

# FAA Office of NextGen (ANG)

**REDAC/NAS Ops** 

Review of FY22 – FY25 Proposed Portfolio

UAS Weather Deep Dive Presenter Name: Kevin Johnston, ANG-C64 Date: 8/30/2022

### Agenda

- Projects
  - FAA
  - NASA
  - Others
- Timeline
- Challenges
- Open Discussion

Return to Outline ANG Starts Here

### UAS Weather Deep Dive Outline

### **FAA** Topics

- 1. Operational Improvement
  - NextGen Aviation Weather Division (ANG-C6) Lead
- 2. <u>MITRE Urban/Suburban Microscale Modeling for Uncrewed Aircraft System (UAS) and Urban Air Mobility (UAM) Interests</u> and Applications
  - ANG-C6 Lead
- 3. Frequent in situ Observations above Ground for Modeling and Advanced Prediction of fog (FOGMAP)
  - NextGen (ANG) Lead/Sponsor
- 4. Icing, Snow, and Rain Means of Compliance for UAS
  - Aircraft Certification (AIR) Lead/Sponsor
- 5. UAS Weather Research in the Boundary Layer
  - Flight Standards (AFS) Lead/Sponsor, ANG-C6 Co-Sponsor
- 6. UAS Weather Hazards
  - AFS Lead/Sponsor, ANG-C6 Co-Sponsor
- 7. Analyzed Weather
  - AFS Lead, ANG-C6 Support
- 8. Performance Based Weather Standard (PBWS)
  - AFS Lead, ANG-C6 Support
- 9. UAS/AAM Integration Research Plan (UIRP) Weather Needs
  - AUS/ANG
- 10. Weather Community of Interest UAS Special Weather Action Team (Wx COI UAS SWAT)
  - ANG-C6/AFS Co-Lead

### UAS Weather Deep Dive Outline

### **NASA** Topics

#### 11. NASA-FAA UIRP

- ANG-C6/UAS Integration Office (AUS) & National Aeronautic and Space Administration (NASA) collaborating
- 12. <u>Support Full Operational Capability of Qualified Weather Supplemental Data Service Providers (SDSPs) and Weather In-</u> <u>time Aviation Safety Management System (IASMS) Mitigation Capability</u>
  - ANG-C6/AFS Research Ties
- 13. Vertiport Sensor Infrastructure Requirements
  - ANG-C6/AFS Research Ties
- 14. SBIR Phase II Urban Wx Sensing Infrastructure Testbed
  - ANG-C6/AFS Research Ties

### **Other Activities**

- 15. <u>ASTM F-38 Standard Specification for Wx Data Performance, Wx Data Interfaces & Wx Information Provider Performance</u> <u>& Interoperability</u>
  - ANG-C6/AFS/AIR/AUS
  - Weather Community of Interest Uncrewed Aircraft System Special Weather Action Team (Wx COI UAS SWAT) Participating
- 16. NOAA-FAA UAS for Atmospheric Measurements
  - ANG-C6/AUS
  - Wx COI UAS SWAT Members Participating
  - National Oceanic & Atmospheric Administration (NOAA) & National Weather Service (NWS) Participating
- 17. WMO UAS Demonstration Campaign (WMO UAS-DC)
  - ANG-C6/AFS/AUS
  - Wx COI UAS SWAT Members Participating
  - NOAA, NWS, and National Center for Atmospheric Research (NCAR) Participating

#### ANG The Future of the NAS Starts Here

# ANG The Future of the NAS Starts Here

# Operational Improvement (OI)

### OI Overview & Program Support

#### What are the benefits to the FAA?

 New role and responsibility of Federal Aviation Administration (FAA) Qualifying weather (Wx) data

#### What determines program success?

 Establishment of FAA processes to qualify the performance of third-party service providers that will assist new entrants, non-traditional aviation users, and even traditional aviation with flight planning, operations, and regulatory dispatch purposes.

#### **Timeline:**

• Fiscal Year 2022 (FY22) - FY27

#### Lead:

- *Kevin Johnston* NextGen Aviation Weather Division (ANG-C64)
- Connections to FAA Projects:
  - MITRE Urban/Suburban Microscale Wx
  - FOGMAP
  - Icing, Snow, and Rain Means of Compliance
  - UAS<sup>1</sup> Wx Research in the BL
  - Analyzed Wx
  - PBWS
  - UIRP<sup>2</sup> New Research Item 1
  - NOAA<sup>3</sup> FAA UAS for Atmospheric Measurement
- Connections to External Projects:
  - NASA<sup>4</sup> Support Full Operational Capability of Qualified Wx SDSPs<sup>5</sup> and Wx IASMS<sup>6</sup> Mitigation Capability

**Starts Here** 

- NASA SBIR<sup>7</sup> Phase II Urban Wx Sensing Infrastructure Testbed
- ASTM F-38 Standard Specification
- WMO<sup>8</sup> UAS-DC<sup>9</sup>

#### FAA Office of NextGen (ANG)

UAS<sup>1</sup> = Uncrewed Aircraft System UIRP<sup>2</sup> = UAS/Advanced Air Mobility Integrated Research Plan NOAA<sup>3</sup> = National Oceanic and Atmospheric Administration NASA<sup>4</sup> = National Aeronautic and Space Administration SBIR<sup>5</sup> = Small Business Innovation Research SDSP<sup>6</sup> = Supplemental Data Service Provider IASMS<sup>7</sup> = In-time Aviation Safety Management System WMO<sup>9</sup> = World Meteorological Organization

WMO<sup>8</sup> = World Meteorological Organization UAS-DC<sup>9</sup> = UAS Demonstration Campaign

### **OI Accomplishments & Focus Areas**

#### Accomplishments:

The Operational Improvement (OI) was included in National Airspace System (NAS) Segment
Implementation Plan - Part of the FAA Enterprise Architecture

### Focus Areas:

- Creation and execution of Increments within the OI
- Uncrewed Aircraft Systems (UAS) Weather Information Standards (Observations, Analyzed Wx, and Forecasts)
  - Related to: ASTM-F38 Standards Specification, PBWS, Analyzed Wx, UAS Wx Research in the BL
- UAS Weather Provider Verification/Quality Assurance
- UAS Weather Provider Dissemination
- UAS Weather Provider Training
- UAS OI Support:
  - UAS Qualified Weather OI Project Plan
  - UAS Qualified Weather OI Roadmap Report
  - UAS Qualified Weather OI Qualifications Report
  - UAS Qualified Weather OI Technical Standards Report
  - UAS Qualified Weather OI Technical Providers Report

The Future of the NAS **Starts Here** 



Urban/Suburban Microscale Modeling for UAS and UAM Interests and Applications - MITRE

### MITRE Urban/Suburban Microscale Modeling Overview & Program Support

#### What are the benefits to the FAA?

- Researchers use of expected results will allow collaboration with other functional FAA interests in order to assess the approach, the data, and the findings to support UAS integrated research needs such as:
  - Planning weather observation networks
  - Developing safety scenarios sets for riskbased assessments
  - Enabling training
  - Informing infrastructure/airspace planning

#### Timeline:

• FY22-FY23

#### Sponsors:

- Kevin Johnston (ANG-C64)
- **Randy Bass** NextGen Human Factors Division (ANG-C61)

#### Authors for Phase 1 - Raleigh:

- MITRE
- Aeris, LLC
- Connections to FAA Projects:
  - UAS Wx Hazards
  - OI
- Connections to External Projects:
  - NASA Vertiport Sensor Infrastructure Requirements

Return to Outline

The Future of the NAS **Starts Here** 

### MITRE Urban/Suburban Microscale Modeling Accomplishments & Focus Areas

#### Accomplishments:

 Published 1st report to the FAA on Raleigh, NC that "Demonstrates the value of fast-time, microscale weather modeling to UAS/Urban Air Mobility (UAM) mission interests."

### Focus Areas:

- "Leverage fast-time urban, microscale weather model" to evaluate weather conditions & severity of weather hazards to UAS/Advanced Air Mobility (AAM) operations"
- Research:
  - 1. "Urban/suburban, microscale weather model runs"
  - 2. Scenario 1 Afternoon, well-mixed environment
  - 3. Scenario 2 Time evolution from morning to afternoon (as BL destabilizes)
  - 4. "Translate... results into preliminary UAS/UAM hazard fields"
  - 5. Results depend upon vehicle & mission types and landing / takeoff, and routing structure
  - 6. "Translate microscale weather model results into UAS micro-weather hazard products"
  - 7. "Develop preliminary probabilistic hazard maps for weather scenarios"
  - 8. "Using Joint Outdoor Indoor Large Eddy Simulation (JOULES), replicate the 2018 downtown Manhattan drone crash conditions"

G The Future of the NAS Starts Here

The Future of the NAS Starts Here Frequent in situ Observations above Ground for Modeling and Advanced Prediction of fog (FOGMAP)

### FOGMAP Overview & Program Support

#### What are the benefits to the FAA?

- Improvements to airport safety and efficiency
- Improvements to efficiency of the NAS

#### What determines program success?

 Determining the potential improvement in the skill of fog predictions that could be attained by collecting high quality observations of the lower atmosphere using small UAS and assimilating these observations into a Numerical Weather Prediction model.

#### **Timeline:**

• FY21-FY23

#### **Researchers:**

- Jenny Colavito NextGen Aviation Weather Division (ANG-C61)
- National Center for Atmospheric Research (NCAR) Research Applications Laboratory
- University of Kentucky
- Connections to FAA Projects:
  - OI
  - UAS Wx Hazards
  - NOAA-FAA UAS for Atmospheric Measurement

Return to Outline

- Connections to External Projects:
  - NASA Support Full Operational Capability of Qualified Wx SDSPs and Wx IASMS Mitigation Capability

The Future of the NAS **Starts Here** 

• WMO UAS-DC

# ANG The Future of the NAS Starts Here

# Icing, Snow, & Rain Means of Compliance

### Icing, Snow, & Rain Means of Compliance Overview & Program Support

#### What are the benefits to the FAA?

- Develop performance-based standards for UAS type certification
- UAS will require new ice detection and ice/snow protection technology to operate safely and efficiently in the NAS
  - Research will provide updated standards to integrate this new technology
- Streamline UAS type certificate regulatory process and will define means of compliance that will minimize cost but provide a high level of safety

#### What determines program success?

• Development of Means of Compliance

#### Timeline:

• FY23-FY26

#### Research Sponsoring Office POC & Sponsoring Office Manager:

Aircraft Certification - Policy & Innovation (AIR-691)

#### Research Managing Office:

NextGen - New Entrants (ANG-C2)

#### Proposed Researcher:

• NextGen - Aviation Research Division (ANG-E282)

#### Offices Dependent on this Research:

- National Aeronautics and Space Administration (NASA) Glenn
- Transport Canada
- European Union Aviation Safety Agency (EASA)
- Connections to FAA Projects:
  - NOAA-FAA UAS for Atmospheric Measurement

Return to Outline

The Future of the NAS **Starts Here** 

- OI
- Connections to External Projects:
  - WMO UAS-DC



# UAS Weather Research in the Boundary Layer (BL)

### UAS Wx Research in the BL<sup>10</sup> Overview & Program Support

### What are the benefits to the FAA?

- Weather cuts across all UAS Operational Capabilities and Implementation Phases, including:
  - Operations Over People
  - Expanded Operations
  - Small UAS Package Delivery
  - Integrated Operations
  - Routine/Scheduled Operations
  - Large Cargo Operations
  - Passenger Transport Operations.
- Research is required to understand the ability to detect and forecast UAS weather hazards so the NAS can maintain a high level of safety.

### What determines program success?

- Developing and verifying a Visual Weather Observation System (VWOS)
- Determining procedural changes for UAS operations in the NAS with respect to establishing a means to accept or approve weather detection, prediction, application, and integration systems for use in all UAS operations

#### Timeline:

• FY23-FY29

#### Research Sponsoring Office Point of Contact (POC):

 Flight Standards - Air Transportation (AFS-200), Flight Standards -Flight Technologies & Procedures (AFS-400), UAS Integration Office - Research, Engineering, & Analysis Division (AUS-300)

#### Research Managing Office POC:

• ANG-C2

#### **Other Sponsor POC:**

• ANG-C64

#### Research Sponsoring Office Manager:

- AUS-300
- Connections to FAA Projects:
  - OI
  - PBWS
  - Analyzed Wx
  - UAS Wx Hazards
  - UIRP ANG-11, ANG-12, ANG-13
- Connections to External Projects:
  - NASA Support Full Operational Capability of Qualified Wx SDSPs and Wx IASMS Mitigation Capability
  - NASA SBIR Phase II Urban Wx Sensing Infrastructure Testbed
  - ASTM F-38 Standards Specification
  - NOAA-FAA UAS for Atmospheric Measurement
  - WMO UAS-DC

### Return to Outline ANG Starts Here

### UAS Wx Research in the BL Accomplishments & Focus Areas

#### Accomplishments:

• Submitted FY25 proposal

#### Focus Areas:

- 1. Determine initial needs/requirements of UAS VWOS program (e.g., weather parameters, frequency of reports, receipt of reports, locations of systems, etc.) based on weather hazards and gaps.
  - Related to: NASA Support Full Operational Capability of Qualified Wx SDSPs and Wx IASMS Mitigation Capability
- 2. Develop Analyzed Weather information standards and forecast weather information standards for UAS
  - Related to: Analyzed Wx & PBWS
- 3. Coordination with UAS Test Site program to verify the needs/requirements of the UAS VWOS program
- 4. Develop a list of modified/new weather standards for data and forecasts needed by UAS operators
  - Related to: PBWS
- 5. Determine a means to accept/approve weather information/data for use in all types of UAS operations
  - Related to: O/
- 6. Standards, procedures, and/or requirements listing, modification, and generation
- 7. Develop the UAS VWOS weather information/data
- 8. Implement modified standards, procedures, and/or requirements for UAS operations

G Starts Here



# UAS Weather Hazards Research

### UAS Wx Hazards Overview & Program Support

#### What are the benefits to the FAA?

- Weather hazards have historically impacted manned aviation operations in the NAS.
- Thus, weather information and products have evolved overtime to help reduce these impacts.
- The unique characteristics of UAS, such as flying at altitudes below 400 feet with reduced speed capabilities and new control system design, introduce new weather hazards that are not fully understood.

#### What determines program success?

• Developing and implementing new weather standards/requirements related to UAS flight planning, weather forecasting, and operations based on research

#### Timeline:

FY23-FY25

#### Research Sponsoring Office Point of Contact (POC):

• AFS-200, AFS-400, AUS-300

#### Research Managing Office POC:

• ANG-C2

#### **Other Sponsor POC:**

• ANG-C64

#### Research Sponsoring Office Manager:

- AUS-300
- Connections to FAA Projects:
  - UAS Wx Research in the BL
  - Analyzed Wx
  - MITRE Urban Microscale Wx Modeling for UAS and UAM Interests and Applications
  - FOGMAP
  - UIRP ANG-14
  - NOAA-FAA UAS for Atmospheric Measurement

Return to Outline

- Connections to External Projects:
  - NASA Support Full Operational Capability of Qualified Wx SDSPs and Wx IASMS Mitigation Capability
  - NASA Vertiport Sensor Infrastructure Requirements
  - NASA SBIR Phase II Urban Wx Sensing Infrastructure Testbed

The Future of the NAS **Starts Here** 

• WMO UAS-DC

### UAS Wx Hazards Accomplishments & Focus Areas

#### **Accomplishments:**

• Submitted FY25 proposal

#### **Focus Areas:**

Focus: Low Level (below 400 feet), Line of Sight UAS

- 1. Request operational feedback on UAS weather hazards
- 2. Determine new test sites/stakeholders to contact to request future weather components in new UAS test sites and evaluations to identify weather hazards/gaps for [focus]
- 3. Based on new inputs, determine methodology & re-prioritize UAS weather hazard/gaps for [focus]
- 4. Based on previous research, develop a list of modified or new weather standards for data & forecasts needed by UAS operators
- 5. Determine how well the current infrastructure can capture weather data relevant to [focus]
- 6. Identify and determine accessibility of existing weather tech and data that mat address UAS weather hazards/gaps and be useful for [focus]
- 7. Determine highest temporal resolution currently possible with exiting or proposed meteorological measurement infrastructure

G Starts Here

# ANG The Future of the NAS Starts Here

# **Analyzed Weather**

### Analyzed Weather Overview & Program Support

#### What are the benefits to the FAA?

- Moves FAA into qualifying weather data
- Improved Qualified weather Information Coverage
  - 3% coverage from current FAA Approved weather Sources
  - UAS operations don't occur at airports
  - Improved access to Qualified weather Information supporting General Aviation
- Improved Safety
  - Better defined Go/No-Go decisions
- Increased Efficiency
  - Less diversions & fewer cancellations when FAA
     Approved weather Source is unavailable
    - Height Above Airport lifesaving operations
- Decreased carbon footprint & fuel savings
- UAS operations Beyond Visual Line of Sight (BVLOS) need these weather Elements to safely conduct operations

#### What determines program success?

Operational use of Analyzed Weather information

#### **Timeline:**

• FY21-FY23

#### Lead:

• AFS-200, AFS-400

#### Sponsor:

- ANG-C64
- Connections to FAA Projects:
  - OI
  - UAS Wx Research in the BL
  - UAS Wx Hazards
  - UIRP ANG-10, ANG-11, ANG-12, ANG-13, ANG-14
- Connections to External Projects:
  - NASA SBIR Phase II Urban Wx Sensing Infrastructure Testbed

The Future of the NAS **Starts Here** 

- NOAA-FAA UAS for Atmospheric Measurement
- WMO UAS-DC
- ASTM F-38 Standards Specification

### Analyzed Weather Accomplishments & Focus Areas

#### Accomplishments:

- National Oceanic and Atmospheric Administration (NOAA) Real Time Mesoscale Analysis (RTMA) Report Published
  - Temperature & Pressure are parameters that verified well
  - Wind direction and speed (when below 15 miles per hour) did not verify well
- Analyzed Weather is being considered for/incorporated into NextGen Aviation Weather Division (ANG-C6) and Flight Standards (AFS) research projects, like:
  - OI
  - UAS Wx Research in the BL
  - ASTM F-38 Standards Specification

#### Focus Areas:

- Explore three-dimensional RTMA being Developed by NOAA as a follow-on to RTMA
- Use Analyzed Weather within:
  - O/ in FY23+
  - UAS Wx Research in the BL in FY23+

The Future of the NAS Starts Here



Performance Based Weather Standards (PBWS)

### PBWS Overview & Program Support

#### What are the benefits to the FAA?

- Moves FAA into qualifying weather data
- Performance Based Weather Standards (PBWS) bolster improved Qualified Weather Information coverage
- Improved Safety
  - PBWS assists with better defined Go/No-Go decisions
- UAS operations BVLOS need these Standards to safely conduct operations

#### What determines program success?

Operational use of tiered PBWS

#### Lead:

• AFS-200, AFS-400, AIR-691

#### Subject Matter Experts (SMEs):

- ANG-C64
- Connections to FAA Projects:
  - *OI*
  - Wx Research in the BL
  - NOAA-FAA UAS for Atmospheric Measurement
  - UIRP ANG New Research 1

#### Connections to External Projects:

 NASA SBIR Phase II - Urban Wx Sensing Infrastructure Testbed

The Future of the NAS **Starts Here** 

- NASA Vertiport Sensor Infrastructure Requirements
- ASTM F-38 Standards Specification

Return to Outline

#### FAA Office of NextGen (ANG)

### PBWS Accomplishments & Focus Areas

#### Accomplishments:

• Used preliminary PBWS for recommendations to ASTM-F38 on their Standards Specification

#### Focus Areas:

- Assist in Finalizing ASTM F-38 Standards Specification, as needed
  - Expected first standards publication Fall 2022
- This work will assist with:
  - UAS Wx Research in the BL in FY 23+
  - OI in FY23+
  - NASA Support Full Operational Capability of Qualified Wx SDSPs and Wx IASMS Mitigation Capability in FY29+

G Starts Here



2022-2027 UAS/AAM Integration Research Plan (UIRP) Weather Needs

### 2022-2027 UIRP Weather Needs Overview & Program Support

#### What are the benefits to the FAA?

- Identifying UAS/AAM Weather Needs that can be accomplished through FAA Research in the UAS/AAM Integrated Research Plan (UIRP)
  - The UAS/AAM Weather needs fit within these Operational Capabilities:
    - Expanded Operations
    - Small UAS (sUAS) Package Delivery
       Operations
    - Integrated Operations
    - Large Carrier Cargo Operations
    - Passenger Transport Operations
    - AAM

#### Timeline:

• FY22-FY27

#### Weather Lead:

• Kevin Johnston (ANG-C64)

Return to Outline

**Starts Here** 

- Program Lead:
  - TBD/Misc.

### 2022-2027 UIRP Weather Needs

- ANG New Research 1: For the purposes of Weather Transition, planned UAS support activities focus on the integration of UAS into the NAS through the development of new FAA processes that will qualify the performance of supplemental third-party service providers in the provision of weather information.
  - This is the O/
- ANG-10: Investigate the feasibility of using RTMA to provide Analyzed Weather information for UAS/UAM/AAM operations.
  - Being accomplished through *Analyzed Wx*
  - Report Provided on RTMA
- ANG-11: Identify the minimum set of requirements to develop a comprehensive flight-relevant weather dataset, including weather observations, Analyzed Weather, weather forecast, aviation, and terrain data, to support UAS/UAM/AMM integration.
  - Being accomplished through UAS Wx Research in the BL



### 2022-2027 UIRP Weather Needs

- ANG-12: Assess the feasibility to improve, refine, and validate off-airport weather observations (e.g., visibility, ceiling, wind) for rural and urban UAS and AAM/UAM operations to increase density of geographically sparse observations outside of terminal areas. This will incorporate the Analyzed Weather capability.
  - Being accomplished through UAS Wx Research in the BL
- ANG-13: Research current weather sensor accuracy and technologies to support current UAS and future UAS/UAM/AAM Operations.
  - Being accomplished through UAS Wx Research in the BL
- ANG-14: Weather forecast and reporting capabilities related to weather phenomena that have been determined to be a hazard to UAS operations and supports hazard mitigation for future UAS/UAM/AAM operations. This will incorporate the Analyzed Weather capability.
  - Being accomplished through UAS Wx Hazards



Direct	F
Connection	• •
Indirect	

Connection

### AA Research Interconnections with UIRP

			ANG/AFS Research						
		<u>Ol</u> Qualifying 3rd Party Wx Providers	Urban Microscale Wx Fast-time Microscale Wx Modeling	FOGMAP UAS for Fog Prediction	Icing, Snow, and Rain Means of Compliance Means of Compliance for UAS	Wx Research in the BL Wx Gaps for UAS Ops in the NAS	UAS Wx Hazards Detect & Forecast UAS Wx Hazards	Analyzed Wx Filling in the gaps for Wx Info	PBWS Tiered Wx Standards Dev for UAS
ANG New Rese Development of FAA g qualify supplemental service provid	earch 1 processes to 3 <sup>rd</sup> party Wx ders	Direct							
ANG-10 RTMA for Analyz	zed Wx							Direct	
ANG-11 ID min. requirements fo to support UAS/AAM	r a Wx dataset integration					Direct			
ANG-12 Improve/refine/validat Wx obs for UAS/AAM of density of obs outside t	te off-airport ps to increase terminal areas					Direct			
ANG-13 Research current W accuracy/tech for cur UAS/AAM O	Vx sensor rent/future 0ps					Direct			
ANG-14 Investigate Wx forecast hazards to UAS	/reporting for S ops						Direct		

Return to Outline ANG Starts Here



Weather Community of Interest UAS Special Weather Action Team (Wx COI UAS SWAT)

### Wx COI UAS SWAT Overview & Program Support

#### What are the benefits to the FAA?

 Problem Statements worked on by a cross-cutting group of SMEs across the FAA, with some industry involvement

#### What determines program success?

Problem Statement closure

#### **Co-leaders:**

- Kevin Johnston (ANG-C64)
- John Steventon (AFS-400)

#### SMEs:

- FAA:
  - ANG-C6
  - AFS
  - AIR
  - AUS
    - Air Traffic Organization (ATO)
      - Terminal Division (AJT)

Return to Outline

- Technical Operations Division (AJW)
- Mission Support Services Division (AJV)
- Safety & Technical Training Division (AJI)
- Air Traffic Controllers
  - National Air Traffic Controllers Association (NATCA)

The Future of the NAS **Starts Here** 

- Other:
  - MITRE
  - AvMet

### Wx COI UAS SWAT Problem Statements

#### **Problem Statement 43:**

- UAS BVLOS conducted under Part 135 or UAS conducted in Instrument Flight Rules (IFR) conditions require an approved weather source. ASTM working group is establishing standards for commercial weather information providers which will supplement the certified weather available today. These standards will have to be reviewed, accepted and published in FAA advisory material. Part 135 Operators under IFR or BVLOS, by regulation will need approval to utilize a Commercial Weather Information Providers in areas where FAA or National Weather Service (NWS) source weather information is not available.
- There are no approved weather standards for UAS operations
  - UAS BVLOS conducted under Part 135 or UAS conducted in IFR conditions require an approved weather source otherwise they cannot operate.
  - There is no certification process to ensure weather providers and Supplemental Data Service Providers (SDSPs) can meet the standards for the provision of weather information.

#### **Problem Statement 44:**

 It is generally accepted that existing weather observation and forecast information (clouds/ceiling, visibility, surface winds, winds aloft, convection, turbulence, icing, precipitation, temperature and barometric pressure) lack the resolution to effectively support remotely operated and autonomous UAS flight operations in the NAS. However, gaps in this information compared to what is readily available today is not well understood and this makes it difficult to determine where to focus research to address the gaps. The FAA needs to understand the critical weather thresholds and weather limitations on UAS vehicles and UAS operations to address potential gaps through research.

The Future of the NAS Starts Here



### **Internal Research Interconnections**

		FAA Wx Research							
		OI Qualifying 3rd Party Wx Providers	Urban Microscale Wx Fast-time Microscale Wx Modeling	FOGMAP UAS for Fog Prediction	Icing, Snow, and Rain Means of Compliance Means of Compliance for UAS	Wx Research in the BL Wx Gaps for UAS Ops in the NAS	UAS Wx Hazards Detect & Forecast UAS Wx Hazards	Analyzed Wx Filling in the gaps for Wx Info	PBWS Tiered Wx Standards Dev for UAS
	OI Qualifying 3rd Party Wx Providers								
	Urban Microscale Wx Fast-time Microscale Wx Modeling								
	FOGMAP UAS for Fog Prediction								
Research	Icing, Snow, and Rain Means of <u>Compliance</u> Means of Compliance for UAS								
A W×F	Wx Research in the BL Wx Gaps for UAS Ops in the NAS								
FΑ	UAS Wx Hazards Detect & Forecast UAS Wx Hazards								
	Analyzed Wx Filling in the gaps for Wx Info								
	PBWS Tiered Wx Standards Dev for UAS								

Return to Outline ANG Starts Here

# ANG The Future of the NAS Starts Here

# NASA-FAA UAS/AAM Integration Research Plan (UIRP)

### NASA-FAA UIRP Overview & Program Support

#### **Overview:**

- Weather is a Primary Topic
- NASA & FAA have identified weather research that intersects both agencies
  - Developed a slide deck together on the connections between NASA-FAA UAM/AAM weather research
  - Presented at the Meeting on August 17<sup>th</sup> between FAA-AUS/ANG & NASA

#### Weather Research Leads:

- Nancy Mendonca (NASA)
- Kevin Johnston (ANG-C64)



NASA - Support Full Operational Capability of Qualified Wx SDSPs & Wx IASMS Mitigation Capability

### NASA - Support Operational Capability of Qualified Wx SDSPs Overview & Program Support

#### What are the benefits to the FAA?

• NASA supporting FAA development of process to qualify weather SDSPs

#### Timeline:

• FY22-FY29

#### Lead:

- Nancy Mendonca (NASA)
- Connections to FAA Projects:
  - OI
  - Wx Research in the BL
  - PBWS
  - UAS Wx Hazards
  - FOGMAP
- Connections to External Projects:
  - ASTM F-38 Standards Specification

Return to Outline A

- NASA Vertiport Sensor Infrastructure Requirements
- NASA SBIR Phase II Urban Wx Sensing Infrastructure Testbed

The Future of the NAS **Starts Here** 

• WMO UAS-DC



NASA - Vertiport Sensor Infrastructure Requirements

### NASA - Vertiport Sensor Infrastructure Requirements Overview & Program Support

#### What are the benefits to the FAA?

 "Lead the development of analysis and modeling of vertiport sensors infrastructure and systems to develop requirements for these sensors and systems"

#### What determines program success?

• Develop requirements for systems and sensors required to support vertiport operations and automation, including system analysis and modeling

#### **Timeline:**

• FY22-FY28

#### Lead:

- Nancy Mendonca (NASA)
- Connections to FAA Projects:
  - UAS Wx Hazards
  - PBWS
  - Urban Microscale Modeling for UAS and UAM Interests and Applications
- Connections to External Projects:
  - NASA Support Full Operational Capability of Qualified Wx SDSPs and Wx IASMS Mitigation Capability

G The Future of the NAS Starts Here

 NASA SBIR Phase II - Urban Wx Sensing Infrastructure Testbed

# The Future of the NAS Starts Here

NASA Small Business Innovation Research (SBIR) Phase II - Urban Weather Sensing Infrastructure Testbed

### Urban Wx Sensing Infrastructure Testbed Overview & Program Support

#### What are the benefits to the FAA?

- Improves wind measurements in the lowest portion of the atmosphere, enabling safe UAS and AAM industries.
- "Monitoring and predicting the weather with an ecosystem of sensing, prediction, and communication is critical for meeting FAA requirements for high data integrity, reliability, and comprehensive predictability"

#### What determines program success?

• This program aims to "mitigate UAS BVLOS and AAM system risk by increasing micro-weather certainty"

#### Timeline:

• FY22-FY24

#### Team:

- NASA
- TruWeather Solutions
- Daniel H. Wagner Associates
- Longbow
- ResilienX
- Connections to FAA Projects:
  - OI
  - UAS Wx Research in the BL
  - PBWS
  - Analyzed Wx
  - UAS Wx Hazards
- Connections to External Projects:
  - NASA Support Full Operational Capability of Qualified Wx SDSPs and Wx IASMS Mitigation Capability

The Future of the NAS **Starts Here** 

NASA - Vertiport Sensor Infrastructure Requirements

Return to Outline

• ASTM F-38 Standards Specification

# The Future of the NAS Starts Here

**ASTM F-38 Standard Specification for Wx Data** Performance, Wx Data Interfaces & Wx Information Provider Performance & Interoperability

### ASTM F-38 Standard Specification Overview & Program Support

#### What are the benefits to the FAA?

- The FAA use the ASTM Standard Specification as a recommendation for a Standard.
  - Standard Specification by Fall 2022

#### What determines program success?

 ASTM will "create a document to address performance and interoperability requirements for data, analysis and service roles performed by a Weather Information Provider in support of an Extensible Traffic Management (xTM) system focusing on low-altitude operations."

#### Timeline:

Final Draft by Late Fall 2022

#### Leads:

• ASTM-F38

#### Subject Matter Experts:

- ANG-C64
- AFS-200, AFS-400
- AIR
- AvMet Applications
- Wx Community of Interest UAS Special Weather Action Team (Wx COI UAS SWAT) Members
- Connections to FAA Projects:
  - 01
    - UAS Wx Research in the BL
  - PBWS
  - Analyzed Wx
- Connections to External Projects:
  - NASA Support Full Operational Capability of Qualified Wx SDSPs and Wx IASMS Mitigation Capability
  - NASA SBIR Phase II Urban Wx Sensing Infrastructure Testbed

Return to Outline

The Future of the NAS **Starts Here** 



NOAA-FAA Collaboration on UAS for Atmospheric Measurements

### NOAA-FAA Collaboration on UAS for Atmospheric Measurements Overview & Program Support

#### What are the benefits to the FAA?

 Direct coordination between NOAA and FAA on a mutually beneficial interest - UAS for Atmospheric Measurement

#### What determines program success?

• UAS sampling the atmosphere to a certain altitude at regular intervals for input into atmospheric models, as a supplement to the upper air observing network.

#### Team:

- NOAA
- NWS
- FAA
  - ANG-C64
  - AFS-200/400
  - UAS Integration Office Operational Programs Branch (AUS-410)

The Future of the NAS **Starts Here** 

- Connections to FAA Projects:
  - OI
  - UAS Wx Research in the BL
  - UAS Wx Hazards
  - PBWS
  - Analyzed Wx
  - FOGMAP
  - Icing, Snow, Rain Means of Compliance

- Connections to External Projects:
  - WMO UAS-DC

# ANG The Future of the NAS Starts Here

WMO UAS Demonstration Campaign (WMO UAS-DC)

### WMO UAS-DC Overview & Program Support

#### What are the benefits to the FAA?

- Leverage world-wide, or United States (US) based, UAS Weather Observation Data
- Use the UAS Weather Observation Data in real-time or assimilate it into atmospheric models to assess its impact on NAS operations.
- Regular involvement in World Meteorological Organization (WMO) UAS Demonstration Campaign (UAS-DC) Airspace Regulation Sub-Group Meetings
- Collaboration with NOAA-FAA UAS for Atmospheric Measurement

#### What determines program success?

- FAA contributes US regulatory guidance to enable US
   Flight Operations
- In turn, FAA can use the collected data for assessment of UAS weather observations and their impacts to the NAS

#### Timeline:

- Planning ongoing
- Campaign March-August 2024
- Reports Due August 2025

#### Scoping, Planning, and Organizing Committee:

- WMO
- FAA
  - Wx COI UAS SWAT Members Participating
- NCAR
- NOAA
- University of Nebraska Lincoln
- University of Colorado
- Collins Airspace
- Connections to FAA Projects:
  - 0/
    - UAS Wx Research in the BL
  - UAS Wx Hazards
  - Analyzed Wx
  - NOAA-FAA UAS for Atmospheric Measurement
  - Icing, Snow, Rain Means of Compliance
  - FOGMAP
- Connections to External Projects:
  - NASA Support Full Operational Capability of Qualified Wx SDSPs and Wx IASMS Mitigation Capability



### NASA & Other Research Interconnections

					ANG/AFS	Research			
		<u>O</u> Qualifying 3rd Party Wx Providers	Urban Microscale Wx Fast-time Microscale Wx Modeling	FOGMAP UAS for Fog Prediction	Icing, Snow, and Rain Means of Compliance Means of Compliance for UAS	Wx Research in the BL Wx Gaps for UAS Ops in the NAS	UAS Wx Hazards Detect & Forecast UAS Wx Hazards	Analyzed Wx Filling in the gaps for Wx Info	PBWS Tiered Wx Standards Dev for UAS
rch	NASA O.0.2.1 FOC of Qualified Wx SDSPs								
SA Resea	NASA O-3.1.4 Vertiport Sensor Infrastructure Requirements								
NA	NASA SBIR Phase II Urban Wx Sensing Infrastructure Testbed								
	ASTM F-38 Standard Specification Tiered Wx standards recommendation for UAS/AAM								
ernal Activities	NOAA-FAA Collaboration on UAS for Atmospheric Measurements Team for collaboration on using UAS for collecting routine atmospheric measurements								
Exte	WMO UAS-DC World-wide campaign aimed at using UAS to collect atmospheric measurements								

Return to Outline ANG Starts Here

### **Research Timeline**

FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	
			Operational	Improvement	;					]
	Urban Microscale Mo UAM Interests a	odeling for UAS and nd Applications								
	FOGMAP									
		Icing, Snow,	and Rain Mea	ans of Complia	ance for UAS					FAA
			l	JAS Weather	Research in th	e Boundary Lay	ver			NASA
		UAS	Weather Haz	ards						
A	nalyzed Weath	er								A311VI-F30
	Sup	port Full Opera	ational Capabi	lity of Qualifie	ed Wx SDSPs &	& Wx IASMS Mit	tigation Capabi	lity		
		V	ertiport Senso	or Infrastructu	ire Requiremei	nts				WMO
	Urban Weat	her Sensing In	frastructure							
		Testbed								
Standard Specif Performance, Wx Information Prov Intero	ication for Wx Data Data Interfaces, & Wx vider Performance & perability									
	U	AS Demonstra	tion Campaig	า						
FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	

Return to Outline ANG Starts Here

### Challenges

### Understanding weather limitations on UAS vehicles and operations

• Difficulty obtaining information from operators (hesitancy to share, sample size, etc.)

### • Synergy/coordination

- Avoiding duplication of efforts
- Maintaining communication between FAA Lines of Business
  - Knowledge of Projects/what's being worked
- Connecting/maintaining research interconnections
- Syncing project timelines
- Dependency
  - Oversight of Commercial Weather Providers—need for a regulatory authority
- Need: Risk assessment that considers the availability & accuracy of real surface weather data or weather data above ground level
  - Reason: Weather Forecasts & Analyses provided through Aviation Weather Services can be insufficient in providing information to remote pilots on the conditions they are (or will be) operating in

G The Future of the NAS Starts Here

### **Open Discussion**

Return to Outline ANG Starts Here

# ANG The Future of the NAS Starts Here

Keys

### Key - FAA Lines of Business & POCs

Line of Business	Description	POC for UAS Wx Research
AFS	Flight Standards	
AFS-200	Flight Standards - Air Transportation Division	Gordon Rother, Scott Stacy
AFS-400	Flight Standards - Flight Technologies & Procedures Division	John Steventon
AIR	Aircraft Certification	
AIR-691	Aircraft Certification - Policy and Innovation Division	Paul Pellicano
ΑΤΟ	Air Traffic Organization	
AJI	Air Traffic Organization - Safety & Technical Training Division	
AJT	Air Traffic Organization - Terminal Division	
AJV	Air Traffic Organization - Mission Support Services Division	
AJW	Air Traffic Organization - Technical Operations Division	
ANG	Next Generation Air Transportation System (NextGen)	
ANG-C1	NextGen - Human Factors Division	Randy Bass
ANG-C2	NextGen - New Entrants Division	Nick Lento
ANG-C61	NextGen - Aviation Weather Division	Jenny Colavito
ANG-C64	NextGen - Aviation Weather Division	Kevin Johnston
ANG-E282	NextGen - Aviation Research Division	
AUS	UAS Integration Office	
AUS-300	UAS Integration Office - Research, Engineering, & Analysis Division	Paul Strande, Sabrina Saunders-Hodge
AUS-410	UAS Integration Office - Operational Programs Branch	

Return to Outline ANG Starts Here

### Key - Acronyms

Acronym	Definition	Acronym	Definition
AAM	Advanced Air Mobility	01	Operational Improvement
BL	Boundary Layer	PBWS	Performance Based Weather Standards
BLI	Business Line Item	RE+D	Research, Engineering, and Development
BVLOS	Beyond Visual Line of Sight	RTMA	Real Time Mesoscale Analysis
COI	Community of Interest	SBIR	Small Business Innovation Research
EASA	European Union Aviation Safety Agency	SDSP	Supplemental Data Service Provider
F+E	Facilities and Equipment	SME	Subject Matter Expert
FAA	Federal Aviation Administration	sUAS	small Uncrewed Aircraft System
FOGMAP	Frequent in situ Observations above Ground for Modeling and Advanced Prediction of fog	SWAT	Special Weather Action Team
FY	Fiscal Year	UAM	Urban Air Mobility
IASMS	In-time Aviation Safety Management System	UAS	Uncrewed Aircraft System
IFR	Instrument Flight Rules	UAS-DC	Uncrewed Aircraft System - Demonstration Campaign
JOULES	Joint Outdoor Indoor Large Eddy Simulation	UIRP	UAS/AAM Integration Research Plan
NAS	National Airspace System	US	United States
NASA	National Aeronautics and Space Administration	UWEX	Urban Weather Experiment
NATCA	National Air Traffic Controllers Association	VWOS	Visual Weather Observation System
NCAR	National Center for Atmospheric Research	WMO	World Meteorological Organization
NOAA	National Oceanic and Atmospheric Administration	Wx	Weather
NWS	National Weather Service	хТМ	Extensible Traffic Management

#### FAA Office of NextGen (ANG)

Return to Outline ANG Starts Here

# ANG The Future of the NAS Starts Here

# Backup

### Urban Wx Sensing Infrastructure Testbed Accomplishments & Focus Areas

#### Accomplishments:

- Coordination between NASA and FAA on Research Projects that compliment this project, directly:
  - NASA Support FOC of Qualified Wx SDSPs & Wx IASMS Mitigation Capability
  - OI
  - UAS Wx Research in the BL (Standards)
  - PBWS

#### Focus Areas:

- 1. Deploy weather sensors for the Urban Weather Experiment (UWEX) campaign
- 2. Validate measured and simulated data
- 3. Create low level wind shear detection service
- 4. Develop wind hazard impact location service
- 5. Develop urban safe entry point service
- 6. Develop enhanced rapid refresh
- 7. Enhance weather sensor data monitoring with wind lidar
- 8. Integration and test
- 9. Demonstration

The Future of the NAS **Starts Here** 

**OI** Out Year Funding

### BLI<sup>11</sup>: 103124

	FY22	FY23	FY24
REQU'	\$TBD	\$TBD	\$TBD

	FY22	FY23	FY24	FY25	FY26	FY27
F&E	\$280K	\$ TBD				

FAA Office of NextGen (ANG)

 $\begin{array}{l} \mathsf{BLI}^{11} = \mathsf{Business \ Line \ Item} \\ \mathsf{RE\&D}^{12} = \mathsf{Research, Engineering, \& Development} \\ \mathsf{F\&E}^{13} = \mathsf{Facilities \& Equipment} \end{array}$ 

Return to Outline ANG Starts Here

### MITRE Urban/Suburban Microscale Modeling Out Year Funding

### **BLI: A11K**

RE&D	FY22	FY23	FY24	
	\$300K	\$500K	\$500K	

	FY22	FY23	FY24	FY25	FY26	FY27
FQE	\$0	\$0	\$0	\$0	\$0	\$0

OC6 - UAS/MITRE CAASD

VG The Future of the NAS Starts Here

### FOGMAP Out Year Funding

### BLI: 693KA8-20-D-00013



гог	FY22	FY23	FY24	FY25	FY26	FY27
F&E						

VG The Future of the NAS Starts Here

### Icing, Snow, & Rain Means of Compliance Out Year Funding

### **BLI: A11L.UAS.80**

	FY22	FY23	FY24	
κεαυ	\$0	\$0	\$0	

гог	FY22	FY23	FY24	FY25	FY26	FY27
FQE	\$0K	\$300K	\$600K	\$605K	\$400K	\$0

The Future of the NAS **Starts Here** 

UAS Weather Research in the BL Out Year Funding

### **BLI: A11L.UAS.81**

	FY22	FY23	FY24
REQU	\$600K	\$600K	\$600K

гог	FY22	FY23	FY24	FY25	FY26	FY27
FÆE	\$TBD	\$TBD	\$TBD	\$TBD	\$TBD	\$TBD

VG The Future of the NAS Starts Here

UAS Weather Hazards Out Year Funding

### **BLI: A11L.UAS.82**

	FY22	FY23	FY24	
ΓΕαυ	\$600K	\$600K	\$600K	

	FY22	FY23	FY24	FY25	FY26	FY27
FQE	\$TBD	\$TBD	\$TBD	\$TBD	\$TBD	\$TBD

VG The Future of the NAS Starts Here

Analyzed Weather Out Year Funding

	FY22	FY23	FY24	
REQU	\$200K	\$TBD	\$0	

	FY22	FY23	FY24	FY25	FY26	FY27
FQE	\$0	\$0	\$0	\$0	\$0	\$0

Return to Outline ANG Starts Here