

Friends and Partners in Aviation Weather (FPAW)

Weather Technology in the Cockpit (WTIC) – Enhancing Efficiency



NextGEN

**Gary Pokodner, WTIC
Program Manager**

October 23, 2014

Weather Technology in the Cockpit (WTIC)

Program Description

- Research projects to develop, verify, and validate requirements for incorporation into Minimum Weather Service (MinWxSvc) standards
 - FAR Part 121, OPERATING REQUIREMENTS: DOMESTIC, FLAG, AND SUPPLEMENTAL OPERATIONS (i.e. commercial operations)
 - FAR Part 135, OPERATING REQUIREMENTS: COMMUTER AND ON DEMAND OPERATIONS AND RULES GOVERNING PERSONS ON BOARD SUCH AIRCRAFT (i.e. commuter, on demand, and air taxi operations)
 - FAR Part 91, GENERAL OPERATING AND FLIGHT RULES (includes General Aviation operations)
- **The MinWxSvc is defined as:**
 - Minimum cockpit meteorological (MET) information
 - Minimum performance standards (e.g. accuracy) of the MET information
 - Minimum information rendering standards



FAA

Next**GEN**

WTIC Program Benefit Objectives

- Enhance General Aviation (GA) safety by identifying and resolving risks before they become accidents
- Enable safe implementation of NextGen Operational Improvements (OIs) and advanced concepts (i.e. Interval Management)
- ***Resolve operational (current and NextGen) inefficiencies attributable to gaps in cockpit MET information***
- Enhance pilot MET-training to enable effective and consistent adverse weather decision-making

Efficiency Shortfalls - Candidates

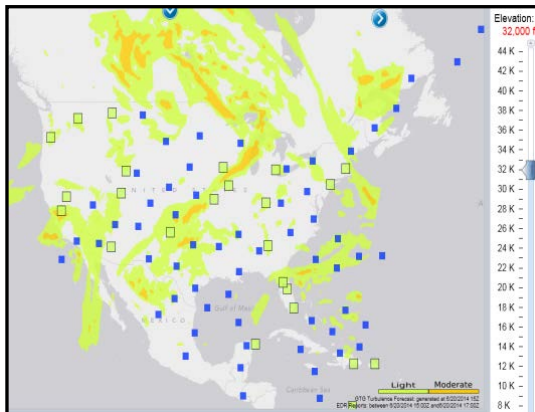
- **Examples of efficiency shortfalls identified in the WTIC Concept of Operations (ConOps):**
 - ✦ Lack of strategic weather information in cockpits leads to reactive decision making and unpredictability in the NAS
 - ✦ Lack of MET information (i.e. enhanced winds) to support trajectory based operations (TBO)
 - ✦ Excessive workload and voice communications due to pilot reports
 - ✦ Collaborative Airspace Constraint Resolution (CACR) program envisioned to end before aircraft takeoff could extend to airborne with enhanced MET information in the cockpit
 - ✦ Ground time to plan next flight could be reduced with in-flight graphical weather
 - ✦ Part 135 aircraft able to negotiate more favorable departure routes with enhanced weather information versus just forward looking radar



EDDY DISSIPATION RATE UPLINK DEMONSTRATION

WTIC – Eddy Dissipation Rate (EDR) Update

- Completed operational demonstration with Delta Airlines on cockpit display of EDR and Graphical Turbulence Guidance (GTG)
- Benefits assessment post demo – Benefits to aircraft and NAS to be assessed
- Developing technical transfer package



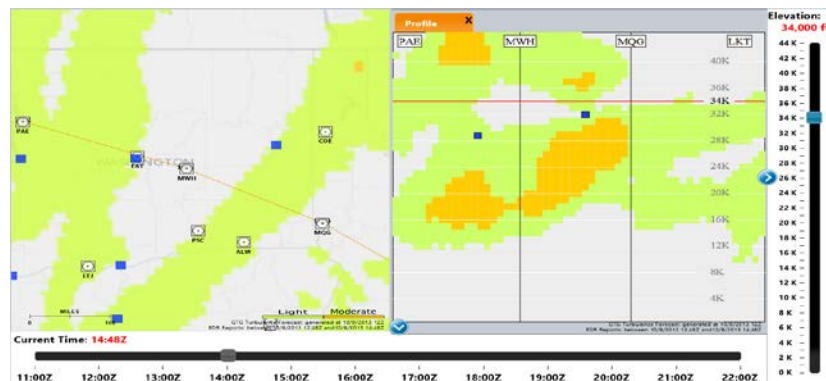
Picture of EDR viewer presentation

WTIC – Demonstration Drivers

- Safety
- Customer Experience
- Capacity = Delays
- **Efficiency/Emissions**
 - ✦ Inefficiencies due to turbulence include:
 - Unwarranted altitude change requests
 - Excessive fuel burn (emissions) due to flight at non-optimum altitude
 - Excessive air space/altitude avoidance reducing capacity

WTIC – EDR/GTG Demo Preliminary Results

- Safety – Enhanced turbulence awareness based on pilot feedback
- Customer Experience – Enhanced due to more accurate turbulence status (cabin management)
- Capacity – Significant improvements indicated due to less airspace avoidance
- Efficiency/Emissions – Preliminary results show fewer altitude changes and less radio communications



EDR viewer showing route and cross section of turbulence



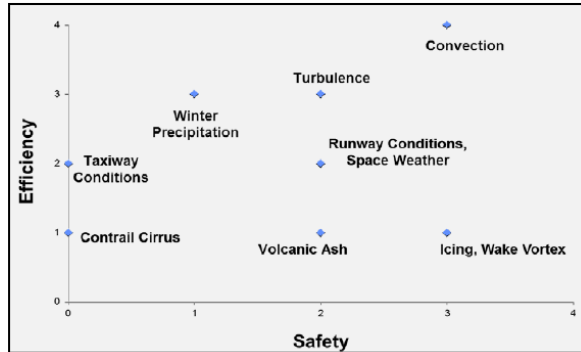


ADVERSE WEATHER ALERTING

MET Condition Prioritization

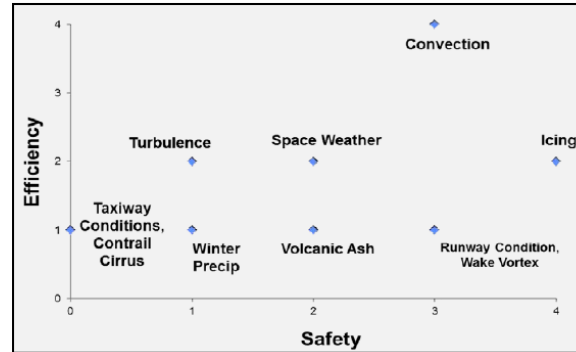
Part 121

	Frequency	Safety	Efficiency	Total
Convection	3	3	4	10
Turbulence	4	2	3	9
Winter Precipitation	3	1	3	7
Runway Conditions	2	2	2	6
Wake Vortex	2	3	1	6
Icing	2	3	1	6
Volcanic Ash	1	2	1	4
Taxiway Conditions	2	0	2	4
Space Weather	0	2	2	4
Contrail Cirrus	2	0	1	3



Part 91(k)/135

	Frequency	Safety	Efficiency	Total
Icing	2	4	2	8
Convection	1	3	4	8
Runway Conditions	3	3	1	7
Wake Vortex	2	3	1	6
Turbulence	2	1	2	5
Winter Precipitation	3	1	1	5
Space Weather	0	2	2	4
Volcanic Ash	1	2	1	4
Taxiway Conditions	2	0	1	3
Contrail Cirrus	2	0	1	3



Charts show preliminary WTIC priority ranking, by aircraft type, for developing an alerting function to potentially reduce the safety and efficiency impacts of various adverse weather conditions

Near Real Time Turbulence Alerting Function

- Provide near real time notification of impending turbulence encounter
- Alerting function primarily to assist with crew/cabin management
- Primarily addressing safety risks
- Plan to perform demonstration using NCAR's NEXRAD Turbulence Detection Algorithm (NTDA)

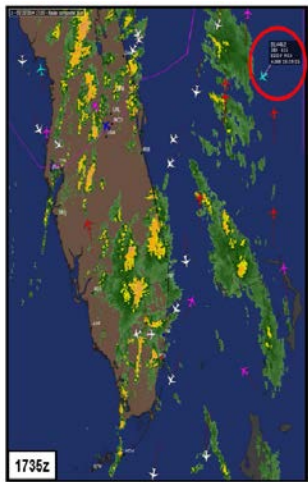
Potential Efficiency Benefits - NTDA

- **Decision support for en-route aircraft**
 - ✦ Improve situational awareness, airspace utilization, and safety.
 - ✦ May help obviate the need for “pathfinder” aircraft after airspace closures
- **Measurements may be assimilated into turbulence nowcasts**
- **May be used as verification “truth” data for turbulence forecasts**

NTDA Alerting - Challenges

- **Turbulence conditions change rapidly and too workload intensive to monitor radar information**
 - ✦ **Alerting may enable early notification resulting in reduced workload**
 - ✦ **Alert calculations, data linking, and rendering must not introduce significant latency**
 - ✦ **Alert lead time must be sufficient to allow for crew management and actions**
 - ✦ **False alarm rate must be low**

Alert Use Case Candidate – Convection Alert to Supplement Arrival Planning



Flight to MIA



Divert to MCO



Thunderstorms
at MCO



Thunderstorms
at FLL



Arrival at MIA
with low fuel

Figures show Use Case based on real scenario of multiple diversions resulting from convection. Candidate convection alerting function may enable enhanced in-flight arrival planning.

Alert Candidate – Convective Weather

Graphic below shows a potential architecture for convective weather alerting function based on the convection Use Case

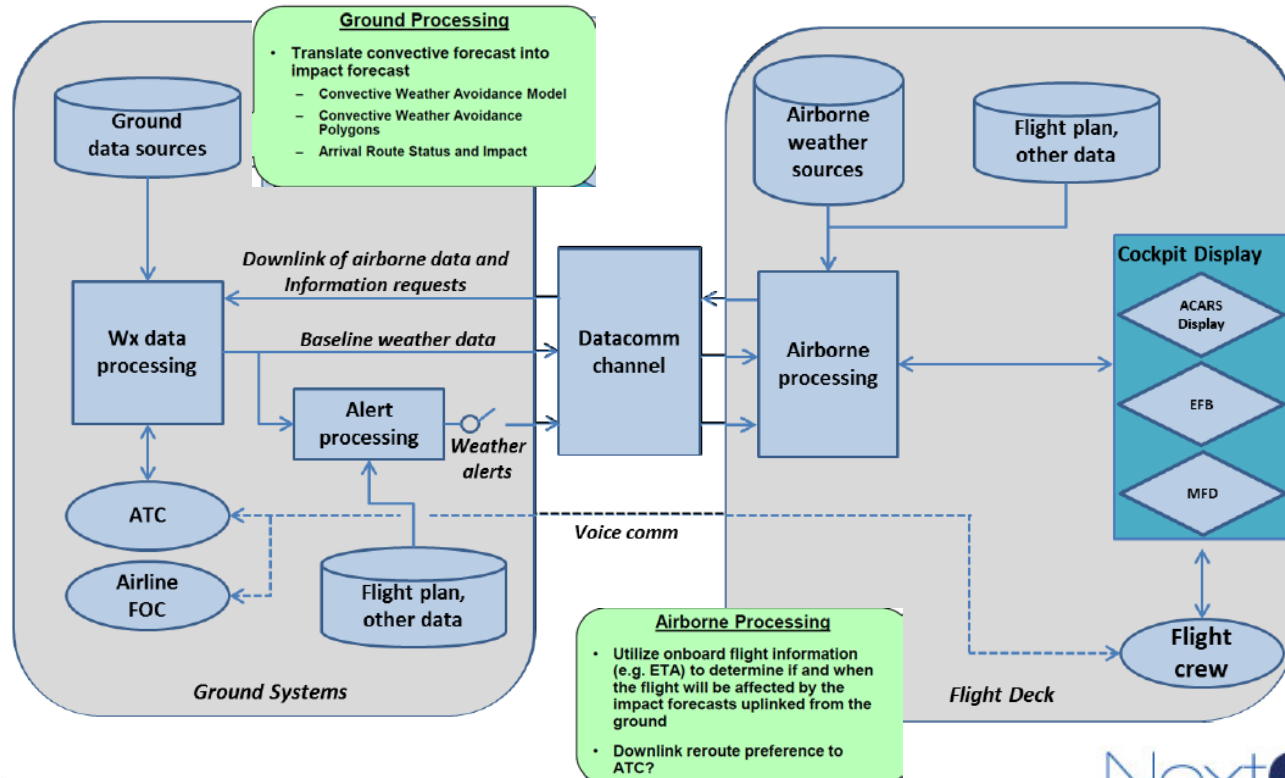
Domain: Terminal or En Route

Mode: Contract

MET Info: NWP or CIWS

Service: WNDS or WPDS

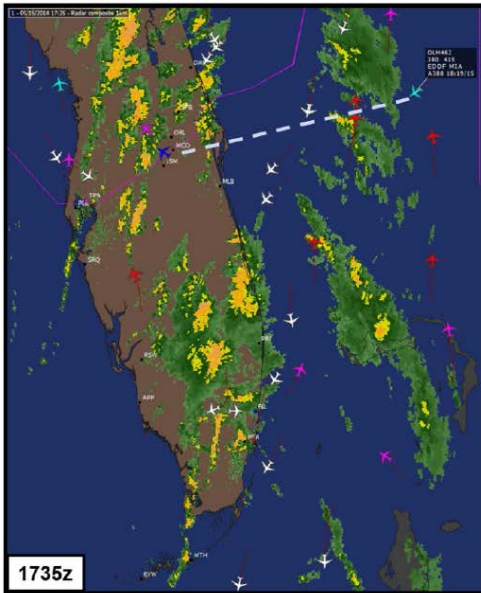
Data Flow: Uplink/Downlink



Alert Candidate – Convective Weather Weather Alert Enabled Decisions

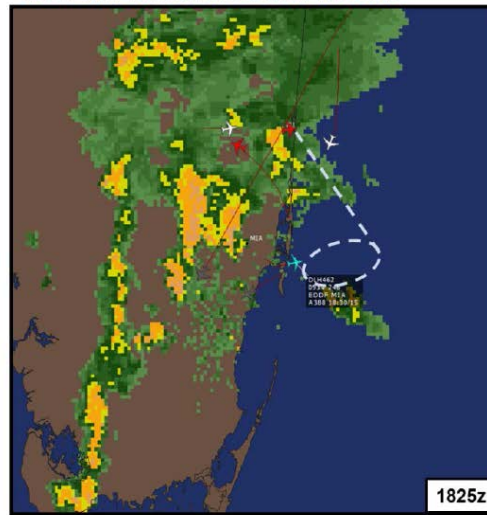
Benefit – less diversions
and unpredictability

Proactive Diversion



OR

Hold and Choose the Best Alternate



ALERT CHALLENGES

- Trade off between detection and false Alarms
- Low latency
- Supports collaborative decision-making



Next**GEN**

CROWD SOURCING AND CLOUD COMPUTING

Cloud Computing and Crowd Sourcing

- **DEFINITIONS**

- ✦ **Crowd Sourcing – The practice of obtaining needed services, ideas, or information from a large group/source, typically via the internet, versus traditional suppliers**
- ✦ **Cloud Computing – The practice of using a network of remote servers hosted on the internet to store, manage, and process data versus a local server or PC**



FAA

Next**GEN**

Cloud Computing– Potential Efficiency Gains

- Enhanced access and dissemination of weather information
- Ability to quickly enhance crowd sourced weather information
- Reduced workloads resulting from cloud processing, trending, image processing, etc



WTIC Cloud Computing and Crowd Sourcing Service Analysis

- Attempt to develop one concept to illustrate benefits of cloud computing and crowd sourcing weather information
 - ✦ Determine metrics to assess benefits
 - ✦ Assess whether data can be readily obtained at low cost and minimal equipage/new technologies
 - ✦ Assess potential benefits of by algorithmic processing and trending
 - ✦ Estimate necessary memory and computing power
- Determine if trial implementation of storing, enhancing, and displaying Alaska weather cam images/video in the aircraft can demonstrate potential benefits



CONTACT INFORMATION

GARY POKODNER, WTIC PROGRAM MANAGER

202-267-2786