ANG The Future of the NAS Starts Here

FAA Office of NextGen (ANG)

REDAC / NAS Ops

Review of FY2022 – 2024 Proposed Portfolio

Weather Program

BLI Number: A11.k

Presenter Name: Randy Bass

Date: March 15, 2022

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
- Incorporation by National Weather Service (NWS) of research capabilities to improve delivery of FAA required services
  - Weather Program funding of High Resolution Rapid Refresh (HRRR) weather model while resulting in NAS benefits, has also provided high resolution severe weather forecasting; benefits to the energy community, est. $200M/yr (enhanced wind prediction); improved freeze forecasts for specialty crops, est. $12.3M/yr; 12 hour precip forecasts (commuter benefit minimizing late arrivals to work) -- Evaluating the Economic Impacts of Improvements to Weather Models – NOAA/Global Systems Lab – 18 Jan 2022
- Incorporation by NWS or commercial industry of research capabilities into weather information that enhances GA safety
- Tangible reduction in avoidable delays and aircraft accidents due to weather
  - Transition of successful weather research capabilities into operations have contributed to a reduction in NAS delays due to weather from 66% in 2007 to 57% in 2019

Weather Program A11.k
Program Support

People:

- Program Manager and 12 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 National Severe Storms Lab – Advanced Wx Radar Techniques (AWRT), TAIWIN
- NOAA NCEP (Environmental Modeling Center and Aviation Weather Center) – MDE
- NWS MDL – C&V
- MIT/LL – Convective Storms, C&V, Weather Observations (Wx Obs)
- NCAR – In-flight Icing (IFI), 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
- Metron Aviation, Inc. – Turbulence
- MITRE CAASD - UAS

Current FY22 Accomplishments

- Convective Storms (CS)
  - Enhanced and released test website for user assessments of Offshore Precipitation Capability (OPC) development
  - Expanded geographical domain of OPC to include additional portions of the Atlantic Ocean, Gulf of Mexico and eastern Pacific
  - Provided OPC forecast capability to test website
  - Commenced transition of Ensemble Prediction of Oceanic Convective Hazards (EPOCH) to National Weather Service (NWS) to support international weather requirements; transition expected to be completed in FY23
- In-flight Icing (IFI)
  - Developed enhanced weather satellite and weather radar techniques for incorporation into the Current Icing Product (CIP) using the In-Cloud Icing & Large-drop Experiment (ICICLE) dataset to validate and verify improvements in the diagnosis of inflight icing
  - Provided Forecast Icing Product (FIP) software code to NOAA Global Systems Laboratory for implementation with the Rapid Refresh Forecast System (RRFS) weather prediction model
- Model Development and Enhancement (MDE)
  - Provided RRFS output to Weather Program research teams for development of specific aviation weather hazard forecast capabilities
  - Continued development of the RRFS with increased efforts on the ensemble portion of the weather prediction model
- Turbulence (TRB)
  - Hosted virtual Turbulence Mitigation Workshop IV. 200+ participants over 3 days
  - Assisted Airbus in deploying Eddy Dissipation Rate capability on A-350 fleet
  - Completed report detailing progress developing probabilistic turbulence forecasts
  - Began transition discussions with NWS for Graphical Turbulence Guidance - Nowcast (GTG-N) algorithm -- NTSB Recommendation
- Ceiling and Visibility (C&V)
  - Conducted the Visibility Estimation through Image Analytics (VEIA) Safety Risk Management (SRM) Panel Meeting, and completed VEIA SRM Document for the display of VEIA on the WeatherCams operational website (weathercams.faa.gov); conducted analysis of VEIA when applied to WeatherCams new 360 degree camera set-up; analyzed performance of VEIA outside Alaska
  - Began development of Cloud Estimation through Image Analytics (CEIA) and conducted initial tests
  - Developed Localized Aviation Model Output Statistics (MOS) Program (LAMP) station-based probabilistic and deterministic C&V forecasts for 15-minute periods ending at 00, 15, 30, and 45 minutes past the hour, out to six hours -- four times the temporal resolution of the operational version for the first six hours
  - Developed station-based forecasts for the timing of onset and cessation of flight categories at airports and gathered feedback from stakeholders on the best way to display or communicate this information
  - Began a field study at Cincinnati/Northern Kentucky International Airport (CVG) to assess the use of drone-based observations to improve fog prediction

Current FY22 Accomplishments (cont'd)

- Advanced Weather Radar Techniques (AWRT)
  - Final deliverable reports completed:
    - Terminal Doppler Weather Radar (TDWR) integration into the NWS's Multi-Radar Multi-Sensor (MRMS) weather mosaic -- NTSB Recommendation
    - Improvements to MRMS quality control algorithm
    - Helicopter Emergency Medical Services algorithm development -- NTSB Recommendation
- Quality Assessment (QA)
  - Verification Plan for GTG-4 Assessment
  - Verification Plan for HRRR-based CIP and FIP assessment
- Aviation Weather Demonstration & Evaluation (AWDE) Services
  - Icing Product Alaska – Diagnosis (IPA-D) Concept of Use (ConUse): Developed a ConUse document detailing how Part 135/121 Pilots, GA Pilots, Part 135/121 Dispatchers, and Meteorologists use IPA-D to support decision making
  - HIWC and TAIWIN User Assessment: Conducted an assessment to determine the overall usability and suitability of the Algorithm for the Prediction of HIWC Areas (ALPHA) and TAIWIN products in providing support for decision making
  - Probabilistic Displays research: Conducted research with NOAA to identify optimal design strategies for presenting probabilistic weather information

Current FY22 Accomplishments (cont'd)

- Terminal Area Icing Weather Information for NextGen (TAIWIN)
  - Conducted the fourth ICICLE workshop which focused on updates to ICICLE-related research for radar, satellite, surface observations, weather forecast models, icing products, and airborne-based analyses
  - Completed development of the first version of the TAIWIN capability that provides diagnosis and forecasting of icing conditions within the Northeast U.S., specifically providing capability output for sixteen airports in the domain
  - Commenced the TAIWIN capability demonstration and evaluation activity for the first version of the TAIWIN capability, performing research flights in January-February 2022 and establishing objectives for a FY22-23 user demonstration and evaluation activity
- High Ice Water Content (HIWC)
  - Continued preparation for HIWC high aerosol campaign with the goal to collect ice crystal icing aircraft data in high aerosol environments
  - Identified case studies for comparison of ALPHA and Convective Diagnostic Oceanic (CDO) products
  - Began preparations for an FY22 ALPHA user demonstration and evaluation in coordination with AWDE Services
- UAS Wx
  - Completed report on ongoing UAS research efforts that may be candidates for technology transfer
  - Commenced urban micro-scale weather (wind) sensitivity study for UAS integration advancement
    - Simulations at 6 meter resolution of Raleigh, NC to determine how landscape and buildings affect wind flow and turbulence below 400 feet for different wind speeds and directions

Anticipated Research in FY23

Planned Research Activities

- CS
  - Integrate FAA Traffic Flow Management (TFM) requirements; target research in NAS sensitive/high traffic areas
  - Collaborate with Weather Evaluation Team (WET) to research possible convective weather tasking to support Collaborative Decision Making (CDM)
  - Work with Weather Information Migration and Transition (WIMAT) to explore streamlining the number of convective weather products; "modernizing" convective weather products by digitizing those that are currently textual and/or graphical
- IFI
  - Incorporate enhanced weather satellite and weather radar capabilities into the prototype CIP and assess increased performance of the enhanced CIP
  - Prepare CIP software code for transition to NWS for FY24 operational implementation
  - Assist NOAA GSL with FIP transition to NWS for FY24 operational implementation
- MDE
  - Finalize initial RRFS code in anticipation of FY24 operational implementation
  - Document performance of the RRFS forecasts of aviation weather hazards
  - Research different techniques for decimating 3 km weather data to 13 km for continued use by FAA systems
- TRB
  - Turbulence Avoidance Model (TAM) prototype development, experimental implementation
  - Eddy Dissipation Rate (EDR) algorithm correlation study
  - Begin transition of GTG-N algorithm tailored for RRFS model to NWS
  - Investigate different methods of reporting turbulence from aircraft

Anticipated Research in FY23

Planned Research Activities

- C&V
  - Complete the field study at CVG airport to assess the use of drone-based observations to improve fog prediction
  - Complete initial testing of new CEIA algorithm; plan and conduct CEIA Quality Assessment and User Assessment
  - Adapt VEIA to 360 degree camera imagery; begin development to assimilate VEIA data into LAMP
  - Develop San Francisco International Airport-specific LAMP guidance for cloud ceiling and visibility
  - Quantify risks and impact of adverse C&V on NAS operations
- AWRT
  - Implement winter weather and convective products into the developmental Multi-Radar, Multi-Sensor (MRMS) system for performance monitoring
  - Continue integration and testing of TDWR data into MRMS
- 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
  - TAM User Assessment: Conduct an assessment to determine if TAM provides usable and sufficient turbulence information to support decision making
  - CIP/FIP Assessment: Conduct an assessment to determine how the higher resolution icing information is used and displayed when adapted into the HRRR and eventually RRFS
  - Flight Category Onset/Cessation User Assessment: Conduct an assessment focused on determining optimal design strategies when presenting flight categories onset and cessation when using a Terminal Aerodrome Forecast (TAF)

Anticipated Research in FY23 (cont'd)

Planned Research Activities

- TAIWIN
  - Complete the TAIWIN capability evaluation and demonstration for the first version of the capability
  - Analyze results of TAIWIN capability evaluation and user demonstration and evaluation, focusing on operational implementation and validation/verification needs
  - Develop objectives for a validation/verification flight campaign for the high-resolution 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
  - Evaluate use of airport and off-airport observations to provide analyzed local information
  - Investigate hazardous weather alerting concepts for UAS operations
- Weather Observations (Wx Obs)
  - Begin matrix of agency weather observing shortfalls with related ICAO/World Meteorological Organization requirements
  - Continue 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 FY23 (cont'd)

Expected Research Products

- CS
  - EPOCH transitioned to NWS to provide better convective weather forecasts for the World Area Forecast System (WAFS)
- IFI
  - Enhance CIP and FIP transitioned to NWS for operational implementation
  - Developmental CIP and FIP drop size information to provide aircraft certification criteria guidance (performance-based standards to meet regulatory compliance)
- MDE
  - Finalize RRFS software code in preparation of FY24 operational implementation
- TRB
  - GTG-Global transitions to experimental phase for WAFS
  - GTG-4 (RRFS) transition to NWS
- C&V
  - Automated visibility estimates and cloud cover detection from weather cameras
  - 15-minute gridded forecasts of ceiling and visibility to support low altitude flyers including general aviation, helicopters, and UAS
  - Model derived forecasts of onset and cessation of IFR condition at airports to support TFM

Anticipated Research in FY23 (cont'd)

Expected Research Products

- AWRT
  - Web tool to display terminal-area winter weather hazards using the MRMS system
- QA
  - New verification techniques for analysis of gridded weather products
  - New verification techniques for analysis of probabilistic ensemble forecasts
- UAS Wx
  - Analysis of weather products that support UAS operations for determination of minimum weather standards
  - Report on hazardous weather alerting concept
- Wx Obs
  - Initial traceability document of observing shortfalls to ICAO/WMO requirements
  - Establish ground truth information for use in LWE mixed precipitation studies

Emerging FY24 Focal Areas

- CS
  - Begin transition of OPC into NextGen Wx Processor initial version; begin research on OPC v2 for remaining requirements
  - Expand the targeted CS research to operationally sensitive areas within the NAS
- IFI
  - Development of initial drop-size capability for CIP and FIP to address aircraft certification criteria
  - Development of initial UAS capability to adapt automated icing products to low-level UAS operations
- MDE
  - Development of RRFS version 2 to include improved aviation weather forecasts (aircraft ability to fly precise paths in space and time, and users being aware of uncertainty)
- TRB
  - TAM verification/validation by users, preparations for transition to operations via FAA CSS-Wx/NWP
  - GTG-N transition to operations at NWS
  - Climate change effects on turbulence patterns for air routes
  - Turbulence mitigation capabilities for use in UAS/UAM operations
- AWRT
  - Transition weather radar data into the Helicopter Emergency Medical Services website maintained by AWC
  - Investigate weather radar capability requirements for NWP and develop strategies for research opportunities in support of these requirements

Emerging FY24 Focal Areas

- C&V
  - Improve the C&V information produced by the LAMP including development of Gridded LAMP cloud top guidance on an expanded domain, Gridded LAMP C&V for Hawaii, and testing data assimilation of camera-based observations
  - Continue to improve the visibility and cloud estimates from weather cameras and conduct a Safety Risk Management review of CEIA technology for implementation on the FAA Weather Camera website
  - Conduct a cost-benefit analysis for the use of fully-autonomous drone-based weather sensing systems near airports with high C&V impacts and complex terrain features
- QA
  - Assessments to include:
    - Ceiling and visibility capabilities for CONUS and Alaska
    - Capability of forecasting the size of super-cooled large droplets
    - Probabilistic Turbulence Forecasts
    - Enhancements to IFI for CONUS, Alaska, and global capabilities
- AWDE
  - Conduct a User Assessment to determine the overall usability and suitability of the Convective Weather Avoidance Model
  - Conduct a follow-on OPC User Assessment to assess the implementation of new requirements

Emerging FY24 Focal Areas (cont'd)

- TAIWIN
  - Continue development of the high-resolution TAIWIN capability (capability to communicate an icing diagnosis and forecast at horizontal and vertical points throughout the terminal area at high spatial and temporal resolutions)
  - Prepare for flight campaign to collect data for validation and verification of high-resolution TAIWIN capability
- HIWC
  - Evaluation of ice crystal icing environments
- UAS Wx
  - Continue collaboration with FAA UAS organizations for understanding weather needs for Advanced Air Mobility and Urban Air Mobility operations
  - Validation of forecast performance of numerical models in UAS domains
- Wx Obs
  - Document human vs automated observing techniques for candidate shortfalls
  - Continue exploring automation of ground truth techniques for evaluating surface sensor capabilities to better distinguish obstructions to visibility such as fog and/or mist from moderate to heavy precipitation events

Convective Storms (CS)

Research Requirements

- Improve observations and forecasts of convective storms. Create and improve standards and techniques integration into Decision Support Processes (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 TFM Convective Forecast (TCF); begin developing convective weather end-to-end prototype
- Continue operational transition of OPC; begin development on OPC version 2 to capture any remaining requirements
- Complete "baseline/legacy" Convective Weather Avoidance Model (CWAM) research requirements for transition

Out Year Funding Requirements

	FY22	FY23	FY24
RE&D	$1.6M	$ 1.6M	$ 1.6M

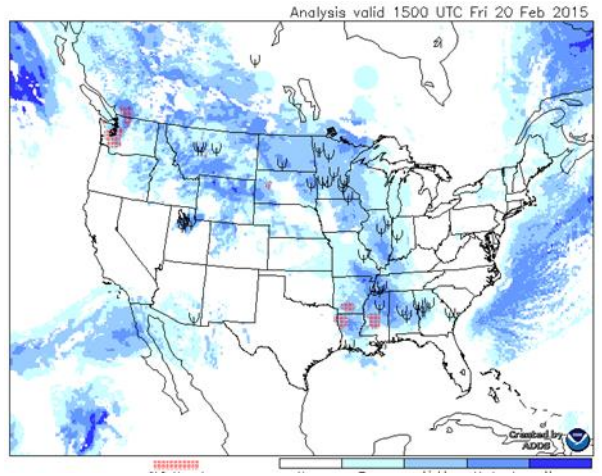
Inflight Icing (IFI)

Research Requirements

- 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

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



FY 2024 Planned Research

- Refine drop-size capability in icing products to meet aircraft certification envelopes
- Merging of CONUS and Alaska capabilities
- Development of initial, prototype capability for low-level UAS operations

Out Year Funding Requirements

	FY22	FY23	FY24
RE&D	$ 1M	$ 1.2M	$ 1.5M

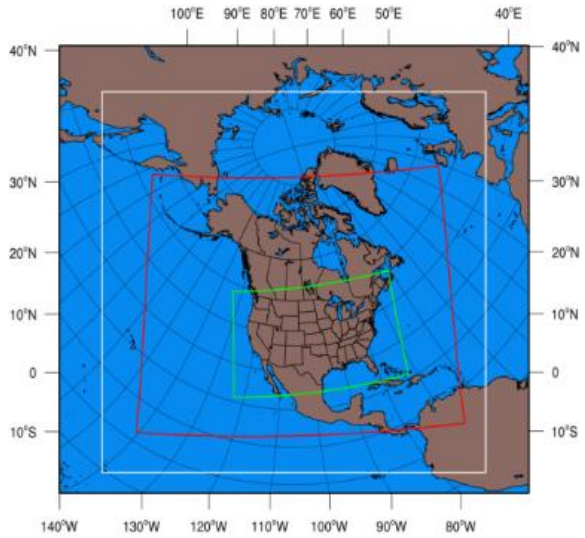
Model Development and Enhancement (MDE)

Research Requirements

- 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

- Enhanced RRFS data assimilation
- Enhanced RRFS model physics
- Development of RRFS version 2 to include improved aviation weather forecasts

Out Year Funding Requirements

	FY222	FY23	FY24
RE&D	$ 0.9M	$ 1.0M	$ 1.2M

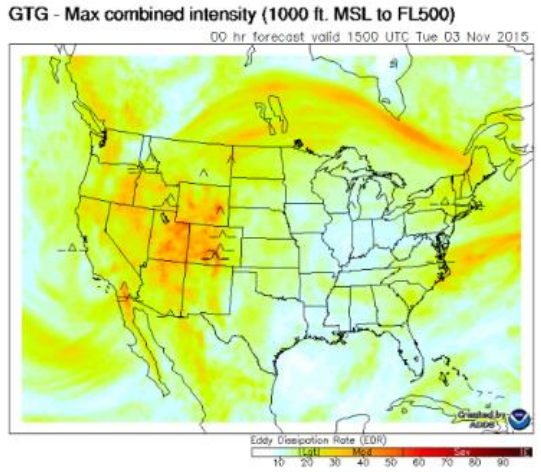
Turbulence (TRB)

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

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



FY 2024 Planned Research

- Turbulence mitigation capabilities for use in UAS/UAM operations
- Climate change effects on turbulence patterns and air traffic route
- TAM transition to CSS-Wx/NWP
- Integrate GTG-N into operations at NWS
- GTG-5 probabilistic transition to operations at NWS

Out Year Funding Requirements

RE&D

FY22	FY23	FY24
$ 1.0M	$ 1.0M	$1.0M

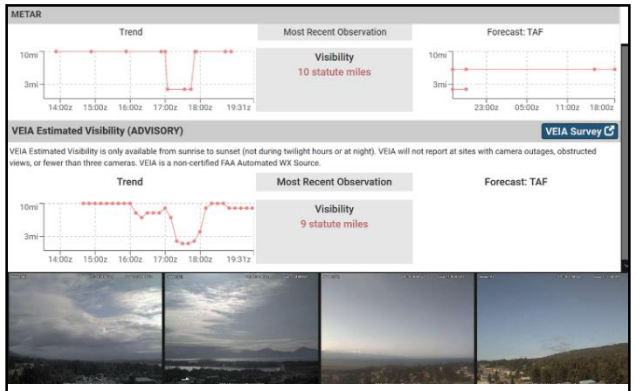
Ceiling and Visibility (C&V)

Research Requirements

- Improve C&V detection and prediction with the goal of reducing GA accidents/incidents and improving airport efficiency.
- Sponsored by ANG-C6, ANG-C7, AJM- 3, AJR-B, AJV-S
- POC: Jenny Colavito, ANG-C61, 202-267-2787

Outputs/Outcomes

- Improvements to C&V guidance at airports
- Improvements to and expansion of C&V gridded guidance
- New sources for C&V observations: camera based and drone based
- C&V predictions translated into actionable Traffic Flow Management Initiatives
- Supports enhanced GA safety and ATM based decision support processes to improve efficiency



Example of VEIA camera based visibility estimates displayed on the WeatherCams test website

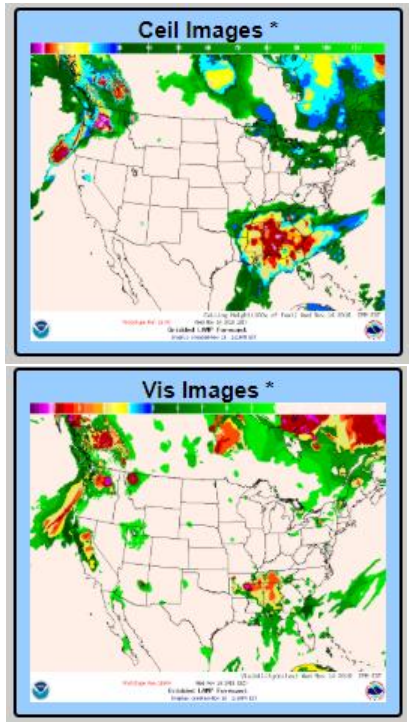
FY 2024 Planned Research

- GLMP ceiling height guidance nests at high impact airports and Cloud Top guidance on an expanded domain
- LAMP upgrades for operational implementation including adaptations for RRFS and GLMP C&V for Hawaii
- Begin testing data assimilation of camera-based observations in LAMP
- Conduct cost-benefit analysis for the use of fully-autonomous drone-based weather sensing systems near airports with high C&V impacts and complex terrain features

Out Year Funding Requirements

RE&D

FY22	FY23	FY24
$ 1 M	$ 1 M	$ 1.5 M



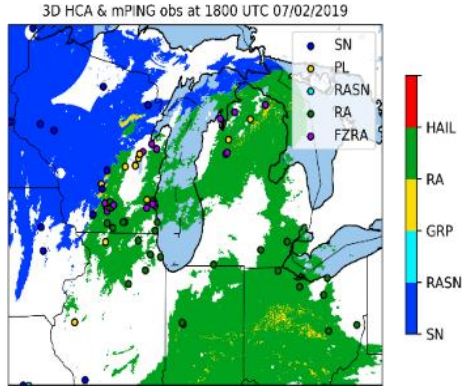
Examples of GLMP images

Advanced Weather Radar Techniques (AWRT)

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

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

FY 2024 Planned Research

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

Out Year Funding Requirements

RE&D

FY22	FY23	FY24
$ 500K	$ 500K	$ 500K

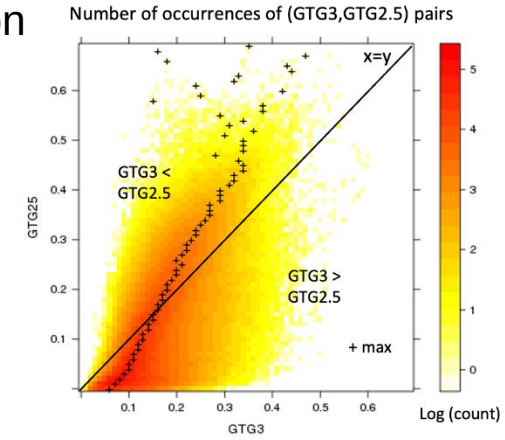
Quality Assessment (QA)

Research Requirements

- 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

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 2024 Planned Research

Assessments:

- RRFS upgrade and its impacts to the icing algorithm
- Ceiling and visibility capabilities for CONUS and Alaska
- Capability of forecasting the size of super-cooled large droplets
- Probabilistic Turbulence Forecasts
- Enhancements to convective weather capabilities for the OPC westward expansion blockage
- Enchantments to IFI for CONUS, Alaska, and global capabilities

Out Year Funding Requirements

	FY22	FY23	FY24
RE&D	$ 1.0M	$ 1.0M	$ 1.0M

Aviation Weather Demonstration & Evaluation (AWDE) Services

Research Requirements

- 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 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

RE&D

FY22	FY23	FY24
$ 500K	$ 500K	$ 500K

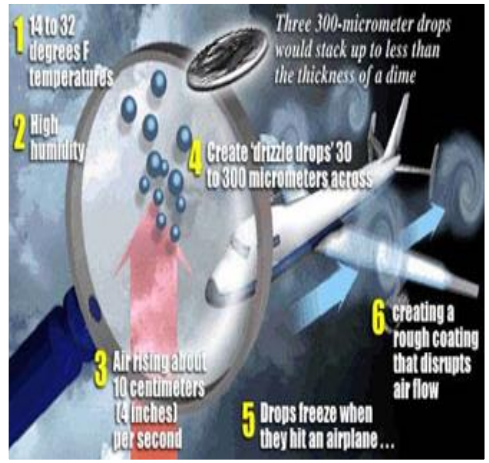
Terminal Area Icing Weather Information for NextGen (TAIWIN)

Research Requirements

- 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

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



FY 2024 Planned Research

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

Out Year Funding Requirements

RE&D

FY22	FY23	FY24
$ 1.4M	$ 1.6M	$ 1.6M

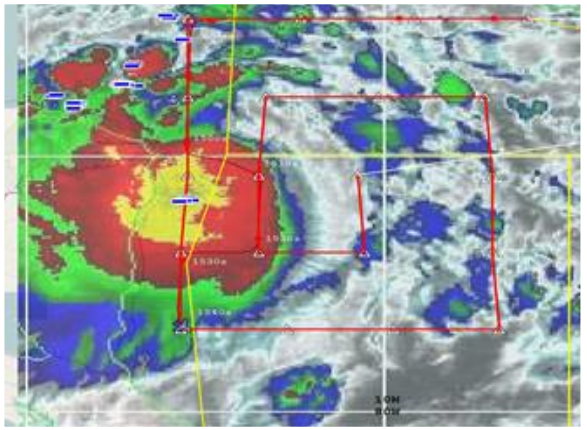
High Ice Water Content (HIWC)

Research Requirements

- 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-624, 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

- Perform analysis on HIWC environment data from previous HIWC campaigns, leveraging data and observations obtained in the FY22/23 high aerosol HIWC flight campaign
- Operational implementation path for ALPHA

Out Year Funding Requirements

RE&D

FY22	FY23	FY24
$ 700K	$ 500K	$ 400K

UAS Weather

Research Requirements

- 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 ANG-C6, ANG-C7, AJM-3, AJR-B, AJV-S
- 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

FY 2024 Planned Research

- Continue collaboration with FAA UAS organizations
- Continuation of understanding weather needs for AAM and 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

RE&D

FY22	FY23	FY24
$ 500K	$ 500K	$ 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 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

	FY22	FY23	FY24
RE&D	$ 250K	$ 400K	$ 500K