# **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

FY17	FY18	FY19	FY20
(Enacted)	(Request)	(Target)	(Target)
\$14.3M	\$12.6M	\$6.16M	\$5.5M





# 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

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





# 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**

FY18	FY19	FY20
\$1.3M	\$1.2M	\$1.1M



# 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 & convectivelyinduced) to support ATM DSTs, dispatcher and pilots resulting in improved safety, increased capacity and reduced atmospheric emissions within the NAS

Aircraft: Heavy • Plot: Combined • Vertical level: 11 max • 11 Forecast time: << 0hr - 152 03 Nov • >>

GTG - Max combined intensity (1000 ft. MSL to FL500)



### FY 2020 Plans

- High Resolution Rapid Refresh (HRRR) based Graphical Turbulence Guidance (GTG) forecast product, with Convectively-Induced Turbulence capability: Complete quality assurance evaluation and ready for Safety Risk Management Panel.
- Graphical Turbulence Nowcast product ready for transition to operations.

### **Out Year Funding Proposed**

FY18	FY19	FY20
\$1M	\$1M	\$900K



# 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

## 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

### **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)



Example of a gridded C&V analysis product for Alaska.

#### **Out Year Funding Proposed**

F	Y18	FY19	FY20
\$	1M	\$ 800K	\$ 700K



# **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**

FY18	FY19	FY20
\$ 1.3M	\$912K	\$800K



# Aviation Weather Demonstration & Evaluation (AWDE) Services

### **Research Requirement**

- NextGen Implementation Plan (Reduce Weather Impact & Validating Concepts) states human factors, human-in-theloop 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**

FY18	FY19	FY20
\$ 500K	\$500K	\$450K



# Mitigating the Ice Crystal Wx Threat to **Aircraft Turbine Engines**

### **Research Requirement**

NTSB: A-96-54, -56, & -58 Atmospheric HIWC ice Characterization of High Ice Water Content (HIWC) ice crystal data set sufficient for crystal environments that can be a threat to turbine assessment of certification engines envelopes, development of Diagnosis and forecasting of HIWC ice crystal test facilities, and diagnosis environments and forecasting for avoidance Sponsored by AFS-200 crvstal data Benefits resulting: POC Jim Riley, ANG-E2; 609-485-4144 Significant reduction in threat to current and future designs

#### Outputs/Outcomes

- Outcome supported:



Flight path for collection of HIWC ice

### 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).

## Out Year Funding Proposed

FY18	FY19	FY20
\$ 1.4M	\$1.15M	\$1.05M



# 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



Freezing drizzle ice accretion process

## 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.

## Out Year Funding Proposed

FY18	FY19	FY20
\$1.5M	\$600K	\$500K



# 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

#### **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.



Maximum icing severity (1000 ft. MSL to FL300)

In-Flight Icing Severity 1000 ft MSL – FL300

### 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.

### **Out Year Funding Proposed**

FY18	FY19	FY20
\$900K	TBD	TBD



# **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

#### 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.

#### **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



#### **Out Year Funding Proposed**

FY18	FY19	FY20
\$ 1.1M	TBD	TBD



# 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



