FPAW – Weather Forecast Performance Requirements Validation

- 25 August 2015
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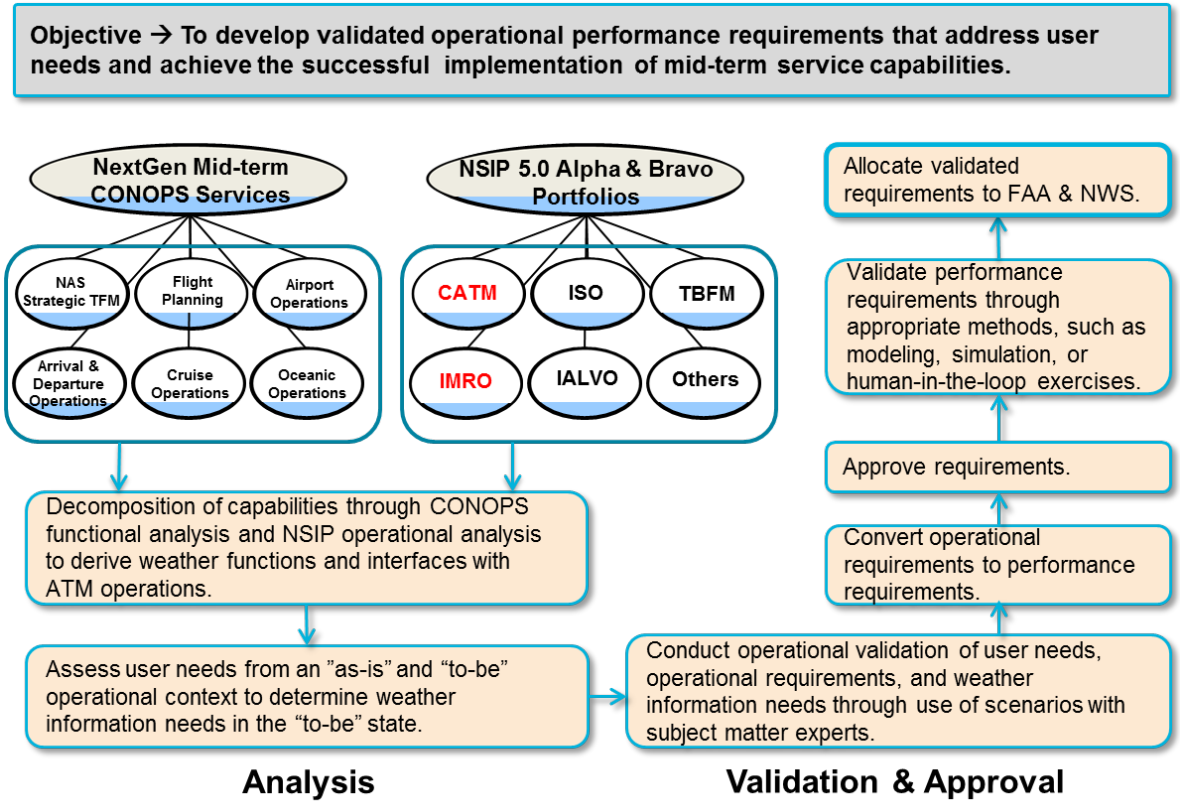
Purpose of Performance Requirements Development[1,2]

- The FAA established a goal to develop firm mid-term performance requirements for enhanced weather information based on key NextGen artifacts.
- Cooperation between FAA-NWS through the TFM Requirements Working Group (TRWG) to develop services out to NextGen MOC.
- This activity will result in the development analytically verified weather forecast performance requirements.



[1] FAA, NAS Lifecycle Planning (NLP) Project Level Agreement (PLA) Systems Development – New ATM Requirements – Weather Transition Fiscal Year 2013.
[2] MITRE CAASD, "Results from the Operational Weather Needs Analysis (OWNA) of Weather Dependent Increments for the NAS Segment Implementation Plan (NSIP) Version 5.0," June 2015.

Preliminary Weather Performance Parameters from Functional Analysis[3]

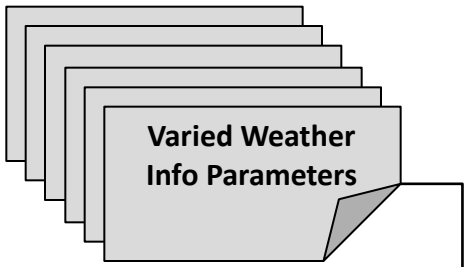
- 102 preliminary weather forecast requirements based off the Mid-Term CONOPS and NSIP, then fleshed out by TRWG.
- Preliminary performance requirements cover onset and cessation of forecasts with look-ahead times of 1-, 2-, 4-, and 8-hours for Convection, Ceiling and Visibility, and Surface Winds.
- Analyze the performance requirements through a lens of CATM operational decisions (i.e., TMIs and responses).

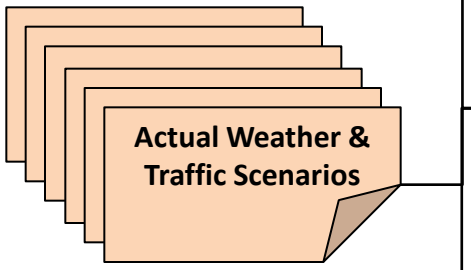
Weather Phenomenon	Location Accuracy	Timing Accuracy	Probability of Detection	False Alarm Ratio
Terminal Convection	✓	✓	✓	✓
En route Convection	✓	✓	✓	✓
Airport C&V		✓	✓	✓
Airport Surface Winds		✓	✓	✓

[3] Heuwinkel, Richard, "Statement of Preliminary Functional Requirements for Weather Information to Support Traffic Management Initiatives," March 2014.

Approach to Deriving/Validating Weather Performance Requirements (Notional Workflow)

Scenario Development → **Simulation and Modeling** → **Analysis of Results** → **Weather Performance Requirements**





Weather and NAS Simulators –

- **Low-fi response models & math models**
- **AvMet and DART (i.e., TFM fidelity)**
- **ANG-C41 and AirTOp (i.e., ATC fidelity)**

NEXTGEN KEY PERFORMANCE INDICATOR AREAS	METRIC
Capacity	Daily Capacity
City Pair	Airborne Time
	Effective Gate-to-Gate
Efficiency	Gate Arrival Delay
	Taxi-In Time
	Taxi-Out Time
Environment	Fuel Burn

OTHER PERFORMANCE INDICATOR AREAS	METRIC
Airline Schedule	Cancellations
	Diversions
Efficiency	Pre-Departure Delay
	Total Departure Delay
	Arrival Delay
	Distance Flown
Airline Flexibility	Substitution Opportunities
Traffic Management Stability	Airport Program (GDP/GS) Re-planning
	Number of Route Availability Changes

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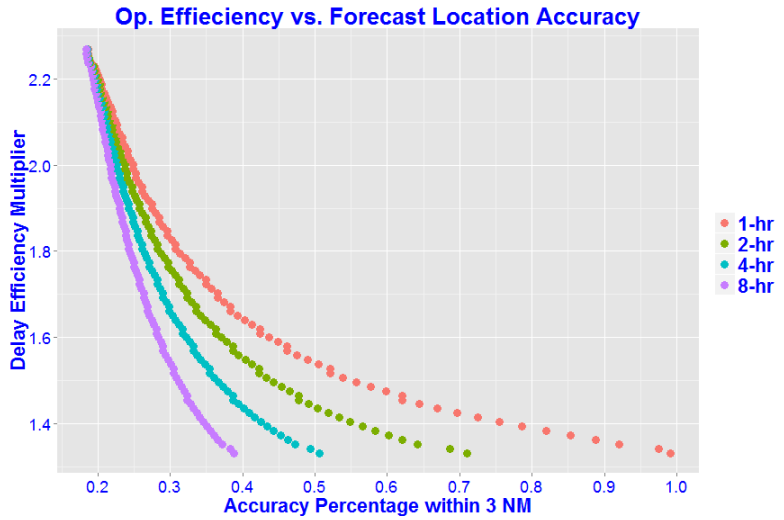
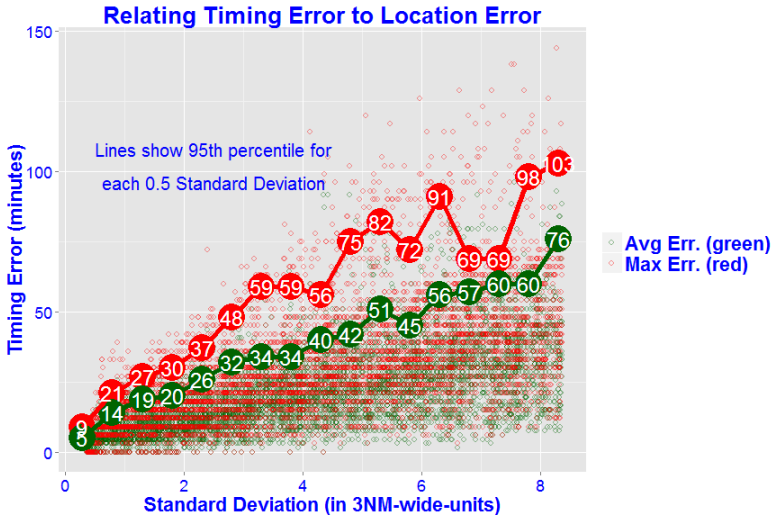
NextGEN

Targeted Outcomes

- Locating an appropriate level of fidelity for each weather scenario/operational efficiency.
  - Must acknowledge dependencies among forecast look-ahead times.
  - Incremental planning is a factor.
  - System that honors previous decisions.



- Must ensure that performance requirements are synchronized.
  - For instance, within the terminal airspace a moving weather system's location error and timing error are related.



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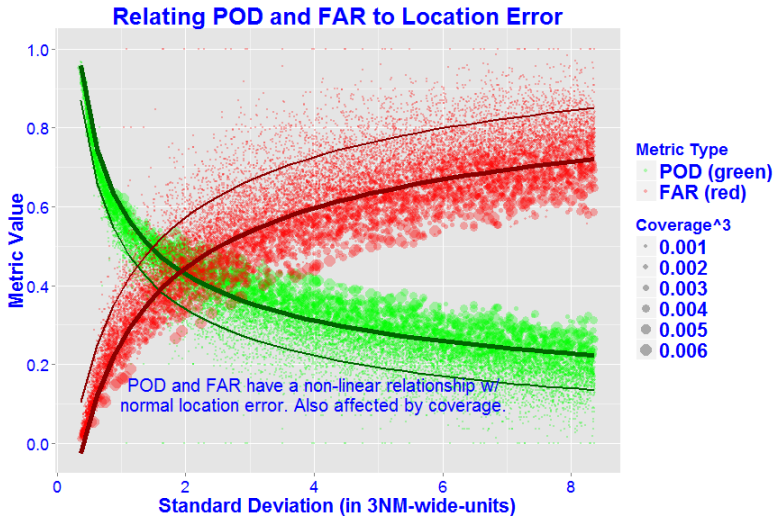
Targeted Outcomes

- Understand the relationship between metric definitions (i.e., location error) and established metrics (i.e., POD and FAR).
  - Acknowledge relationships between POD/FAR and the definition of location/timing accuracy.
  - Related to weather coverage.



- Design a set of synchronized requirements for each of the weather phenomenon. Requirements include
  - Location and timing error tolerances.
  - Target POD and FAR values.
  - Cast with the appropriate level of fidelity for the CATM WP4 operating environment.

Acc. w/ 3 NM	POD Range	FAR Range	Timing Error
1.00	0.91 - 0.96	0.05 - 0.10	6
0.99	0.76 - 0.81	0.15 - 0.20	8
0.98	0.66 - 0.71	0.22 - 0.27	9
0.96	0.59 - 0.64	0.28 - 0.33	11
0.91	0.54 - 0.60	0.33 - 0.39	12
0.86	0.50 - 0.56	0.38 - 0.44	13
0.81	0.47 - 0.54	0.41 - 0.48	15
0.76	0.44 - 0.51	0.44 - 0.51	16
0.71	0.42 - 0.50	0.47 - 0.55	18
0.67	0.40 - 0.48	0.49 - 0.57	19
0.63	0.38 - 0.47	0.51 - 0.60	20
0.6	0.37 - 0.46	0.53 - 0.62	22
0.57	0.35 - 0.44	0.55 - 0.64	23
0.54	0.34 - 0.44	0.56 - 0.66	25
…	…	…	…

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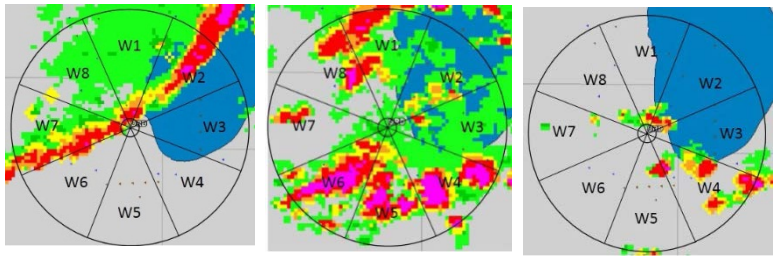
Current status: Generating and Mining Simulated Data

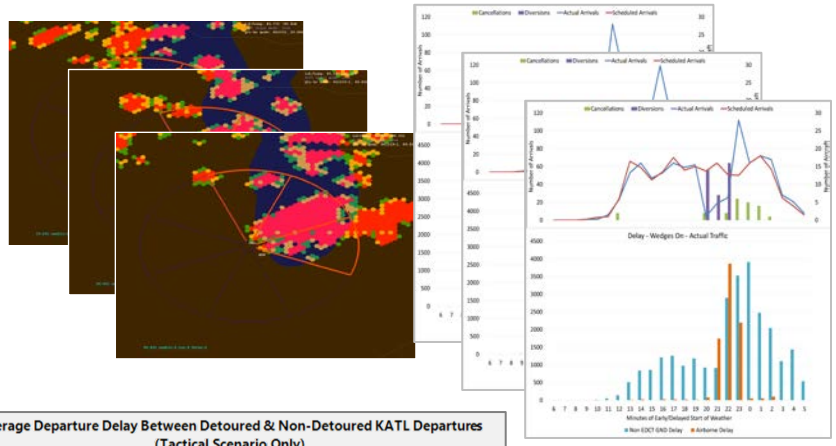
- AvMet developed ~200 scenarios covering CATM operations addressing
  - Terminal convection,
  - En route convection,
  - Airport Ceiling & Visibility,
  - Surface Winds

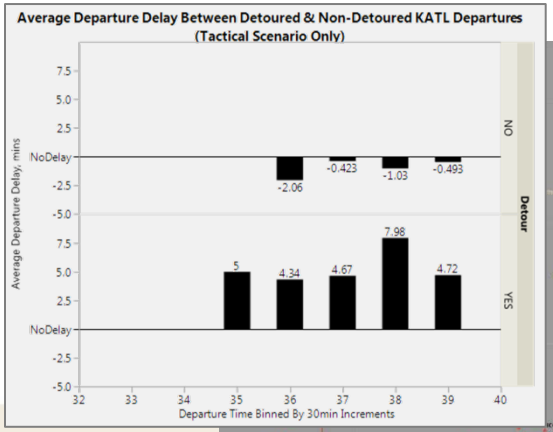
- AvMet simulating all weather scenarios with DART

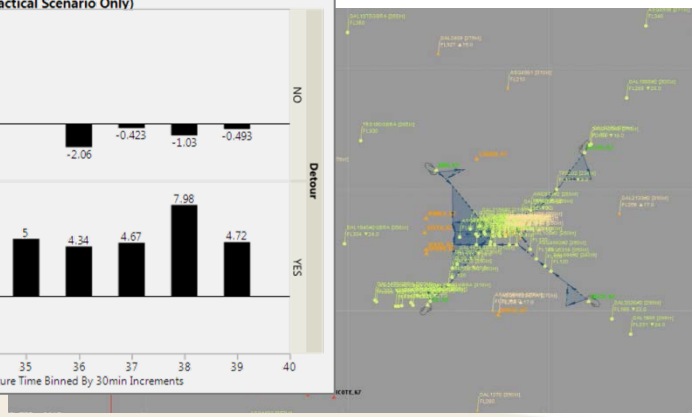
- ANG-C41 simulating scenarios with AirTOp covering terminal convection at ATL.

- Preliminary results were delivered at the end of July 2015.

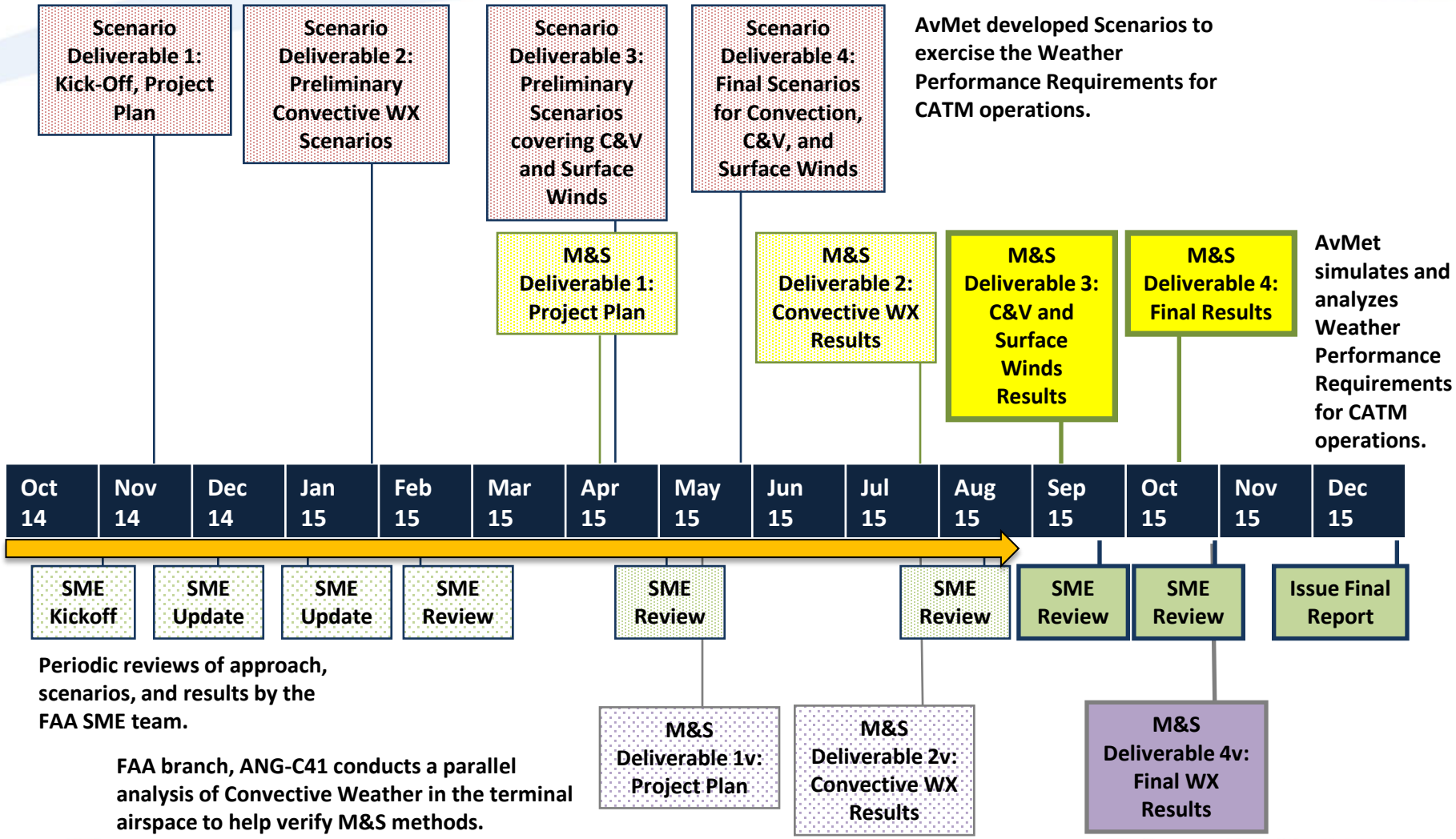








Schedule



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NextGEN