UAS and Weather: Current Capabilities and Future Trends

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Current UAS Weather Limitations

- Commercial operations (Part 107 or Section 333) generally follow § 91.155 VFR cloud clearances
  - 3 mile visibility
  - 500 feet below clouds
  - 2,000 feet horizontally away from clouds

- Public Aircraft (COA) follows N8900.227
  - Requires VMC
  - If VFR flight plan, follow § 91.155
  - If IFR flight plan, remain clear of clouds

- Military, operate in weather as aircraft enable
  - Widely varied aircraft sizes and capabilities, and thus large variances in tolerance of wind, temp, precip
  - Some existing/future anti-ice/de-ice capabilities
Future UAS Weather-Capable Needs Will Drive Technology Research and Regulatory Changes

Envisioned UAS BLOS CONOPS in NAS
- High altitude comms node
- Large UAS transit (military)
- Border surveillance
- Cargo delivery (includes OPVs)
- Remote sensing (agriculture, resources)
- Weather research, in situ measurements
- Linear Infrastructure monitoring
- Search and rescue
- Traffic reporting/Media
- Package delivery, urban canyon
- Videography, inspections

Example UAS–Centric RDT&E Initiatives

NASA
- Detect & Avoid (DAA)
- Command/Control (C2)
- UTM Weather Workshop 7/2016

FAA
- UAS COE (ASSURE)
- RTCA
- UAS Test Sites
- Tech Center
- NextGen

Nat’l Science Foundation
- “CLOUD MAP” (OSU)
- “Dear Colleague” UAS Letter, 8/2016

DoD Initiatives
- SBIR Anti–Ice 2/2016
- Many Other

Private Sector Initiatives

Weather Capable/Enabled UAS

Weather–Accomodative UAS

Regulatory Environment

“Next generation RPA must be able to execute missions (both sense and engage) in extreme weather conditions and adverse environments.”

NASA UAS-NAS Project

Unmanned Aircraft Systems (UAS) Integration National Airspace System (NAS) Project

- DAA
- C2

Graphic courtesy NASA
NASA UAS Traffic Management (UTM)

- Research platform for low-altitude UAS CONOPS development
- Enable safe separation/segregation via data-exchanged mission plans and ops updates
- Integrate with UAS Ground Control Stations (GCS)
- Industry-Funded
- Wx Workshop 7/16
  - Wx Impacts
  - User Needs
  - Research Reqts
- UAS Test Site Participation

Graphic courtesy NASA
Northern Plains UAS Test Site (NP UAS TS)

- One of six FAA-designated national UAS test sites
- Led by ND Dept of Commerce
- Operations housed at UND to leverage aviation/safety expertise
- Extensive infrastructure to safely conduct UAS testing in the NAS
- NASA testing for UTM, DAA, LVC–DE
- Private and public sector research/testing
- Key COA initiatives
  - 1,200 ft AGL statewide
  - Night Ops
  - Daisy Chain visual observers
  - Radar observer (DSR–11 @ GFAFB)
  - IMC conditions
UAS R&D Focus Areas at UND

- Leverage Academic Program, Research Assets
- Training/Ops R&D
  - MALE RPA
  - Human Factors*
- Airspace Integration
  - Airborne/Ground-Based DAA*
  - BVLOS Command/Control
  - UAS Traffic Management
- Aircraft/Payload Integration
  - Engineering*
  - Data Analytics
- UAS Applications, including
  - Atmospheric Sciences
  - Infrastructure Inspection
  - Law Enforcement

* ASSURE Tasks

> 200 UAS Undergraduates

2D Radar Truck

AFRL “PRINCE” Training R&D

Powerline Inspection R&D

Northern Plains UAS Test Site

The FAA's UAS Center of Excellence for UAS Research

ASSURE

Alliance for System Safety of UAS through Research Excellence

UND

UNMANNED AIRCRAFT SYSTEMS
UAS and Weather – Priority Areas at UND

- Many research directions possible; need to focus on initial/best value
  - Integration of UAS into the NAS
  - Benefits to UAS community
  - Benefits to aviation-weather community

- Investigations we are pursuing include:
  - Weather hazards (accuracy, range) for radar DAA systems, both airborne and ground-based
  - Methods for assimilating, into forecast Observation System Simulation Experiment (OSSE), in situ measurements taken by UAS
  - Using UAS to improve conditional awareness of and forecasting for winter weather
  - Fine-scale measurements using UAS to better estimate localized wind fields/gusts
  - Low-level turbulence assessments
  - Boundary layer sampling

WRF OSSE assimilation of synthetically sampled phase array radar data, tornadic event (8/26/07)
Closing Remarks

- UAS ability to fly in adverse weather is limited by current regulations and by current technology.

- UAS are a hugely disruptive technological driver; advances in weather-related technology driven by UAS can benefit the entire aviation community.

- Next advances will be in best-value near-term economic returns to the UAS business aviation community.