REDAC / NAS Ops

Review of FY 2020 Proposed Portfolio

Weather Program

BLI Number: A11.j

Randy Bass, ANG-C6
March 27, 2018
Program Overview

What is this program?

Purpose

• Applied research to minimize the impact of weather on the NAS
  – Specific initiatives to support NextGen weather Operational Improvements contained in the NextGen Implementation Plan
  – Collaborative, complimentary initiatives with NWS to transition legacy capabilities to meet NextGen requirements
  – Focused initiatives to help mitigate safety and/or efficiency issues associated with well documented weather problems

Funding

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<tr>
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<th>FY17 (Enacted)</th>
<th>FY18 (Request)</th>
<th>FY19 (Target)</th>
<th>FY20 (Target)</th>
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<tbody>
<tr>
<td>Funding</td>
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Weather Program

A11.j

What are the benefits to the FAA

– Enhance NAS safety via reduction of accidents associated with hazardous weather
– Improve NAS capacity/efficiency via reduced delays and cancellations and increased capacity in high traffic areas
– Reduction in environmental impact (i.e. lower fuel consumption via improved accuracy and accessibility of observed and forecast weather information
– Enhanced GA safety via improved accuracy and accessibility of observed and forecast weather information

What determines program success

– Transition of research capabilities into evolving ATM decision support tools
– Research capabilities align with NSIP and NextGen emerging solution sets
– Incorporation by NWS of research capabilities to improve delivery of FAA required services
– Incorporation by NWS of research capabilities into weather information that is enhancing GA safety
# FY20 Wx Program Portfolio

<table>
<thead>
<tr>
<th>Core Wx Program</th>
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<tbody>
<tr>
<td>Provide Improved Thunderstorm Information to increase NAS efficiency, capacity, and safety (CW)</td>
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<tr>
<td>Improve Capacity of NAS and Reduce Accidents Related to Turbulence (TRB)</td>
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<tr>
<td>CONUS Ceiling and Visibility (C&amp;V) Research</td>
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<td>Develop Alaska Ceiling and Visibility (C&amp;V) Analysis for (CVA-AK)</td>
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<tr>
<td>Perform Quality Assessment (QA) to verify and validate relevant weather nowcast and forecast capabilities</td>
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<td>Provide aviation weather demonstration, evaluation (AWDE) services to assess aviation weather research concepts to improve the delivery of capabilities</td>
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<td>Reduce Accidents and Fatalities Related to In-Flight Icing (IFI) Encounters</td>
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<td>Develop and Improve Aviation Weather Numerical Modeling Capabilities to improve safety and capacity of the NAS (MDE)</td>
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<tr>
<td>Integrate high resolution 4D weather radar analysis in support of safety and capacity in the NAS (AWRT)</td>
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<tr>
<td>Improve weather capabilities to support safe and efficient Unmanned Aircraft System (UAS) operations in the NAS</td>
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<tr>
<th>AVS Wx</th>
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<tr>
<td>Mitigating the Ice Crystal Weather Threat to Aircraft Turbine Engines (HIWC)</td>
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<tr>
<td>Terminal Area Icing Weather Information for NextGen (TAIWIN)</td>
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<tr>
<td>Safety Driven Weather Requirements for Wake Mitigation</td>
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FY20 AVS Wx Portfolio

AVS sponsored and prioritized research initiatives to address select safety concerns in the short and mid-term time horizon, but consistent with current and future requirements

| Develop Terminal Area Icing Weather Information for NextGen |
| Improved icing weather information including SLD in terminal area in response to new SLD certification rule |

| Mitigate the Ice Crystal Weather Threat to Aircraft Turbine Engines |
| HIWC ice crystal data set sufficient for assessment of certification envelopes, development of test facilities, and diagnosis and forecasting for avoidance |

| Safety Driven Weather Requirements for Wake Mitigation |
| Develop an airport wind-based wake vortex separation advisory system |
Convective Weather

Research Requirement

- Improve observations and forecasts of convective weather and create and improve standards and techniques for weather DSTs to mitigate impacts on and improve efficiency of the NAS
- Improve accuracy over legacy systems; higher spatial and temporal resolution; well-defined probabilistic and gridded information; guidelines and strategies for developing products and DSTs that meet users’ requirements and are applicable to their needs
- Sponsored by ANG-C6, ANG-C7, AJV, AJR, AJM
- POC: Randy Bass, ANG-C61, 202-267-2800

Outputs/Outcomes

- OPC: Blend lightning data, satellite imagery and weather model data to produce an estimate of precipitation for areas that lack radar coverage, merged with existing radar mosaic to provide controllers with better situational awareness for offshore sectors
- CWAM: Redesign of the model to incorporate machine learning techniques and optimize use in strategic time frames (2-8 hour forecasts)
- EPOCH: Probabilistic convection guidance with lead times from 0 to 36 hours used for current operations and strategic planning of transoceanic flights

FY 2020 Plans

- Complete integration of new blending techniques developed in FY16-18 between CIWS and CoSPA (or other weather forecast model) for the 1-4 hour forecast period into NWP
- Expand OPC domain to the Pacific; integrate new data sets such as polar satellite imagery into the algorithm
- Develop, test, & integrate new CWAM redesign that incorporates new machine learning techniques, computational capability, & larger volumes of archived weather & traffic data
- Complete transition of the EPOCH algorithm to operations at the NWS for use by the Washington WAFC

Out Year Funding Proposed

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<td>$1.3M</td>
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Turbulence

Research Requirement

- Improve turbulence observation and forecasting capabilities throughout the NAS to accurately identify & predict time, locations, & intensity of turbulence; improving safety, capacity, and efficiency in the NAS
- Sponsored by ANG-C6, ANG-C7, AJV, AJR, AJM
- POC: Tammy Farrar, ANG-C64, 202-267-2796

Outputs/Outcomes

High resolution, gridded, global detection and probabilistic forecasts of turbulence (clear-air, mountain wave & convectively-induced) to support ATM DSTs, dispatcher and pilots resulting in improved safety, increased capacity and reduced atmospheric emissions within the NAS

FY 2020 Plans

- Graphical Turbulence Nowcast product ready for transition to operations.

Out Year Funding Proposed

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Weather Program
Ceiling and Visibility (C&V)

Research Requirement
- Improve C&V prediction models with the goal of reducing GA accidents / incidents and improving airport efficiency
- Applications for improved C&V predictions include support for current and future TAF production; production of automated TAFs in areas where no TAF exists; improvements to the accuracy & resolution of AIRMETs; improvements to forecasts in TRACON areas; updates to the C&V analysis of Helicopter Emergency Medical Services (HEMS) tool
- Done in collaboration with NWS to improve products and services the FAA requires
- Sponsored by ANG-C6, ANG-C7, AJV, AJR, AJM
- POC: Jenny Colavito, ANG-C62, 202-267-2787

Outputs/Outcomes
Products:
- Improvements to C&V analysis in HEMS tool
- Improve NAS analysis and forecast guidance products
- C&V Analysis for Alaska (CVA-AK)

FY 2020 Plans
- Development of RTMA-3D clouds
- Evaluation of short-term C&V forecasts in the HEMS tool
- Development of advanced techniques to blend multiple models while still maintaining the structure of the clouds.
- Development and testing of software to blend web cam fields with the CVA-AK prototype

Out Year Funding Proposed

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Quality Assessment (QA)

**Research Requirement**

- Improved observations & enhanced forecasts must have effective & reliable verification prior to becoming operational to ensure the accuracy, performance, and value of these products for NAS users
- Sponsored by ANG-C6, ANG-C7, AJV, AJR, AJM
- POC Danny Sims, ANG-C61, 202-267-2785

**Outputs/Outcomes**

- Verification/assessment of aviation impact weather forecasts and analyses
- Data provided supports transition of research weather forecast products based on forecast accuracy, quality, and operational meaningfulness to ATM, dispatchers, and pilots

**FY 2020 Plans**

- Conduct quality assessments of weather research products to address uncertainty information in forecasts of cloud ceiling and visibility, convective weather, turbulence, and advanced inflight icing (pending availability of funding), along with investigation of new techniques and data sources.

**Out Year Funding Proposed**

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Image: Echo Top

Federal Aviation Administration
Aviation Weather Demonstration & Evaluation (AWDE) Services

Research Requirement

- NextGen Implementation Plan (Reduce Weather Impact & Validating Concepts) states human factors, human-in-the-loop testing and demonstrations are essential tools for validating NextGen concepts.
- Demonstration and evaluation services are required to assess weather research maturity and concept readiness for transition.
- Sponsored by ANG-C6, ANG-C7 AJV, AJR, AJM
- POC Sonia Alvidrez, ANG-C63; 609-485-7613

Outputs/Outcomes

Enhanced demonstration and evaluation services with subject matter expertise, improved data resources including live aircraft situation data, and metrics capability.

FY 2020 Plans

- Conduct assessments of diagnosis and forecasting products.
  Including:
  • Turbulence Forecast and Graphical Guidance
  • Ceiling and Visibility Analysis and Graphical Guidance
  • Convective Weather Forecast Statements & Graphical Guidance
  • In-flight Icing Diagnosis and Forecast (pending availability of funds)
- Advance the AWDE Concept and Product Capability for the integration, evaluation and demonstration of future NextGen weather concepts and technologies.

Out Year Funding Proposed

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Mitigating the Ice Crystal Wx Threat to Aircraft Turbine Engines

Research Requirement

- NTSB: A-96-54, -56, & -58
- Characterization of High Ice Water Content (HIWC) ice crystal environments that can be a threat to turbine engines
- Diagnosis and forecasting of HIWC ice crystal environments
- Sponsored by AFS-200
- POC Jim Riley, ANG-E2; 609-485-4144

Outputs/Outcomes

- Outcome supported: Atmospheric HIWC ice crystal data set sufficient for assessment of certification envelopes, development of test facilities, and diagnosis and forecasting for avoidance
- Benefits resulting: Significant reduction in threat to current and future designs

FY 2020 Plans

- Plan for additional flight research focusing on continental engine ice crystal icing (ICI) per data requested by the Ice Crystal Icing Working Group (ICIWG).

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Terminal Area Icing Wx Information for NextGen (TAIWIN)

Research Requirement

- Responds to operational needs - new SLD Rule 25.1420 and NextGen Reduce Weather Impact capacity and throughput requirements in freezing precipitation
- Develop capability/technology to manage impact of new certification Supercooled Large Drops (SLD) rule on terminal area operations; research on automated reporting systems and improved weather diagnostic/forecast tools
- Sponsored by: ANE-100, ANM-100
- POC Jim Riley, ANG-E2; 609-485-4144

Outputs/Outcomes

- Outcome supported: Improved icing weather information including SLD in terminal area
- Benefits resulting: Maintain/improve efficiency and safety in icing conditions under new SLD rules in terminal area, facilitating smooth transition to new operational rules and/or guidance anticipated from Flight Standards corresponding to new SLD certification rule

FY 2020 Plans

- Conduct analysis of initial flight test results to quantify the ability to diagnose and forecast the detection/discrimination of freezing drizzle from freezing rain aloft.
- Use available results from analysis of ICICLE flight campaign data to begin improving model microphysics and icing weather tools with emphasis on supercooled large drops.
- Demonstrate a TAIWIN capability that identifies and distinguishes between App C and App 0 icing conditions in the terminal area.

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Acronyms

- Airmet - Airmen's Meteorological Information
- AK - Alaska
- ATM – Air Traffic Management
- CIWS - Corridor Integrated Weather System
- CoSPA - Consolidated Storm Prediction for Aviation
- CWAM - Convective Weather Avoidance Model
- DSTs – Decision Support Tools
- EPOCH - Ensemble Prediction of Oceanic Convective Hazard
- FLs – Flight Levels
- GA – General Aviation
- GTG – Graphical Turbulence Guidance
- HEMS - Helicopter Emergency Medical Services
- HRRR - High Resolution Rapid Refresh
- ICICLE - In-Cloud Icing and Large-Drop Experiment
- MRMS - Multi-Radar, Multi-Sensor
- NAS - National Airspace System
- NSIP - NextGen Segment Implementation Plan
- NWP - Numerical Weather Prediction
- NWS - National Weather Service
- OPC – Offshore Precipitation Capability
- RTMA - Real-Time Mesoscale Analysis
- SLD – Supercooled Large Droplet
- TAF - Terminal Area Forecast
- TDWR – Terminal Doppler Weather Radars
- TRACON - Terminal Radar Approach Control Facilities
- WAFC – World Area Forecast Center
Back-up Slides
### In-Flight Icing

#### Research Requirement
- Improve operationally-available, high-resolution, accurate diagnoses and forecasts of aircraft icing conditions that can be used by aviation users to make decisions on icing threat areas, optimum routings, and areas to avoid in compliance with recently updated regulations and aircraft certification envelopes.
- Sponsored by ANG-C6, ANG-C7, AJV, AJR, AJM
- POC: Danny Sims, ANG-C61, 202-267-2785

#### FY 2020 Plans
- Transition to National Weather Service CONUS and Alaska high resolution in-flight icing diagnosis and forecast capability to explicitly predict conditions associated with certification envelopes.

#### Outputs/Outcomes
- Diagnostic & forecasts up to and beyond 18 hours over the CONUS and Alaska for operational use by ATM, dispatchers, and pilots to enhance capacity and safety.

#### Out Year Funding Proposed

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Model Development and Enhancement

Research Requirement

• Weather prediction models are the basis for all aviation weather hazard forecasts beyond 2 hours. Improve operationally available numerical weather prediction model resolution and refresh rates to enhance forecasts of aviation weather hazards including inflight icing, turbulence, convective weather, and ceiling and visibility will require model enhancements.

• Sponsored by ANG-C6, ANG-C7, AJV, AJR, AJM

• POC: Danny Sims, ANG-C61, 202-267-2785

Outputs/Outcomes

• 0-36 hour high resolution rapid refresh to include oceanic airspace to support aviation forecast products

• Global model with hourly output compatible with suite of NOAA models

• Enhanced NAS safety and capacity/efficiency from improved forecasts of aviation specific weather hazards

FY 2020 Plans

• Transition and incorporate High Resolution Rapid Refresh (HRRR) capabilities for input to the NOAA High Resolution Ensemble Forecast (HREF) system.

• Conduct research towards hourly updated global forecasts to supplant current, regional, hourly-updated models.

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Other Core Wx Program FY20 Efforts

- **AWRT** – Multi-Radar Multi-Sensor (MRMS) research: to improve real-time detection of in-flight hazards using high-res, high quality, 3D weather radar data analysis from national & international radar networks; also support NWS operational capability. MRMS capability will also function as a validation tool for high-resolution forecasts & decision support tools.

- FY20 – Complete ingest of the full suite of CONUS TDWRs into MRMS; Improve capabilities for determining the age of radar data and ways to alert users with a time indicator on the current mosaic; Complete integration of icing and hydrometeor classification algorithms

- **Improve weather capabilities to support safe and efficient Unmanned Aircraft System (UAS) operations in the NAS** – Analyze gaps between current weather capabilities and weather info needed for safe and efficient airspace management of UAS operations.

- FY20 – Collaborate with FAA UAS community to develop collaborative strategy for weather research to meet operational needs