UAS Research Applicable to Rotary Operations

Presented to: USHST 8th Annual Infrastructure Summit

By: Randy Bass

Date: April 6, 2022
UAS Projects Applicable for Rotary Operations

• NAS Segment Implementation Plan
• FAA Weather Community of Interest
• Weather COI UAS SWAT Problem Statement 43
• Weather COI UAS SWAT Problem Statement 44
• Aviation Weather Division UAS Research
• Aviation Safety Funded Research
• Weather Research in Response to Zaleski, OH Accident
NAS Segment Implementation Plan

- Enterprise Architecture Operational Improvement approved NAS Segment Implementation Plan in February 2022 to Qualify Weather Information
  - Developing Supporting Activities to develop/implement internal processes
    - FY22 Tasks:
      o Conduct a survey of current weather information providers that support UAS operations or could reasonably be expected to do so
      o Research and report on existing and/or previous models or processes for qualifying service providers, particularly of MET information
      o Research and report on existing weather information standards and/or requirements to support UAS operations
    - FY23 Tasks:
      o Develop a roadmap that addresses required changes and necessary transitions from current weather-related concepts and policies to enable third party providers of weather information to help integrate UAS into the NAS
      o Develop the framework for qualifying third-party weather information providers

Credit: nasa.gov
FAA Weather Community of Interest (COI)

- Breakdown “silos of excellence” by promoting collaboration, communication, and sharing of weather information among FAA organizations, other Federal agencies, industry, and international partners
- Resolve and/or mitigate mission-specific, information-sharing challenges across the weather enterprise
- Ensure appropriate access to, and availability and consistency of weather information
- Over 40 personnel across the agency participating
- Special Weather Action Teams (SWAT) developed by the COI to develop problem statements and tackle issues, including UAS SWAT
Weather COI UAS SWAT Problem Statement 43

• 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
  – No certification process to ensure weather providers and Supplementary Data Service Providers (SDSPs) can meet the standards for the provision of weather information
  – ASTM* working group is establishing standards for commercial weather information providers
  – These standards will be reviewed, accepted and published in FAA advisory material
• Working with ASTM-F38 Weather Group on standards development
• Identifying important weather thresholds through Aircraft Certification Process

*ASTM, formerly known as American Society for Testing and Materials, is an international standards organization that develops and publishes voluntary consensus technical standards
Weather COI UAS SWAT Problem Statement 44

- It is generally accepted that existing weather observation and forecast information lack the resolution to effectively support remotely operated and autonomous UAS flight operations in the NAS.
- Gaps in this information compared to what is readily available today is not well understood and 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 same is true for rotary operations. WTIC is doing some work in this area, and the HEMS tool helps, but typically weather support to helicopters have been based what’s available for General Aviation. The UAS weather need may help us to finally bridge that gap.
Aviation Weather Division UAS Research

• Report on Weather related UAS activities (AvMet); completed September 2021
• Micro-scale Modeling of wind in an Urban environment - MITRE
  – Report just received and in review
  – Initial results demonstrate that modeling at meter(s) scale resolution can identify when, where, and why specific microscale weather conditions exist
  – Provides excellent opportunity to collaborate with other functional FAA and Industry interests to support UAS integrated research
    o Planning weather observation networks, developing safety scenarios for risk-based assessments, enabling training, informing infrastructure/airspace planning
• Improving fog forecasts using drones to sample atmosphere
  – Testing at Covington Airport near Cincinnati
  – Unfortunately weather didn’t cooperate this winter, trying again this summer
  – Provides mobile coverage around airfield or other areas of interest to collect data
Figure 4-12. Time-Averaged Horizontal (Two-Left Columns) and Vertical (Two-Right Columns) Wind Speed, at 3 m Resolution and 40.5 m Altitude, above and near the USPS Building (Gray Box) and Sanford Federal Building for Different Wind Speed/Direction Event Scenarios. Upward (Downward) Vertical Wind Speed in Red (Blue).
Aviation Safety Funded Research

• UAS Weather Research in the Boundary Layer
  – Develop and verify a Visual Weather Observation System (VWOS)
    o Determine initial needs/requirements (e.g., weather parameters, frequency of reports, receipt of reports, locations of systems, etc.) for VWOS
  – Determine procedural changes for UAS operations in the NAS with respect to establishing a means to accept and/or approve weather detection, prediction, application, and integration systems for use in all UAS operations

• UAS Weather Hazards Research
  – Understand the ability to detect and forecast UAS weather hazards so the NAS can maintain a high level of safety
    o Especially at altitudes below 400 feet
    o Capabilities that presently exist, including non-traditional sensors, and gaps not previously identified
Weather Research in Response to Zaleski, OH Accident
Zaleski, OH Accident NTSB Recommendations

- NTSB Recommendations stemming from Zaleski, OH accident investigation
  - A-20-16: Require the National Weather Service (NWS) to add terminal doppler weather radar data to the Helicopter Emergency Medical Services (HEMS) Weather Tool overlay (as recommended in Safety Recommendation A-20-19 to the NWS)
  - A-20-17: Require the NWS to provide capability in the HEMS Weather Tool to graphically display areas of weather radar limitations, including areas where beams may lack low-altitude coverage, areas that lack radar coverage, and areas of beam blockages (as recommended in Safety Recommendation A-20-20 to the NWS)
  - A-20-19 (NWS): Add terminal Doppler weather radar data to the HEMS Weather Tool overlay (as recommended in Safety Recommendation A-20-16 to the FAA)
  - A-20-20 (NWS): Provide capability in the HEMS Weather Tool to graphically display areas of weather radar limitations, including areas where beams may lack low-altitude coverage, areas that lack radar coverage, and areas of beam blockages (as recommended in Safety Recommendation A-20-17 to the FAA)
Weather Radar Integration Research (Pre-Zaleski)

- AWRP sponsors NOAA’s National Severe Storms Lab (NSSL) to develop aviation threat-specific information through the Multi-Radar Multi-Sensor (MRMS) platform by conducting research and testing future weather sensing and processing capabilities
- The current MRMS domain contains WSR-88D radars, Canadian radars, and several Caribbean radar networks
- Over the past few years, AWRP funded NOAA NSSL to evaluate the benefits of integrating the FAA’s Terminal Doppler Weather Radars (TDWR) into the experimental MRMS max-composite reflectivity product
- TDWR observations are beneficial by providing coverage above and beyond areas covered by the WSR-88Ds, and has potential benefit for enhancing the use of low-altitude mosaics
Missing Low Reflectivity Radar Research

- Compare the HEMS composite reflectivity (CREF) mosaic to the MRMS reflectivity-at-lowest-altitude (RALA) product (currently used in the AWC HEMS tool)

- Background
  - Returns are generally quite weak for low-topped precipitation systems
  - May impact the end users’ ability to discern if icing exists given the current color shading used by the HEMS tool
    - HEMS tool does not display echoes less than 5 dBZ

- Research outcomes
  - 25% of all RA, SN, FZRA, PL, and DZ profiles have reflectivity less than 5 dBZ; 70% of FZDZ profiles have reflectivity less than 5 dBZ
  - These phases are not represented in the HEMS tool using current color shading
  - There are gaps in coverage below 4 km AGL (Fig. 1)
  - Overall, the HEMS CREF provides more coverage than RALA (Fig. 2)
Future TDWR/HEMS Research

• In the coming years, NOAA NSSL will continue to quantify the impact of using TDWR data in MRMS by evaluating its relative coverage and determining whether TDWR observations may be beneficial for improving products, such as the flight-layer reflectivity and echo tops

• Possible options for including TDWR observations into the HEMS tool
  – Include TDWR observations in existing MRMS system
  – Create separate 3D merge of TDWR observations and blend with HEMS CREF

• A shift in the color map used by the HEMS tool is recommended so that light echoes capable of icing are depicted

• Examining ways to alert HEMS users to areas with no radar coverage
  – Figure 1 displays a potential option for highlighting areas where there is currently no radar coverage below 4 km AGL

Figure 1: HEMS-CREF mosaic with areas of no coverage below 4-km AGL hatched.
Questions?

Randy Bass
Manager, Weather Research Branch
Aviation Weather Division
FAA NextGen Advanced Concepts & Technology Development Directorate

randy.bass@faa.gov