

# REDAC / NAS Operations



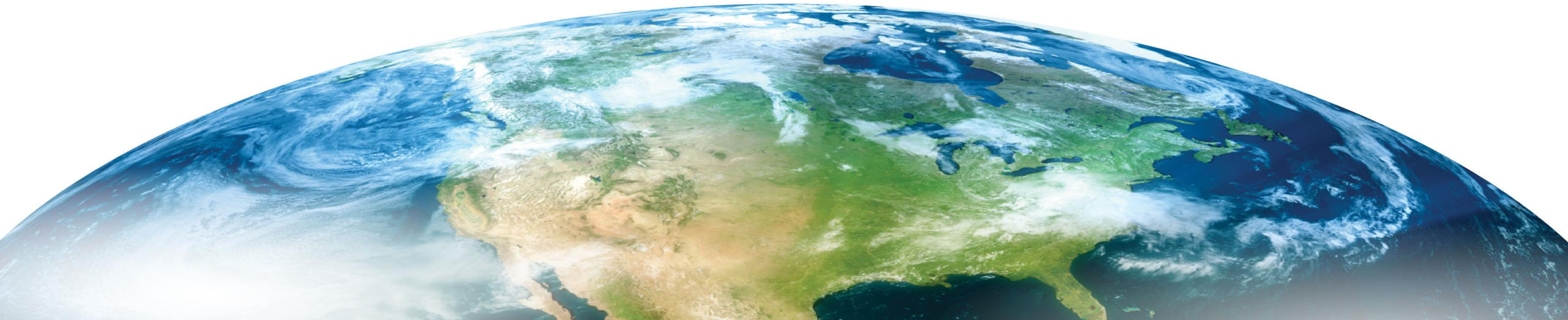
*Name of Program*

*BLI Number: A11.k*

*Presenter Name: Randy Bass*

*Date: August 31, 2021*

*Review of FY 2021 - 2024  
Proposed Portfolio*



# Weather Program A11.k Overview

## **What are the benefits to the FAA**

- Enhanced NAS safety via reduction of accidents associated with hazardous weather
- Improved 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 processes
- Research capabilities align with NSIP and NextGen emerging solution sets as well as the FAA's Charting Aviation's Future vision
- Incorporation by National Weather Service (NWS) of research capabilities to improve delivery of FAA required services
- Incorporation by NWS or commercial industry of research capabilities into weather information that is enhancing GA safety
- Tangible reduction in avoidable delays and aircraft accidents due to weather
  - Transition of successful weather research capabilities into operations have directly contributed to a reduction in NAS delays due to weather from 68% in 2007 to 54% in 2019



# Weather Program A11.k

## Program Support

### People:

- Program Manager and 11 Project Leads/Subject Matter Experts

### Laboratories:

- NOAA GSL – Model Development & Enhancement (MDE), Quality Assessment, Terminal Area Icing Weather Information for NextGen (TAIWIN), Ceiling & Visibility (C&V)
- NOAA NSSL – Wx Radar Techniques, TAIWIN
- NOAA NCEP (EMC and AWC) – MDE, C&V
- NWS MDL – C&V
- MIT/LL – Convective Storms, C&V, Weather Observations (Wx Obs)
- NCAR – In-flight Icing, Turbulence, Convective Storms, C&V, MDE, TAIWIN, High Ice Water Content (HIWC), Wx Obs
- FAA Tech Center – Aviation Weather Demonstration and Evaluation (AWDE), Wx Obs, TAIWIN, HIWC
- NRC – TAIWIN
- ECCC – TAIWIN
- Diakon – TAIWIN
- NASA – HIWC, TAIWIN, In-flight Icing
- Metron Aviation, Inc. – Turbulence
- MITRE CAASD – UAS Wx



# Current FY21 Accomplishments

- **Convective Storms (CS)**
  - Completed assessment of Offshore Precipitation Capability (OPC) v3 (w/ Geostationary Lightning Mapper)
  - Improvements to expand the OPC web display domain
  - Enhanced OPC to include up to 12-hour CS forecast
  - Updated machine learning model in expanded domain
  - Report on aircraft lightning encounters opportunities for diagnosing relevant meteorological conditions and operational impacts
- **In-flight Icing (IFI)**
  - Commenced enhancements to the Current Icing Product (CIP) and Forecast Icing Product (FIP) using full dataset from the In-Cloud Icing & Large-drop Experiment (ICICLE) field program in support of FAA aircraft certification requirements
  - Enhanced CIP and FIP to use the higher resolution High Resolution Rapid Refresh (HRRR) numerical weather prediction model (versus the coarser resolution Rapid Refresh (RAP) model) as well as incorporating new weather satellite and weather radar datasets
- **Modeling Development and Enhancement (MDE)**
  - Enhanced version of the High Resolution Ensemble Forecast (HREF) using the Wx Program developed HRRR operationally implemented by the NWS
  - Continued development of the Rapid Refresh Forecast System (RRFS) including feedback from NWS testbed experiments
- **Turbulence (TRB)**
  - Development of global probabilistic turbulence capability in support of ICAO World Area Forecast System (WAFS) requirement
  - Continued efforts to include additional Convectively-Induced Turbulence (CIT) diagnostics and the overall CIT diagnosis into Graphical Turbulence Guidance v4 (GTG4). This includes the investigation of in-cloud turbulence in different types of convection/stratiform regions as well as their diagnosis within GTG
  - Development of GTG-Nowcast (GTGN) algorithm and incorporation of new observations into GTGN including satellite data, in situ Eddy Dissipation Rate (EDR) combined with water vapor information and ADS-B derived turbulence information
- **Ceiling and Visibility (C&V)**
  - Completed the quality assessment of a capability to estimate visibility in FAA Weather Camera imagery using automation (Visibility Estimation through Image Analytics (VEIA) algorithm)
  - Continued development to increase the temporal resolution of Localized Aviation Model Output Statistics Program (LAMP) C&V forecasts and utilization of satellite data to improve the performance between stations
  - Improved the quality control and display of non-certified weather observations for the Helicopter Emergency Medical Services tool



# Current FY21 Accomplishments (cont'd)

- **Advanced Weather Radar Techniques (AWRT)**
  - Completed data transfer of Multi-Radar, Multi-Sensor (MRMS) archived products to support a testbed assessment of MRMS products “on the glass” for Air Traffic Controllers
- **Quality Assessment (QA)**
  - Completed assessment of the OPC westward domain expansion
  - Completed assessment of upgrades to the Convective Weather Avoidance Model (CWAM)
- **Aviation Weather Demonstration and Evaluation (AWDE) Services**
  - Conducted a virtual Table Top Demonstration for Precipitation on the Glass (PoG) and developed a report summarizing demonstration results and recommendations
  - Conducted a virtual assessment for the Icing Product Alaska-Diagnosis (IPA-D) and developed a report summarizing assessment results and recommendations
  - In collaboration with the Aviation Weather Center (AWC) Testbed, commenced obtaining feedback from participants of the Summer Experiment, focusing on the Graphical Forecast Area-Alaska product
  - Conducted a virtual user assessment for the Visibility Estimation through Image Analytics (VEIA) algorithm with Alaska participants
- **Terminal Area Icing Weather Information for NextGen (TAIWIN)**
  - Completed ICICLE Research Review Workshop
  - Continued preparations for TAIWIN Winter 21/22 demonstration
  - Developed draft version of initial TAIWIN capability discriminating between Appendix C and Appendix O icing conditions in the terminal area
- **High Ice Water Content (HIWC)**
  - Commenced preparation for HIWC Japan campaign which will collect ice crystal icing aircraft data in high aerosol environments
  - Initiated planning for user demonstration and evaluation of the HIWC weather tool, ALPHA (Algorithm for the Prediction of HIWC Areas)
- **UAS Wx**
  - Completed report on current and planned UAS test sites within FAA, DHS, DoD, NASA and Industry
  - Completed report on ongoing UAS research efforts that may be candidates for technology transfer



# Anticipated Research in FY22

## Planned Research Activities

- **CS**
  - OPC enhancements including faster refresh rate, wider geographical domain (to Guam), and longer forecast times
  - Integrate FAA TFM requirements
  - Collaborate with Weather Evaluation Team (WET) and Weather Information Migration and Transition (WIMAT) project to explore streamlining number of convective weather products while “modernizing” them by digitizing those that are currently textual and/or graphical
- **IFI**
  - Use explicit icing parameter output (such as liquid water content, drop size, and precipitation type) from the HRRR and RRFS models to better define icing threats
  - Begin initial development of capabilities to support UAS operations
- **MDE**
  - Further development and enhancement of initial RRFS to include deterministic and ensemble capabilities
- **TRB**
  - Complete GTGN2 (RRFS-based); conduct Technical Review Panel
  - Continue Turbulence Avoidance Model (TAM) development in support of ATM planning processes
- **C&V**
  - Adapt VEIA to 360 degree camera imagery and begin development of Cloud Estimation through Image Analytics
  - Continue development of LAMP 15-minute forecasts and prototype LAMP forecasts of onset and cessation of IFR conditions at airports
  - Increase the use of satellite data and other novel data sets to improve the accuracy of RRFS C&V fields
  - Assess benefits of assimilating drone observations to improve the prediction of low visibility conditions caused by fog – conduct an initial study in Cincinnati, Ohio
- **AWRT**
  - Implement winter weather and convective products into the developmental MRMS system for performance monitoring
- **QA**
  - Coordinate, and conduct scientific meteorological assessments of GTG4, CIP and FIP comparison between 13-km RAP and the 3-km HRRR forecast models
  - Quality assessment/evaluation comparing the performance of RRFS to the current HRRR model



# Anticipated Research in FY22 (cont'd)

## Planned Research Activities

- **AWDE**
  - Continue to develop virtual techniques to improve data collection and collaborations with participants and internal/external partners
  - Develop Use Cases and CONOPs for IPA-D
  - Conduct user assessments for the OPC, TAIWIN, and TAM
- **TAIWIN**
  - Assess and validate data from Numerical Weather Prediction models, weather radars, and other data sources in comparison with ICICLE research flight data collected
  - Leveraging findings from FY21 capability development efforts and analyses, continue development capability to discriminate between freezing drizzle and freezing rain at surface and aloft in terminal area
  - Demonstrate initial TAIWIN prototype and prepare for and perform user evaluation
- **HIWC**
  - Prepare for FY22/23 Japan flight campaign
  - Evaluate options for operational transition of ALPHA
  - Perform ALPHA user demonstration and evaluation
- **UAS Wx**
  - Determine Urban Air Mobility weather needs
  - Complete Urban Microscale Weather Modeling Project
  - Identify existing weather capabilities for low altitude operations that may be applicable to UAS operations
  - Develop processes for FAA Qualifying Weather Providers
- **Wx Obs**
  - Initiate exploration of new sensor technology to determine if sensor capabilities can be consolidated for future iterations of surface observing systems
  - Explore how various Liquid Water Equivalent (LWE) measurements during mixed-phase precipitation can be used to develop more robust determinations of LWE



# Anticipated Research in FY22 (cont'd)

## Expected Research Products

- CS
  - OPC output with forecast capability for CONUS
- IFI
  - Initial experimental versions of CIP and FIP with drop size information to provide guidance according to aircraft certification levels
- MDE
  - Experimental RRFS deterministic and ensemble running in near real time for determination of final configuration in preparation of FY23 operational implementation
- TRB
  - Continued development of a Global Probabilistic Gridded Turbulence Forecast and transition of GTG family of forecasts to 3km resolution
  - TAM for use by ATM
- C&V
  - VEIA operational on the FAA weather camera website
  - Accurate model derived forecasts of onset and cessation of IFR condition at airports to support TFM
- AWRT
  - Create separate 3D merge of Terminal Doppler Weather Radar (TDWR) observations and blend with Composite Reflectivity output – response to NTSB Recommendation A-20-16
  - Improved hydrometeor detection for the improvement of potential icing conditions through a radar-based algorithm
- TAIWIN
  - Initial version of TAIWIN icing-detection and forecast capability
- UAS Wx
  - Initial set of weather observation and forecast requirements for UAM operations
  - Report on the use of existing weather capabilities that can support UAS domains



# Anticipated Research in FY23

## Planned Research Activities

- **CS**
  - Complete Ensemble Prediction of Oceanic Convective Hazards (EPOCH) (6-48 hour forecast of convection) transition to NWS
  - Finish legacy OPC evaluations and quality assessments
  - OPC and CWAM transitions
  - Perform research to integrate TFM requirements
  - Begin research to modernize convective weather product suite
- **MDE**
  - Finalization of initial RRFS for operational implementation to include deterministic and ensemble capabilities
  - Further development and enhancement of RRFS version 2 with enhanced performance for aviation applications
- **TRB**
  - GTG4 and GTGN2 transfer to NWS
  - GTG-Global probabilistic experimental implementation
  - TAM Phase 4 transition to CSS-Wx/NextGen Weather Processor (NWP)
  - Turbulence mitigation capabilities for use in UAS/UAM operations as well as to support FAA's Charting Aviation's Future vision
- **C&V**
  - Demonstrate use of weather sensing drones to profile fog conditions near a major airport (likely SFO)
  - Gridded LAMP (GLMP) SFO-area specific ceiling guidance and high resolution model nest.
  - Development of GLMP for Hawaii
  - Develop RRFS cloud cover diagnostics and trends for onset and cessation of IFR events
- **AWRT**
  - Implement winter weather and convective products into the developmental MRMS system for performance monitoring

# Anticipated Research in FY23 (cont'd)

## Planned Research Activities (cont'd)

- **QA**
  - Coordinate, and conduct scientific meteorological assessments of icing drop size, upgrades to the CONUS – AK, high resolution modeling capabilities, C&V short-term forecasts, UAS Wx, GTG forecasts, and OPC mountain obscurations
- **AWDE**
  - Conduct research to define information gaps to further enhance requirement development and design of weather capabilities
  - Conduct user assessments for Icing, CS, Turbulence, and C&V to ensure existing and emerging weather products enhance user decision making
  - Participate/support the Aviation Weather Center (AWC) Testbed Summer and Winter Experiments
  - Collaborate with NOAA to determine how probabilistic displays are used and identify user needs and preferences with probabilistic displays
- **TAIWIN**
  - Analyze results of TAIWIN evaluation with focus on operational implementation and validation/verification needs
  - Prepare for flight campaign that will be utilized to validate and verify the TAIWIN capability
- **HIWC**
  - High aerosol environment flight campaign (if not conducted in FY22)
  - Evaluation of ice crystal icing certification envelope
  - Develop operational implementation path for ALPHA
- **UAS Wx**
  - Development of Weather Standards for UAS to support Operational Improvements for Qualified Weather
  - Validation of forecast performance of numerical models for UAS domains
- **Wx Obs**
  - Explore further automation of ground truth techniques to evaluate surface sensor capabilities to better distinguish obstructions to visibility such as fog and/or mist from moderate to heavy precipitation events



# Anticipated Research in FY23 (cont'd)

## Expected Research Products

- CS
  - Improve World Area Forecast System (WAFS) convective weather forecast grids
- IFI
  - Transition enhanced CIP and FIP to NWS, including utilization of new satellite information and 3-D and dual-polarization weather radar information for increased diagnosis of icing environments, along with higher resolution (smaller grid spacing) output
- MDE
  - Transition to NWS of initial RRFS code with improved convective weather output and uncertainty information through the use of ensemble based techniques
- C&V
  - VEIA with enhanced capabilities including cloud categorization and analysis of 360 degree views
  - Model derived forecasts of onset and cessation of IFR condition at airports to support TFM
- AWRT
  - Development of web tool to display terminal-area winter weather hazards using the MRMS system
- QA
  - Develop new verification techniques for analysis of gridded weather products
  - Develop new verification techniques for analysis of probabilistic ensemble forecasts



# Emerging FY24 Focal Areas

- **Weather Program: Continued emphasis on transition to operations of successful weather projects into FAA, National Weather Service and commercial weather provider systems. Development and implementation of weather standards for all segments of UAS, alignment of future research with FAA's Charting Aviation's Future vision.**
- **CS**
  - Begin transition of OPC into NextGen Wx Processor initial version; begin research on OPC v2
  - CS Program fully integrated into FAA requirements process
  - Expand the targeted CS research to operationally sensitive areas within the NAS
  - Begin research to support FAA's Charting Aviation's Future vision
- **IFI**
  - Continue collaboration with TAIWIN on development of drop-size capability to address aircraft certification envelopes
  - Further development of initial UAS capability to adapt automated icing products to low-level UAS operations
- **MDE**
  - Development of RRFS v2 to include improved aviation weather forecasts
- **TRB**
  - RRFS-based GTG transition to operations at NWS
  - GTG Global Probabilistic transition to operations
- **C&V**
  - Begin transition to operations of weather sensing drone observations
  - GLMP ceiling height guidance nests at high impact airports (e.g. ATL, LGA, and ORD)
  - Develop GLMP cloud height guidance
  - Increased use of satellite data to improve GLMP-Alaska
- **AWRT**
  - Monitor performance of new products and algorithms on the developmental MRMS system, including winter precipitation algorithms and convective polygons
  - Investigate weather radar capability requirements for NextGen Wx Processor and develop strategies for research opportunities in support of these requirements



# Emerging FY24 Focal Areas (cont'd)

- QA
  - Impact of C&V on new NAS entrants assessment
  - RRFS v2 assessment
- AWDE
  - Conduct research to define information gaps to further enhance requirement development and design of weather capabilities
  - Conduct user assessments for Icing, CS Turbulence, and C&V to ensure existing and emerging weather products enhance user decision making
  - Participate/support the AWC Testbed Summer and Winter Experiments
- TAIWIN
  - Conduct flight campaign to collect data for validation and verification of TAIWIN capability
- HIWC
  - Evaluation of ice crystal icing certification envelope
- UAS Wx
  - Continued collaboration with FAA UAS organizations
  - Understanding weather needs for UAM operations
  - Continued validation of forecast performance of numerical models in UAS Domains
  - Examine how reports of adverse weather conditions correlate to topography and pilot reports. Demonstrate that specific routes or areas are accessible to low-level flight when heights of cloud bases at selected reference stations reach specified values
- Wx Obs
  - Continue exploring automation of ground truth techniques to evaluate surface sensor capabilities to better distinguish obstructions to visibility such as fog and/or mist from moderate to heavy precipitation events
  - Facilitate pre-concept demonstration activities for dual AWOS and ASOS baselines, such as tailored mission analysis and shortfall analysis





# Convective Storms

## Research Requirement

- Improve observations and forecasts of convective storms. Create and improve standards and techniques integration into DSPs 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 capabilities for integration into DSPs that meet users' requirements and are applicable to their needs
- Sponsored by ANG-C6, ANG-C7, AJM-3, AJR-B, AJV-S
- POC: Jason Baker, ANG-C61, 202-267-1625

## 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 seamlessly 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: Transfer to NWS to improve forecast for oceanic airspace
- TCF: More accurate forecast with infusion of high resolution data and AI



## FY 2024 Planned Research

- Plan/scope forecast for near-term TFM requirement, with focus on NAS high traffic sectors
- Research and apply techniques to modernize TCF; begin developing convective weather end to end prototype
- Continue operational transition of OPC; begin development on version 2 to capture any remaining requirements

## Out Year Funding Requirements

FY21	FY22	FY23
\$ 1.2M	\$ 1.2M	\$ 1.6M

# In-Flight Icing

## Research Requirement

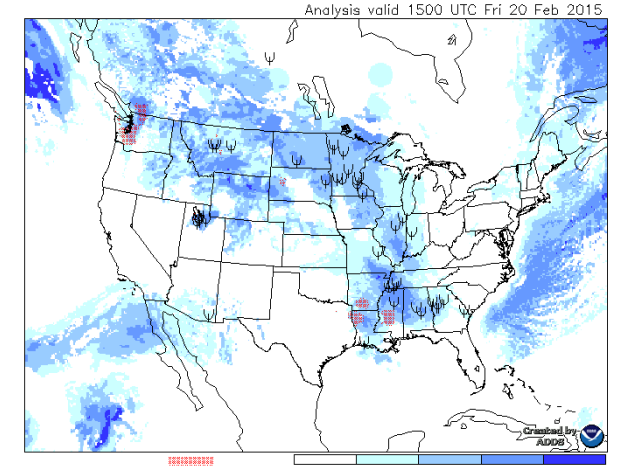
- Improve operationally-available diagnoses and forecasts of aircraft icing conditions that can be used by aviation users to make decisions on icing threat areas, optimum routings, and areas to avoid in compliance with recently updated regulations and aircraft certification envelopes
- Sponsored by ANG-C6, ANG-C7, AJM-3, AJR-B, AJV-S
- POC: Danny Sims, ANG-C61, 202-267-2785

## FY 2024 Planned Research

- Develop and refine drop-size capability in icing products to meet aircraft certification envelopes
- Further development of initial UAS capability to adapt CIP, FIP, and Icing Product Alaska (IPA) to low-level UAS operations

## Outputs/Outcomes

- Diagnostic and 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 Requirements

FY21	FY22	FY23
\$ 1.3M	\$ 1.3M	\$ 1.4M

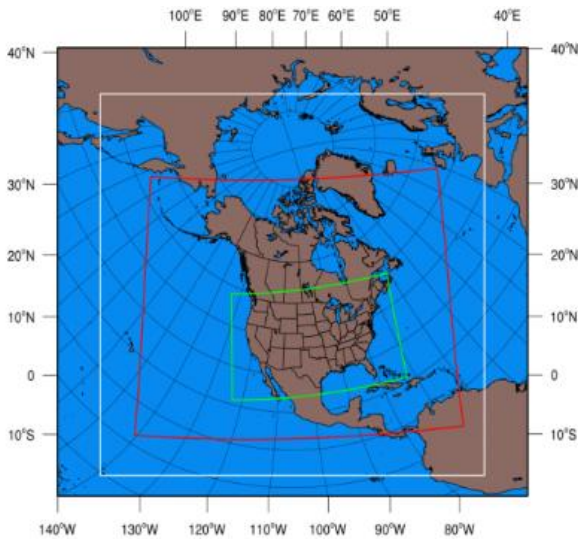
# Model Development and Enhancement

## Research Requirement

- Weather prediction models are the basis for all aviation weather hazard forecasts beyond 2 hours. Improvement of operationally available numerical weather prediction models 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, AJM-3, AJR-B, AJV-S
- POC: Danny Sims, ANG-C61, 202-267-2785

## Outputs/Outcomes

- 0-48 hour high resolution rapid refresh to support aviation forecast products
- Enhanced NAS safety and capacity/efficiency from improved forecasts of aviation specific weather hazards



## FY 2024 Planned Research

- Development of RRFS version 2 to include improved aviation weather forecasts

## Out Year Funding Requirements

FY21	FY22	FY23
\$ 1.0M	\$ 1.0M	\$ 1.1M

# Turbulence

## Research Requirement

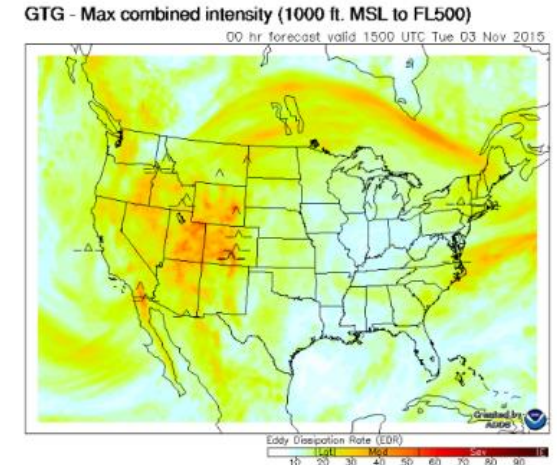
- Improve turbulence observation and forecasting capabilities throughout the NAS to accurately identify and predict time, locations, and intensity of turbulence; improving safety, capacity, and efficiency in the NAS
- Sponsored by ANG-C6, ANG-C7, AJM-3, AJR-B, AJV-S
- POC: Tammy Flowe, ANG-C61, 202-267-2796

## FY 2024 Planned Research

- GTGN2 transition to NWS
- TAM Phase 4 begin transition to CSS-Wx/NWP
- Turbulence mitigation capabilities for use in UAS/UAM operations

## Outputs/Outcomes

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



## Out Year Funding Requirements

FY21	FY22	FY23
\$ 1.0M	\$ 0.8M	\$1.0M



# Ceiling and Visibility (C&V)

## Research Requirement

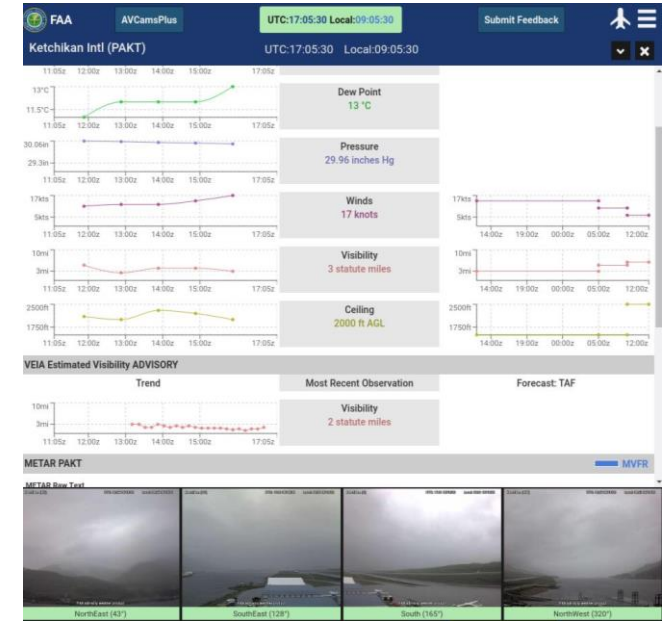
- Improve C&V prediction models with the goal of reducing GA accidents/incidents and improving airport efficiency
- Applications for improved C&V predictions include support for current and future TAF AIRMETS and TRACON forecasts; production of automated TAFs in areas where no TAFs exists; updates to graphical weather tools; new observations in data-sparse regions
- Done in collaboration with NWS to improve products and services the FAA requires
- Sponsored by ANG-C6, ANG-C7, AJM-3, AJR-B, AJV-S
- POC: Jenny Colavito, ANG-C61, 202-267-2787

## FY 2024 Planned Research

- Begin transition to operations of weather sensing drone observations
- Develop GLMP ceiling height guidance nests at high impact airports (e.g. ATL, LGA, and ORD)
- Develop GLMP cloud height guidance
- Improve GLMP-Alaska through increased use of satellite data

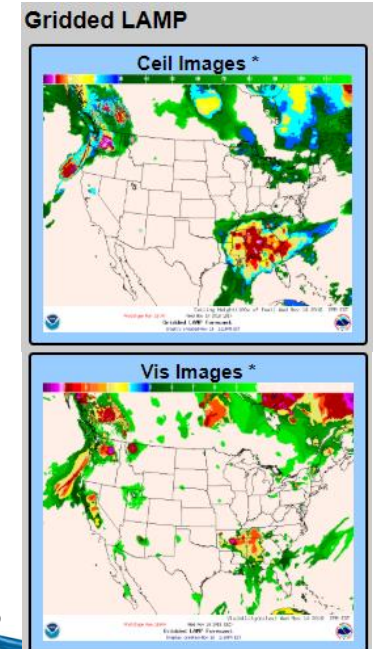
## Outputs/Outcomes

- Improvements and expansion of C&V gridded data
- New sources for C&V observations: camera based and drone based
- Supports enhanced GA safety and ATM based decision support processes to improve efficiency



## Out Year Funding Requirements

FY21	FY22	FY23
\$ 1.0M	\$ 1.0M	\$ 1.0M





# Advanced Weather Radar Techniques

## Research Requirement

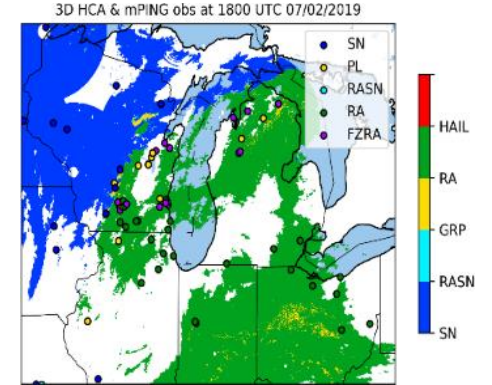
- Conduct and implement research toward a high-resolution, high quality, three-dimensional (3D) weather radar data analysis from national and international radar networks
- Provide improved detection and forecasting for hazardous phenomena such as turbulence, icing and convection, and deliver these products and services in a manner that allows for their rapid and effective use by NAS decision-makers
- Sponsored by ANG-C6, ANG-C7, AJM-3, AJR-B, AJV-S
- POC: Randy Bass, ANG-C61, 202-267-2800

## FY 2024 Planned Research

- Monitor performance of new products and algorithms on the developmental MRMS system, including winter precipitation algorithms and convective polygons
- Investigate weather radar capability requirements for NWP and develop strategies for research opportunities in support of these requirements

## Outputs/Outcomes

- Aviation threat-specific information provided through the MRMS platform
- Reflectivity at specific flight levels beneficial to aviation users
- Improved diagnosis and depiction of icing conditions of interest to aircraft operations
- Improved validation techniques to ensure that MRMS data can be used effectively and reliably for operational decision-making
- Improved weather radar diagnosis and depiction of turbulence conditions of interest to aircraft operations



## Out Year Funding Requirements

FY21	FY22	FY23
\$ 350K	\$ 350K	\$ 350K

# Quality Assessment (QA)

## Research Requirement

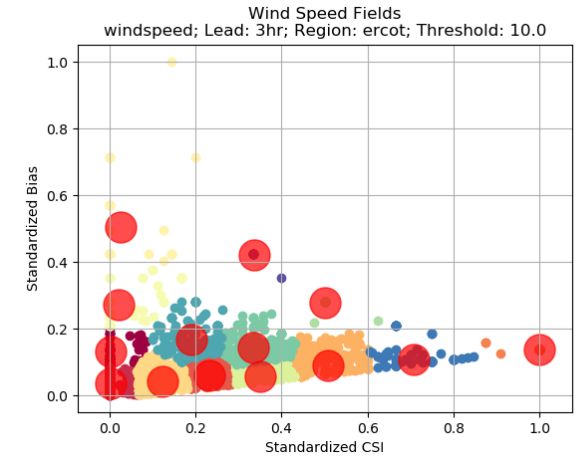
- Improved observations & enhanced forecasts must have effective & reliable verification prior to becoming operational to ensure the accuracy, performance, and value of these products for NAS users
- Sponsored by ANG-C6, ANG-C7, AJM-3, AJR-B, AJV-S
- POC: ANG-C63 Sean Whelan 609-485-4838; ANG-C63 Steve Maciejewski 609-485-5950

## FY 2024 Planned Research

- Impact of C&V on new NAS entrants assessment
- RRFS Version 2 assessment

## 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



## Out Year Funding Requirements

FY21	FY22	FY23
\$ 1.0M	\$ 1.0M	\$ 1.0M

# 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, AJM-3, AJR-B, AJV-S
- 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
- Data and analysis to reduce programmatic risk, aid in definition and validation of requirements and inform AMS lifecycle management activities to improve the delivery of research capabilities developed



## FY 2024 Planned Research

- Conduct research to define information gaps to further enhance requirement development and design of weather capabilities
- Conduct user assessments for Icing, Convective Storms, Turbulence, and C&V to ensure existing and emerging weather products enhance user decision making and support decision making
- Participate/support the AWC Testbed Summer and Winter Experiments

## Out Year Funding Requirements

FY21	FY22	FY23
\$ 500K	\$ 500K	\$ 500K

# Terminal Area Icing Weather 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: AFS-200, AFS-400
- POC Stephanie DiVito, ANG-E2; 609-485-7152

## FY 2024 Planned Research

- Evaluate capabilities met vs. required for a final TAIWIN capability
- Focus on planning operational implementation
- Conduct flight campaign to collect data for TAIWIN capability validation/verification efforts

## Outputs/Outcomes

- Improved icing weather information including SLD in terminal area
- 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



## Out Year Funding Requirements

FY21	FY22	FY23
\$ 1.3M	\$ 1.3M	\$ 1.6M



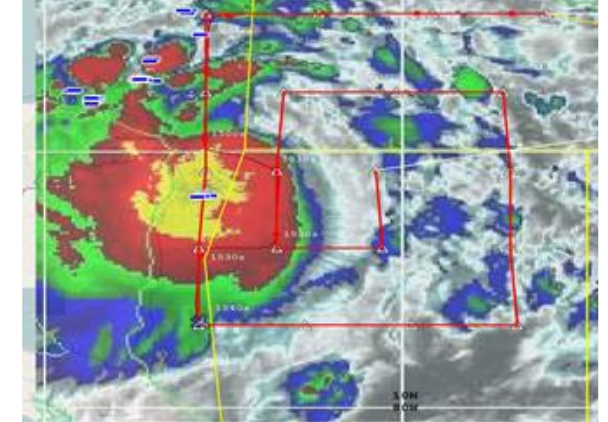
# High Ice Water Content (HIWC)

## Research Requirement

- NTSB: A-96-54, -56, & -58
- Characterization of HIWC ice crystal environments that can be a threat to turbine engines
- Diagnosis and forecasting of HIWC ice crystal environments
- Sponsored by AIR-6A1, AFS-400
- POC Stephanie DiVito, ANG-E2; 609-485-7152

## Outputs/Outcomes

- Atmospheric HIWC ice crystal data set sufficient for assessment of certification envelopes, development of test facilities, onboard detection for avoidance, and diagnosis and forecasting for avoidance
- Enhanced avoidance of HIWC conditions



## FY 2024 Planned Research

- Evaluation of ice crystal icing certification envelope
- Operational implementation path for ALPHA

## Out Year Funding Requirements

FY21	FY22	FY23
\$ 1.4M	\$ 1.0M	\$ 1.2M



# UAS Weather

## Research Requirement

- Gaps between current weather capabilities and weather information needed for safe and efficient airspace management of UAS operations
- The goals of the UAS Weather project are to further research identified gaps and explore the potential enhancement of current weather capabilities or development of new capabilities to close those gaps
- Support Operational Improvement for Qualified Weather Information
- Sponsored by AFS 200,400,800, ANG-C6
- POC: Kevin Johnston, ANG-C64, 202-267-6377

## Outputs/Outcomes

- Improved weather information required for safe and efficient UAS operations and integration into the NAS
- Processes that enable FAA oversight of Third-Party Weather Providers



## FY 2024 Planned Research

- Continue collaboration with FAA UAS organizations
- Continuation of understanding weather needs for UAM operations
- Validation of forecast performance of numerical models in UAS Domains
- Examine how reports of adverse weather conditions correlate to topography and pilot reports. Demonstrate that specific routes or areas are accessible to low-level flight when heights of cloud bases at selected reference stations reach specified values

## Out Year Funding Requirements

FY21	FY22	FY23
\$ 500K	\$ 750K	\$ 500K

# Weather Observations (Wx Obs)



## Research Requirement

- Conduct and transition research that enhances or increases weather observations on the surface with the goal of improving capacity and surface operations.
- Evaluation of emerging observing technologies are required to validate user needs and assess readiness for formal concept demonstration and transition into operations.
- Sponsored by ANG-C6, ANG-C7, AJM-3, AJR-B, AJV-S
- POC Victor Passetti, ANG-C63; 609-485-6260

## Outputs/Outcomes

- Affirmation of automated weather detection capabilities synchronized to new or emerging weather observation requirements
- Reinforce the safety risk management process via early user interactions with new observing technologies to clarify desired needs and harmonize transition of new capabilities into existing weather observing platforms

## FY 2024 Planned Research

- Continue assessment of various Liquid Water Equivalent (LWE) measurements during mixed-phase precipitation to determine which can be used to develop more robust determinations of LWE
- Explore further automation of ground truth techniques to evaluate sensor capabilities to better distinguish obstructions to visibility such as fog and/or mist from moderate to heavy precipitation events
- Explore the sensitivity of measuring false accretions during “wet” snow events to develop a method for determining wet snow conditions utilizing the existing ASOS sensors (This is a potential shortfall in observations for UASs)
- Facilitate pre-concept demonstration activities for dual AWOS and ASOS baselines, such as tailored mission analysis and shortfall analysis

## Out Year Funding Requirements

FY21	FY22	FY23
N/A	\$ 500K	\$ 300K

# Acronyms

- AI – Artificial Intelligence
- Airmet - Airmen's Meteorological Information
- AK - Alaska
- ALPHA – Algorithm for Prediction of HIWC Areas
- AMS – Acquisition Management System
- ASOS - Automated Surface Observing Systems
- ATM – Air Traffic Management
- AWC - Aviation Weather Center
- AWDE – Aviation Weather Demonstration and Evaluation
- AWRT – Advanced Weather Radar Techniques
- CAASD – Center for Advanced Aviation System Development
- CIP – Current Icing Product
- CIT – Convectively-Induced Turbulence
- CONOPs – Concept of Operations
- CWAM – Convective Weather Avoidance Model
- DSPs – Decision Support Processes
- ECCC – Environmental & Climate Change Canada
- EMC – Environmental Modeling Center
- EPOCH - Ensemble Prediction of Oceanic Convective Hazards
- FIP – Forecast Icing Product
- GA – General Aviation
- GLMP – Gridded Localized Aviation MOS Program
- GSL – Global Systems Laboratory
- GTG – Graphical Turbulence Guidance
- GTGN – GTG Nowcast
- HIWC – High Ice Water Content
- HRRR – High Resolution Rapid Refresh
- ICAO - International Civil Aviation Organization
- ICICLE – In-Cloud Icing and Large-Drop Experiment
- IFR – Instrument Flight Rules
- IPA - Icing Product Alaska
- LAMP – Localized Aviation MOS Program
- LWL - Liquid Water Equivalent
- MDL – Meteorological Development Laboratory
- MIT/LL – Massachusetts Institute of Technology Lincoln Laboratory
- MRMS – Multi-Radar, Multi-Sensor
- NAS – National Airspace System
- NASA – National Aeronautics and Space Administration
- NCAR – National Center for Atmospheric Research
- NCEP – National Centers for Environmental Prediction
- NOAA – National Oceanic and Atmospheric Administration
- NRC – National Research Council of Canada
- NSIP – NextGen Segment Implementation Plan
- NSSL – National Severe Storms Laboratory
- NWP – NextGen Weather Processor
- NWS – National Weather Service
- OFC - Offshore Forecast Capability
- OPC – Offshore Precipitation Capability
- PoG - Precipitation on the Glass
- RAP – Rapid Refresh
- RRFS - Rapid Refresh Forecast System
- SLD – Supercooled Large Droplet
- TAF – Terminal Area Forecast
- TAIWIN – Terminal Area Icing Wx Information for NextGen
- TAM - Turbulence Avoidance Model
- TCF - Traffic Flow Management Convective Forecast
- TFM - Traffic Flow Management
- TRACON – Terminal Radar Approach Control
- TRB – Turbulence
- UAM - Urban Air Mobility
- UAS – Unmanned Aircraft Systems
- VEIA - Visibility Estimation through Image Analytics
- VRMC - Verification Requirements and Monitoring Capability
- WAFS - World Area Forecast System
- WET - Weather Evaluation Team
- WIMAT - Weather Information Migration and Transition
- Wx - Weather
- Wx Obs – Weather Observations

# Back Up Slides

