

Weather-Technology-in-the-Cockpit (WTIC) General Aviation (GA) Research Activities Overview

Next **GEN**

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FAA

Presentation Outline

- WTIC Overview
- WTIC General Aviation Research Tasks
- Overview of Research Projects
- WTIC Outreach Partners
- WTIC Gap Tracking



Weather Technology in the Cockpit (WTIC) Program

- Portfolio of research projects to develop, verify, and validate recommendations to the WTIC Minimum Weather Service (MinWxSvc)
- MinWxSvc is defined as:
 - Minimum cockpit meteorological (MET) information
 - Minimum performance standards/characteristics of the MET information
 - Minimum information rendering standards
 - Enhanced MET training

WTIC is not building cockpit applications or avionics so outreach to industry is necessary for implementing MinWxSvc(s).



WTIC General Aviation (GA) Research Tasks

- Identify MET information gaps and operational shortfalls that have been shown or have the potential to be causal factors in future GA weather-related accidents
- Identify shortfalls in pilot understanding and proper use of MET information and gaps in current pilot training to resolve those shortfalls
- Recommend minimum weather service (MinWxSvc) for Part 91 aircraft to enable consistent and effective pilot decision-making relative to adverse weather
 - ✦ Minimum cockpit MET information needed
 - ✦ Minimum accuracy, latency and availability of cockpit MET information
 - ✦ Minimum information rendering standards needed to enable correct and consistent interpretation
- Determine GA willingness to spend on aircraft equipage and services to enable proper implementation and use of the MinWxSvc

Overview of WTIC Research Projects



Partnership to Enhance General Aviation Safety, Accessibility and Sustainability (PEGASAS) – Quantify Causality

Purpose

- To gain additional insight into causes and locations of GA weather related accidents and incidents to identify MET information gaps and operational safety risks.



Phase I

Key Findings / Gaps:

- Lack of MET product symbology standards
- Latency issues
- Training shortcomings
- Inventory of current products

Phase II

Key Findings / Gaps:

- Developed searchable database
- Developed training / guidance material on in-cockpit weather technologies and usage

Phase III

Proposed Next Steps:

- Finalize database
- Trend analysis

Phase IV

Proposed Next Steps:

- MinWxSvc Recommendations

Slide Legend:

- Arrow indicates relative status of research effort(s)
- Each "Phase" is relatively 1 year in length

PEGASAS - Transition from VFR to IMC

Purpose

- To identify cockpit weather information gaps with the potential to be a causal factor for inadvertent transition from Visual Flight Rules (VFR) to Instrument Meteorological Conditions (IMC).



Phase I

Key Findings / Gaps:

- Gaps in FBO training
- Gap in recognizing IMC conditions in a timely manner
- Minimal training on limitations and use of weather information technology

Phase II

Key Findings / Gaps:

- Developed workshop
- Developed interactive short course
- Demonstrations showed no statistical benefit from training

Phase III

Proposed Next Steps:

- Immersive training
- MinWxSvc Recommendations

Phase IV

Proposed Next Steps:

- TBD
- MinWxSvc Recommendations

PEGASAS - GA Alerting Functions

Purpose

- To assess the impact on pilot decision making and situational awareness effects through the use of more advanced display / alerting technologies



Phase I

Key Findings / Gaps:

- Aural tones distracted from flying the aircraft
- Demonstration of several alert renderings
- Weather notifications that were conspicuous and conveyed urgency performed best
- Alerting results in better weather decision making

Phase II

Key Findings / Gaps:

- Developed and demonstrated prototype alert displays
- Evaluated tactile alerting methods
- Developed initial MinWxSvc recommendations for rendering of cockpit alerting

Phase III

Proposed Next Steps:

- TBD
- Finalize MinWxSvc Recommendations

PEGASAS - GA MET Info Optimization

Purpose

- To evaluate the utility of selected current MET products as decision support tools



Phase I

Key Findings / Gaps:

- Effectiveness of mobile devices and application tools is unknown (Pugh Matrix)
- Produced Goal Directed Task Analysis
- Information content and rendering does not adequately support pilot planning and decision making
- Latency issues

Phase II

Key Findings / Gaps:

- Designed and built PC-based Weather Information Latency Demonstrator(WILD)
- Worked with Tech Center on simulation effort
- Developed preliminary courseware for latency trainer
- Began evaluation of latency trainer benefits (i.e. Sun 'n Fun)

Phase III

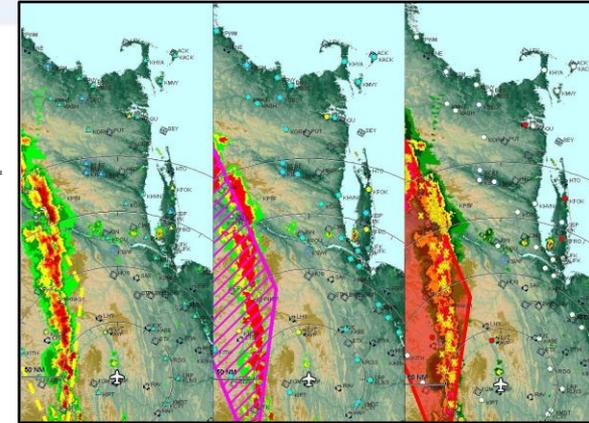
Proposed Next Steps:

- Continue evaluation of latency trainer
- Analyze outreach pilot data
- Coordinate with industry partners
- MinWxSvc Recommendations

GA MET Standardization

Purpose

- To explore the effects of cockpit MET presentations on GA pilot weather avoidance, weather presentation usage, and workload.
- To perform a human factors assessment of the effects of variations in cockpit weather symbology on GA pilot symbol perception
- To assess the operational importance of variations in GA pilot decision-making and behavior from the use of cockpit weather presentations.



Phase I

Key Findings / Gaps:

- Differences in pilot behavior and decision making due to variations in weather presentations
- Identified “change blindness”

Phase II

Key Findings / Gaps:

- Verified “change blindness” is a significant issue in terms of pilot performance
- Part-task identified additional “change blindness” gaps

Phase III

Key Findings / Gaps:

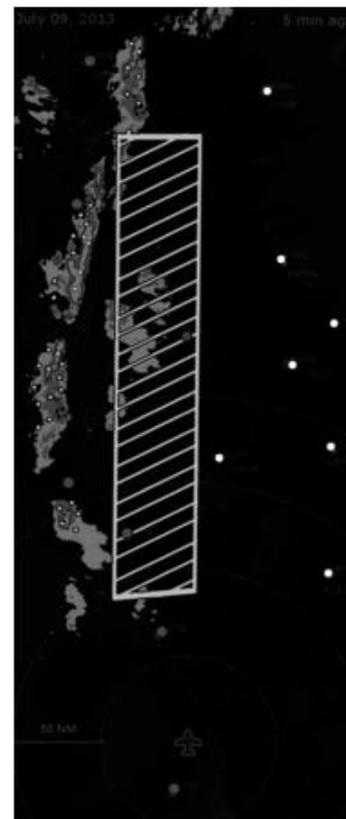
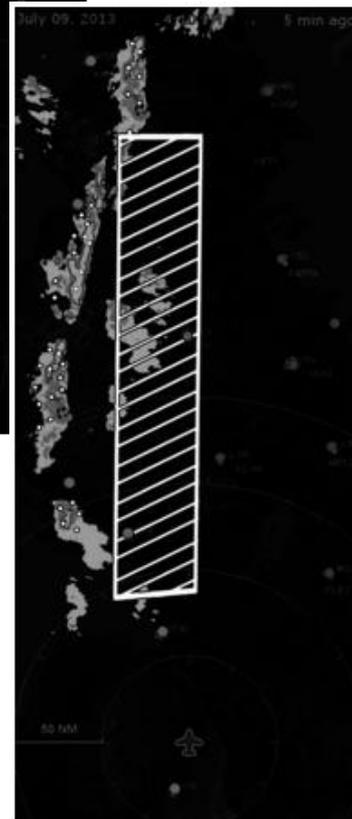
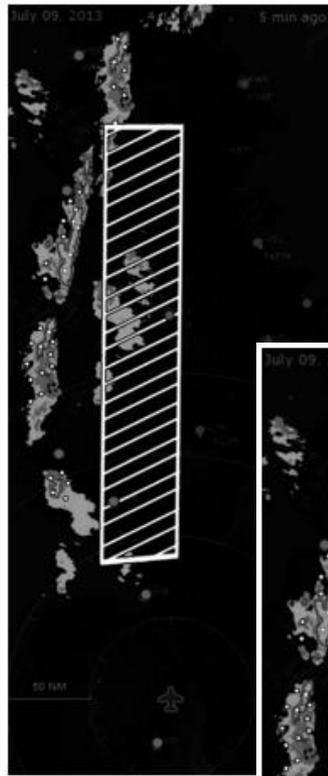
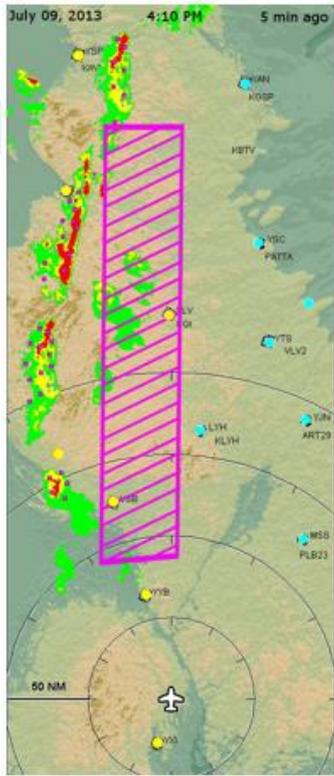
- Mobile MET application enhanced situational awareness
- Pilots recommended additional MET capabilities
- Resolution of “change blindness” resulted in 20% improvement in avoiding IMC (but not statistically significant)

Phase IV

Proposed Next Steps:

- Evaluate salience
- Evaluate adjustable distance to weather range line
- MinWxSvc Recommendations

GA MET Standardization



Phase IV

Proposed Next Steps:

- Evaluate salience
- Evaluate adjustable distance to weather range line
- Awaiting Final Report and MinWxSvc Recommendations

GA MET Standardization



Phase IV

Proposed Next Steps:

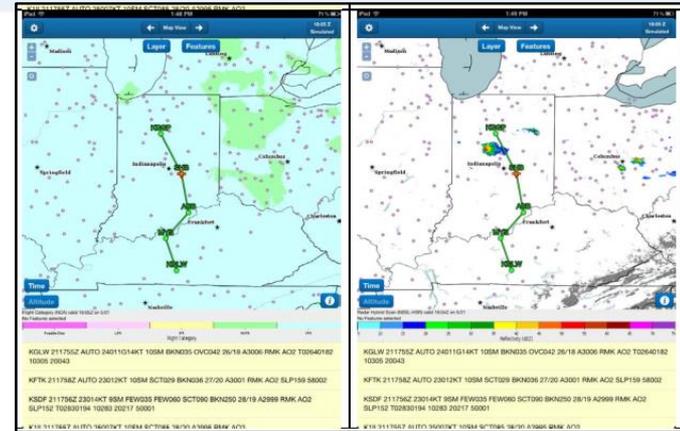
- Evaluate salience
- Evaluate adjustable distance to weather range line
- Awaiting Final Report and MinWxSvc Recommendations

GA Handheld Study

[Conducted simultaneously with GA MET Standardization Phase III]

Purpose

- To examine (1) the potential benefits and effect on pilot flying behavior from the use of portable weather presentations; and (2) to assess pilot sensitivity to weather symbology changes.



Phase I

Key Findings / Gaps:

- Collaborative effort between NCAR and Tech Center
- Positive effects with use of portable weather application
- Higher cognitive engagement with use of portable weather application
- Pilots flew closer than recommended to adverse weather
 - But did increase distance

Phase II

Proposed Next Steps:

- NCAR to work with CAMI to evaluate specific cockpit MET presentation requirements (e.g. surface winds) by phase of flight
- MinWxSvc Recommendations

Pilot Training Requirements

Purpose

- To conduct research to identify and resolve gaps in pilot training on the safe use of cockpit MET technology and information
- To develop a self-study online version of the existing instructor led data-link convective weather course and develop and validate aviation weather questions suitable for inclusion in the FAA pilot written examination.
- Develop and conduct Psychometric Assessment of weather-knowledge questions



Phase I

Key Findings:

- Developed learning roadmaps and course content
- Developed NEXRAD training module
- Developed and submitted 100 new weather knowledge test questions to AFS (accepted by AFS)
- Self-Study online course on FAASite website
- Collected additional pilot data

Phase II

Key Findings:

- Review psychometrics
- Examine relationship of weather-knowledge and performance in Latency Demonstrator (PEGASAS)
- Use sample test questions to evaluate pilot knowledge and retention
- MinWxSvc Recommendations



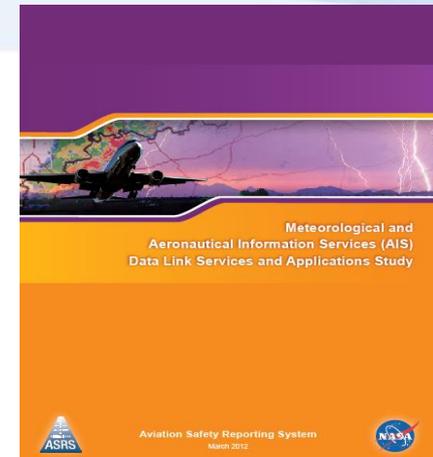
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Aviation Safety Reporting System (ASRS)

Purpose

- To analyze and codify information from users of data link technologies as reported in ASRS incident reports



Phase I

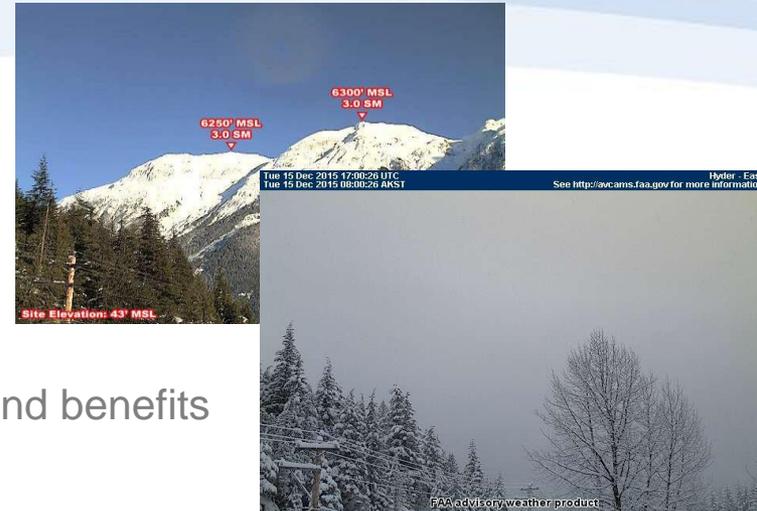
Key Findings:

- Gaps identified
- Initial report submitted
- Responders identified “stale” and “inaccurate” information as a part of their data linked MET information
- Continuing to conduct Callbacks until full dataset received (78 received to date)
- New phase of outreach to be initiated to socialize the request

Crowdsourcing / Cloud Technology

Purpose

- Assess the potential of Crowd Sourcing and Cloud Technology to enhance MET information and user access
- Identify current crowd sourcing techniques, applications, and quality controls
- Recommend options for demonstrating the feasibility and benefits of using crowd sourcing and cloud technology



Phase I

Key Findings / Gaps:

- Determined that crowdsourcing of MET information feasible and could provide benefit

Phase II

Ongoing:

- Developing a crowdsourced evaluation system using the Alaska webcam information (ceiling and visibility)
- Data to be stored in Tech Center cloud

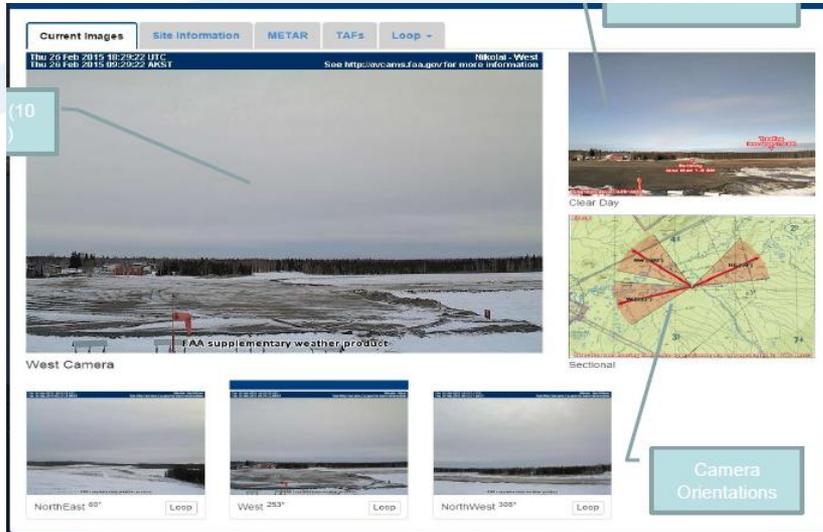
Phase III

Proposed Next Steps:

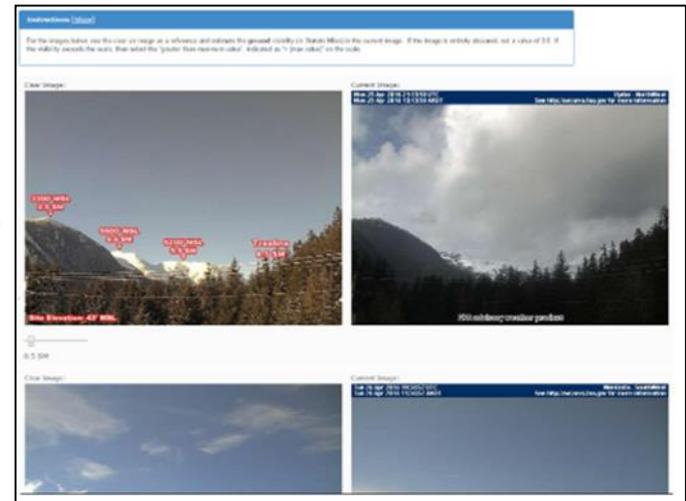
- TBD
- MinWxSvc Recommendations

Crowd Sourcing Visibility Information

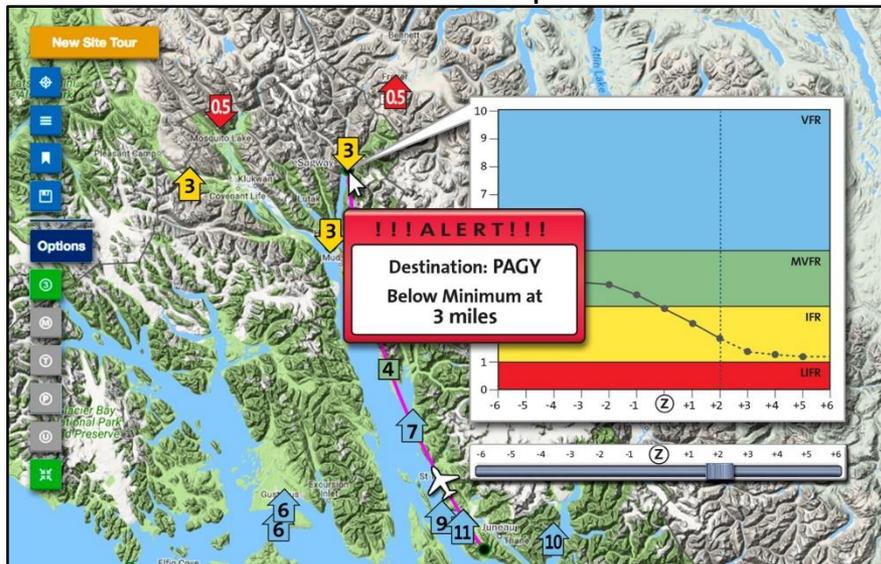
Images from Alaska Wx Cameras



Still images from cameras to Amazon Turk for Human Intelligence Tasks to assess visibility



Notional output



Baysian algorithmic processing to determine when crowd has reached a visibility assessment that meets preset confidence level

WTIC Outreach Partners

Government

- FAA
 - Flight Standards Service
 - Test questions AFS-630
 - NEXRAD Online Course AFS-850
 - ASRS report AFS-430
 - Aircraft Certification
 - Small Aircraft Directorate
 - Office of Aviation Safety
 - Human Factors Research & Engineering
 - William J. Hughes Technical Center(WJHTC)
 - Civil Aerospace Medical Institute (CAMI)
- NASA
 - Ames and Langley
- NTSB
- NCAR

International

- Eurocontrol



Academia

- Embry-Riddle Aeronautical University
- Florida Institute of Technology
- Georgia Institute of Technology
- Iowa State University
- Purdue University
- Texas A&M University
- The Ohio State University
- University of Oklahoma
- Western Michigan University

Professional Societies

- AOPA
- GAMA
- RTCA
- SAE
- Others (via GAJSC)

Industry

- Lockheed Martin (via PEGASAS)
- Frasca (via PEGASAS)



Questions / Comments



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