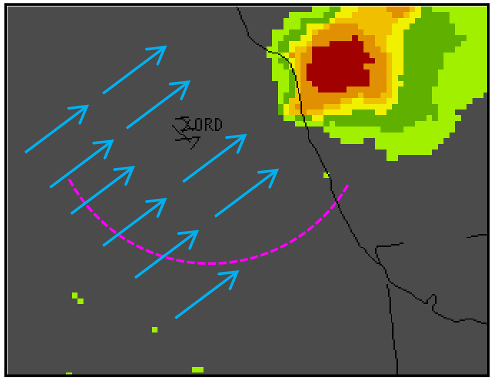
Synoptic Wind Direction



Storm Impact – Winds Shift



When Will Wind Return?



- Enhanced surface management flexibility
- Reduced taxi time and fuel burn;
- Increased airport throughput (capacity)
- Reduced terminal congestion/complexity
- Increased safety

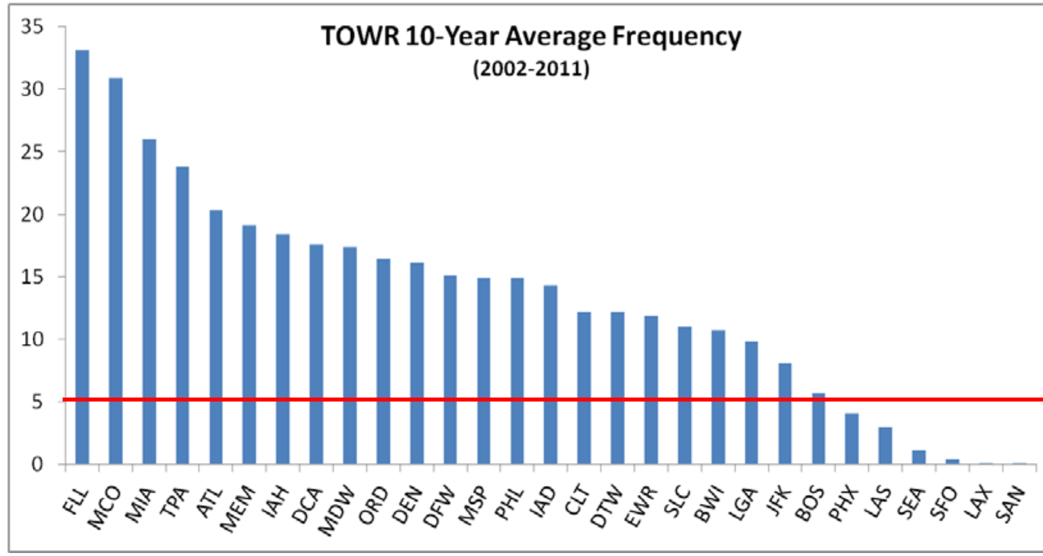
Preferred Configuration

Reconfigure to Non-Preferred

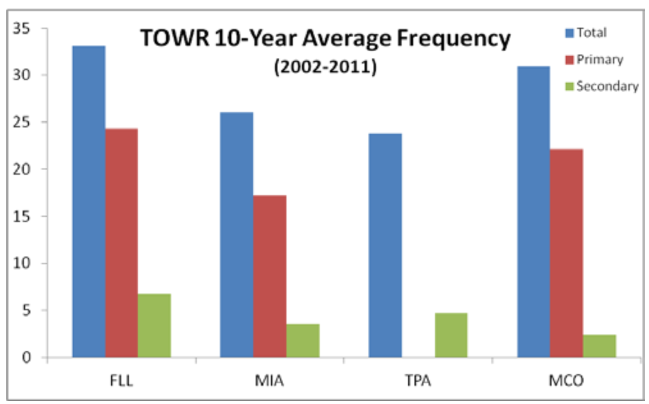
When to Reconfigure to Preferred?

TOWR Events at Core-29 Airports (2002-2011)

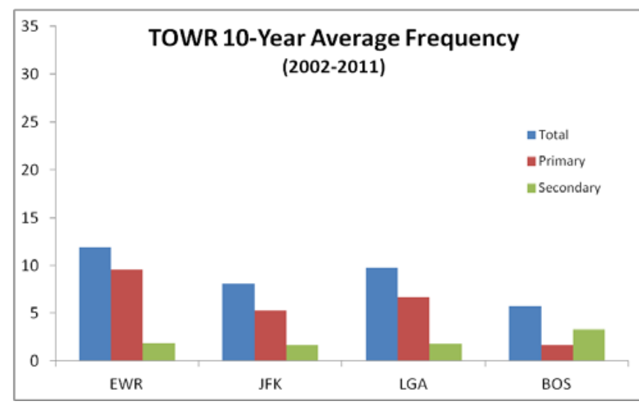
	TS with TOWR	WS with TOWR
ATL	38%	69%
BOS	35%	66%
BWI	29%	70%
CLT	33%	74%
DCA	43%	70%
DEN	34%	57%
DFW	40%	68%
DTW	35%	69%
EWR	40%	71%
FLL	46%	78%
IAD	39%	78%
IAH	37%	70%
JFK	32%	60%
LGA	36%	69%
MCO	38%	73%
MDW	38%	75%
MEM	35%	66%
MIA	41%	74%
MSP	36%	66%
ORD	36%	72%
PHL	42%	70%
SLC	40%	64%
TPA	42%	75%
LAS	29%	57%
LAX	25%	50%
PHX	42%	62%
SAN	10%	33%
SEA	32%	73%
SFO	50%	100%



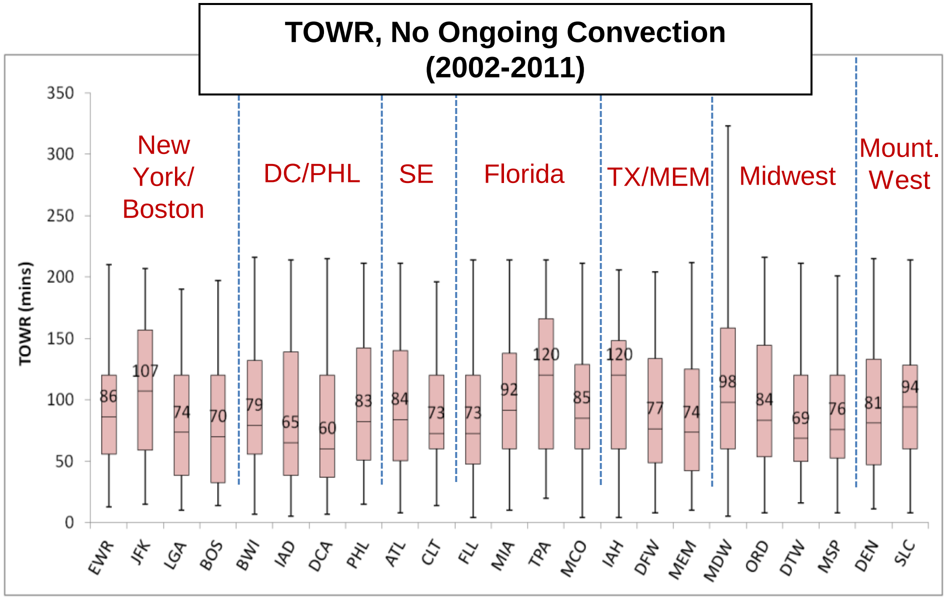
Florida

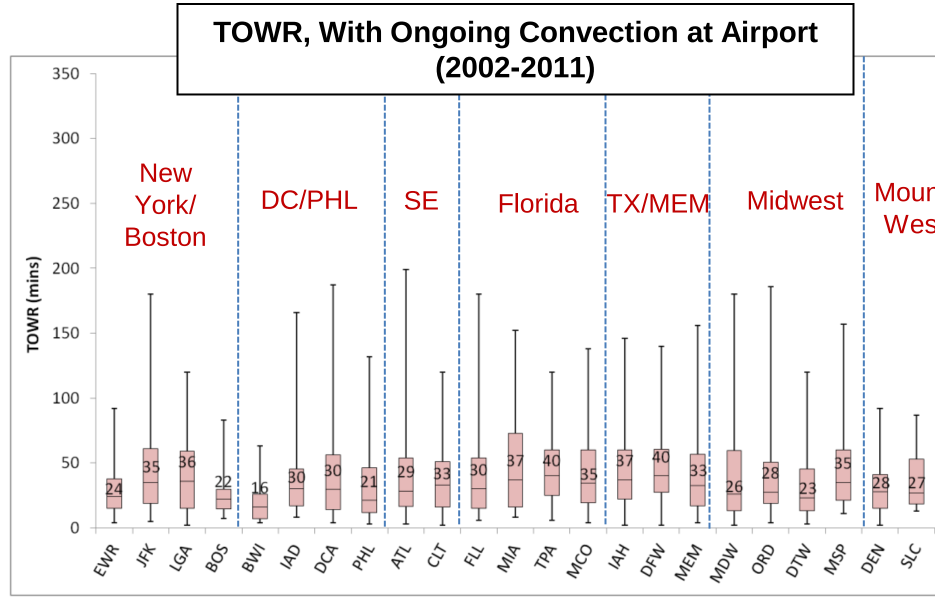


New York/Boston



Time Of Wind Return (TOWR) – 2002-2011



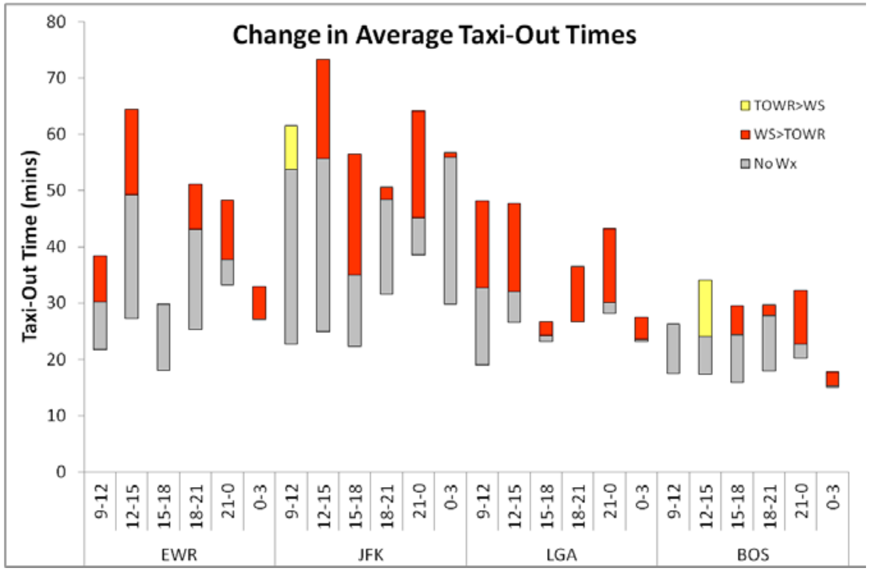


- Moderate similarity in TOWR length among airports in each region
  - JFK, IAH, TPA interesting outliers

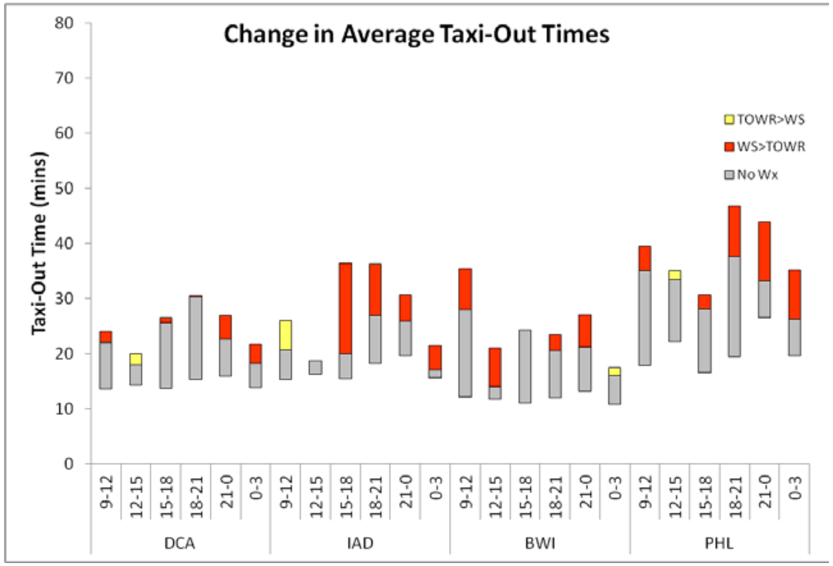
- Separating TOWR that occurs with / without ongoing airport convection isolates “operational opportunities” and increases value of results

TOWR Taxi-Out Impacts, Potential Benefits Pool
(NYC/BOS & DC/PHL Example)

New York/Boston



Washington DC/Philadelphia



- Largest WS and TOWR impacts associated with convection at New York airports
  - Mostly between 9-15Z, extending most of the day at JFK
  - Occurs during peak departure demand period
- TOWR (‘back-end’) impacts greater than WS (‘front end’) impacts at one point during the day at most Northeast airports
  - Between 9-15 Z at majority of airports, also during peak departure demand time
  - Between 00-03Z at BWI

TOWR 'Back-End Impact' Potential Improvement

- Airports ranked by combined TOWR event frequency and "size" of taxi-out impact
  - Does not take into account other potential impacts / potential benefits associated with runway reconfigurations, taxi-in times and arrival operations, etc.
  - Includes both avoidable and unavoidable impact, so only ROM estimate for potential improvement

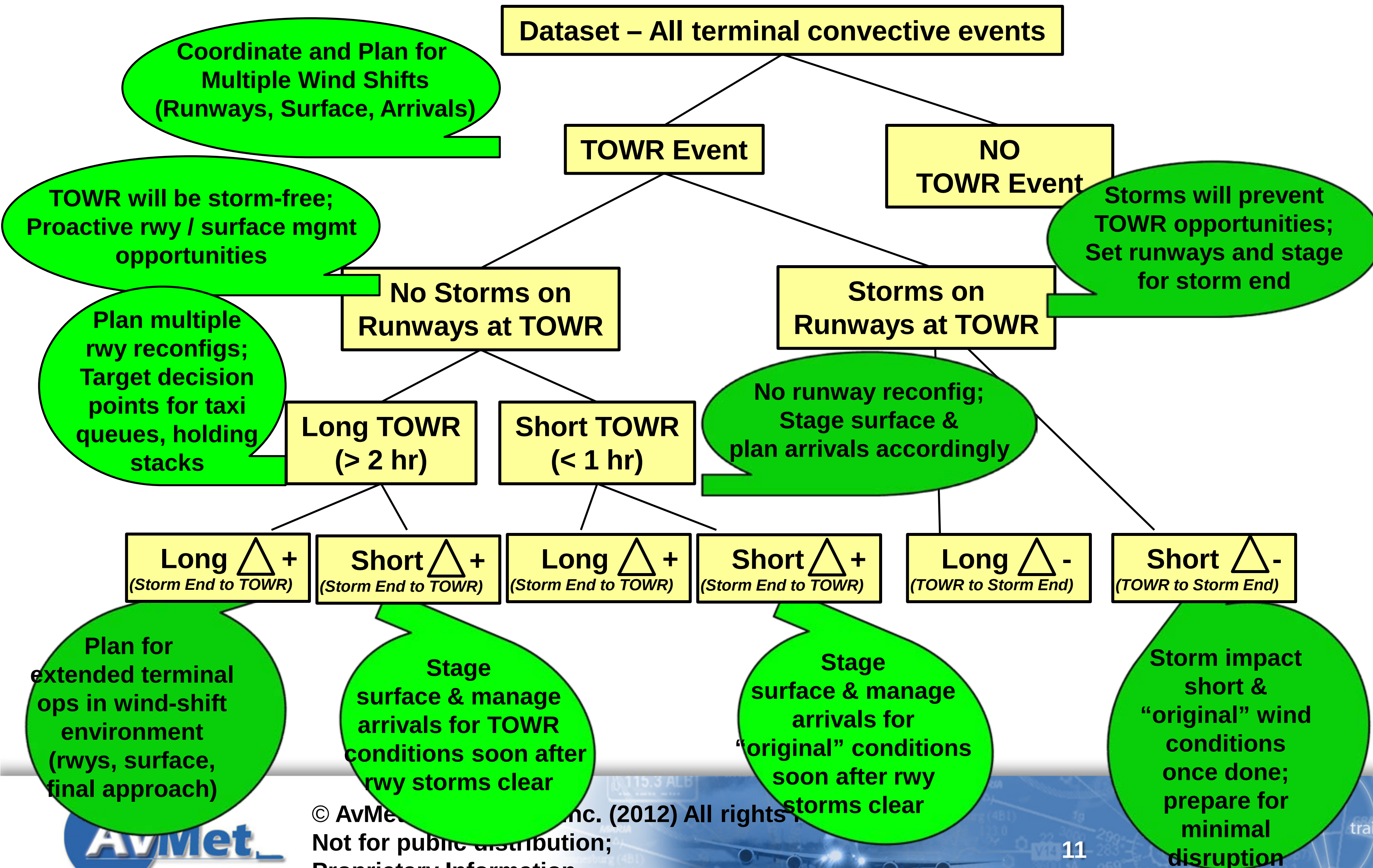
- Rankings change when individual components combined
  - Florida airports have top 4 most TOWR events annually, rank low for TOWR taxi-out impacts per aircraft

- **Airports ranking highest for annual TOWR impact: ORD, PHL, JFK, IAH, DCA**

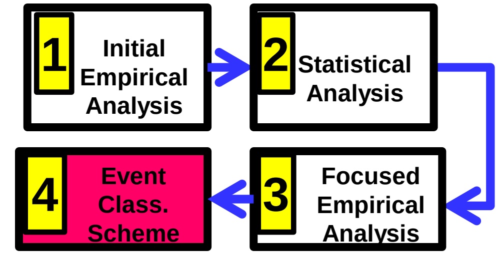
	FLL	MCO	MIA	TPA	DFW	MEM	IAH	MDW	ORD	MSP	DTW	PHL	DCA	IAD	BWI	ATL	CLT	SLC	DEN	LGA	JFK	EWR	BOS
Annual Average TOWR Events (A)	33	31	26	24	15	19	18	17	16	15	12	15	18	14	11	20	12	11	16	10	8	12	6
Avg. TOWR Taxi-Out Impact per Aircraft (B)	4	4	3	3	8	2	9	7	12	6	6	12	9	6	9	7	5	2	6	4	22	11	8
Annual TOWR Taxi-Out Impact per Aircraft (C = A x B)	132	124	78	72	120	38	162	119	192	90	72	180	162	84	99	140	60	22	96	40	176	132	48
Annual TOWR Event Rank (A)	1	2	3	4	12	6	7	9	10	13	16	13	8	15	20	5	16	19	11	21	22	18	23
Avg. TOWR Taxi-Out Impact per Aircraft Rank (B)	17	18	20	21	8	22	6	11	2	13	14	3	7	15	5	10	16	23	12	19	1	4	9
Annual TOWR Taxi-Out Impact Rank (C)	7	9	16	17	10	22	4	11	1	14	17	2	4	15	12	6	19	23	13	21	3	7	20

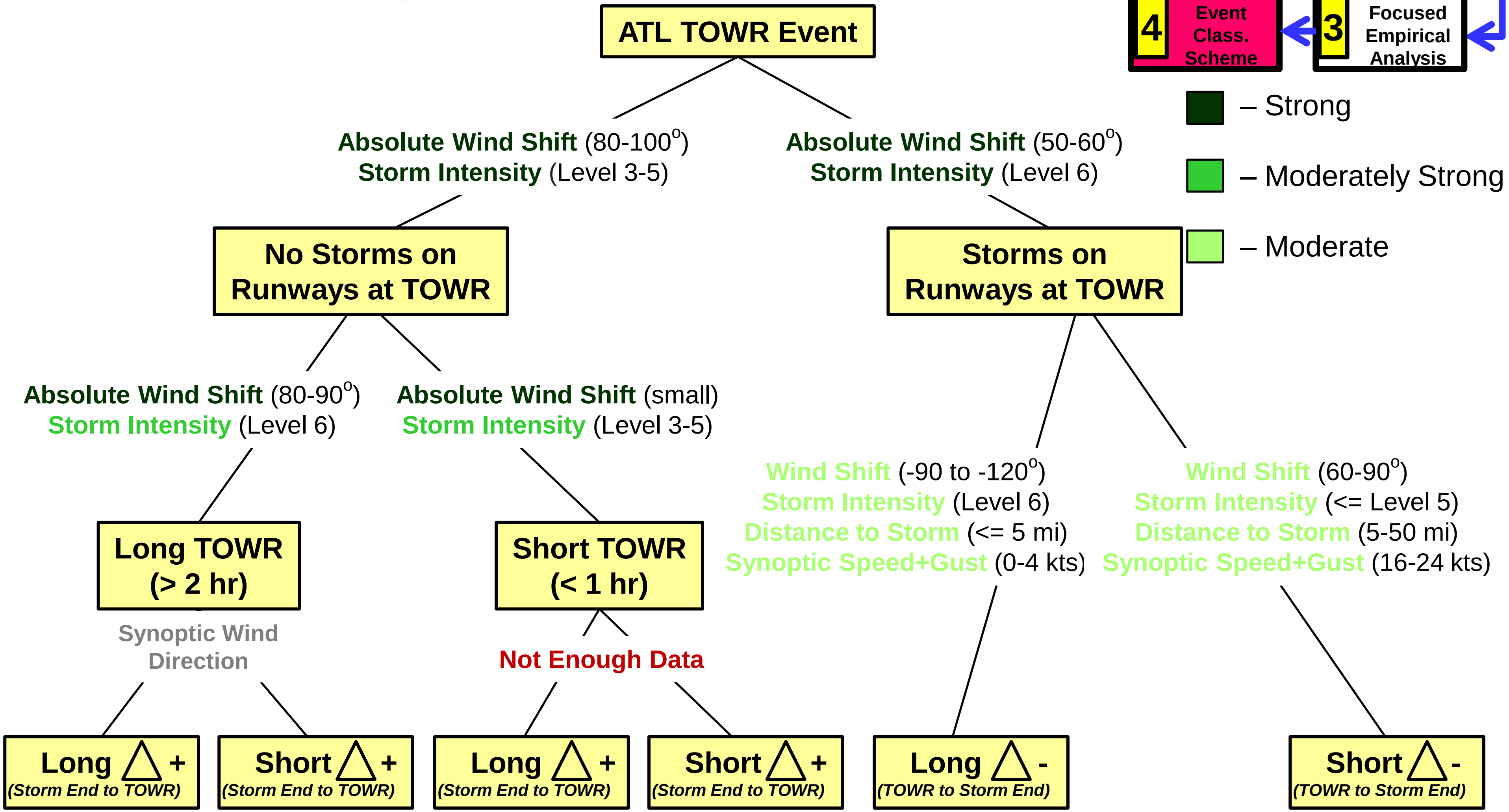
TOWR Event Classification Tree Diagram

Seeking Operationally-Relevant TOWR Predictions



Preliminary TOWR Event Classification Scheme: ATL *(Precursor to Predictor)*





Summary

- TOWR events pervasive among most Core-29 airports
  - Most wind shift events have an associated wind return across all airports

- Initial analysis of TOWR impacts / benefits pool for departure operations demonstrates need and potential applications of TOWR predictor
  - Largest avg per aircraft TOWR taxi-out delay per day: JFK (22 min)
  - Top-5 airports with highest TOWR annual taxi-out delay benefits pool:
    (1) ORD, (2) PHL, (3) JFK, (4) IAH, (5) DCA

- Technically feasible to create preliminary TOWR classification scheme (precursor to TOWR predictor)
  - Event classification tree developed in context of operational needs
  - Statistical model identifies most important classifiers
  - Adding more data to refine thresholds and "touch on all branches of the tree"
  - Examining numerical forecast data, additional sensor data, etc.

- Work continues on developing / testing initial TOWR predictor & evaluating opportunities / benefits for current ops and NextGen OI's and DSTs under development

Tower Flight Data Manager