UAS and Weather: Current Capabilities and Future Trends

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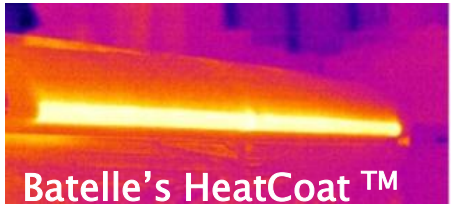
Current UAS Weather Limitations

- 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

Magpie during UTM testing at UND



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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

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

"RPA Vector: Vision and Enabling Concepts 2013-2038", USAF Feb 2014

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

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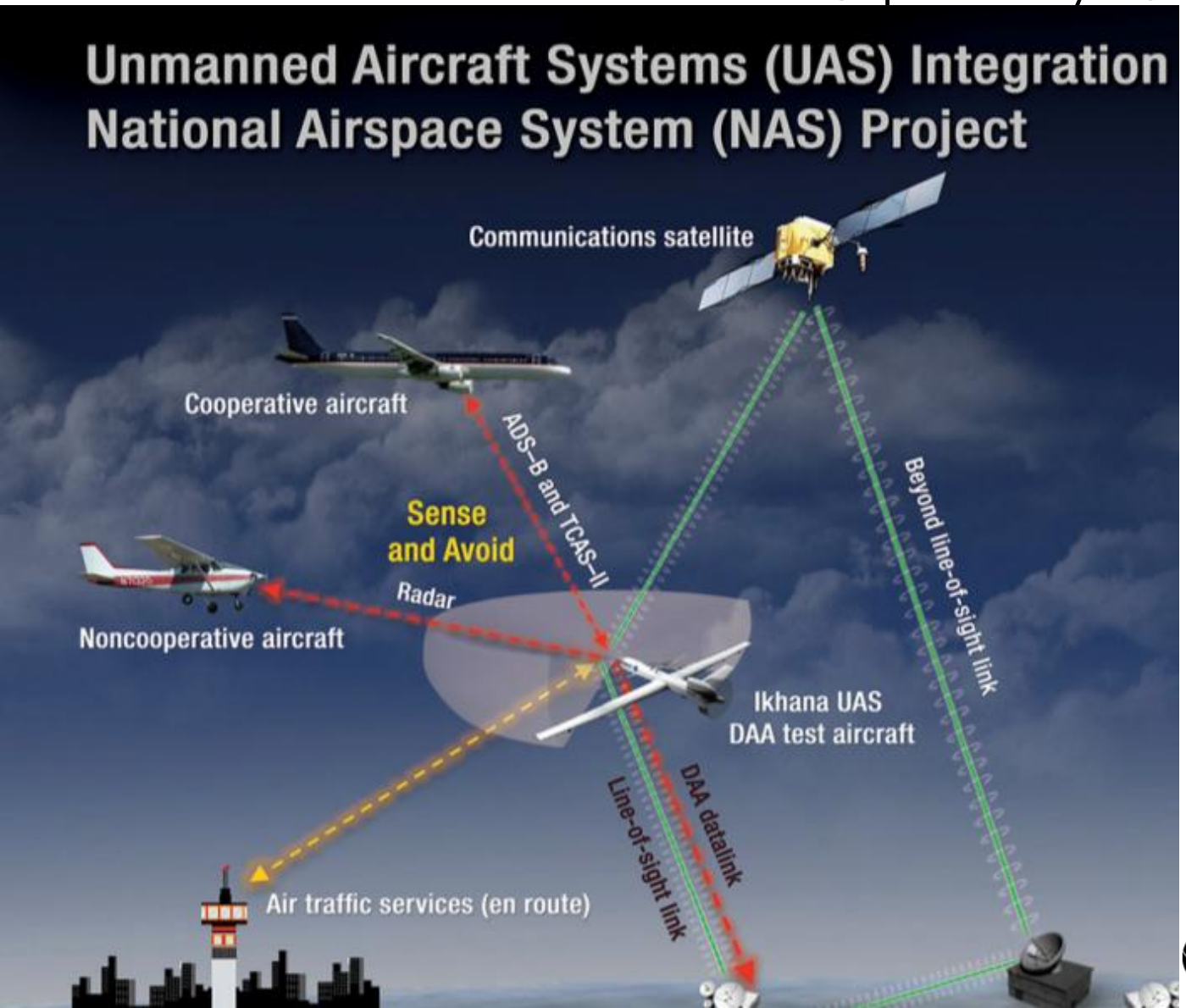
NASA UAS-NAS Project

Graphic courtesy NASA



- DAA
- C2

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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

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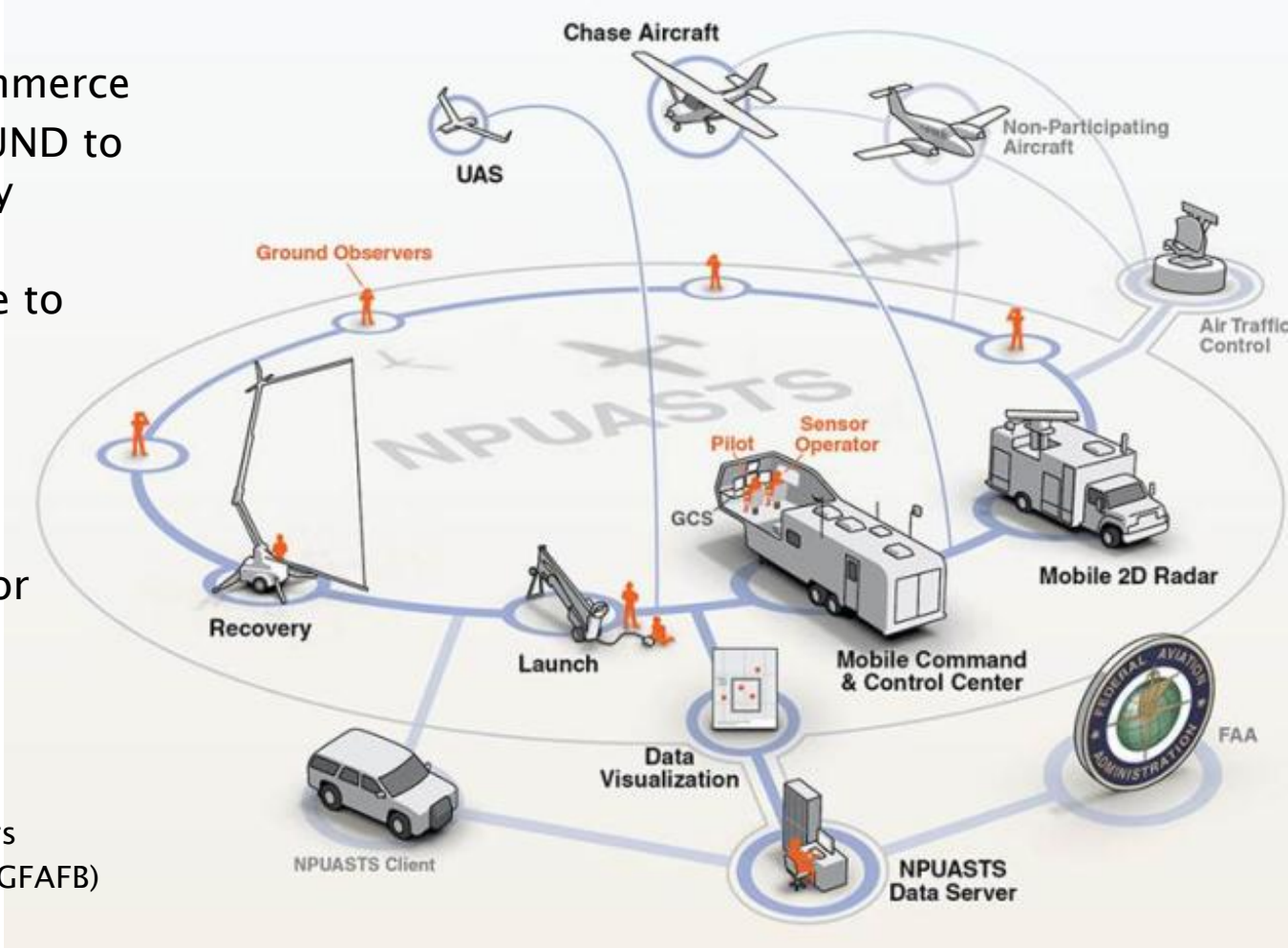
Northern Plains UAS Test Site (NP UAS TS)

- 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



NORTHERN PLAINS UAS TEST SITE

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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

> 200 UAS Undergraduates

2D Radar Truck

AFRL "PRINCE" Training R&D

GRANDSKY
GRAND FORKS COUNTY, ND

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Powerline Inspection R&D

* ASSURE Tasks

The FAA's UAS Center of Excellence for UAS Research
ASSURE
Alliance for System Safety of UAS through Research Excellence

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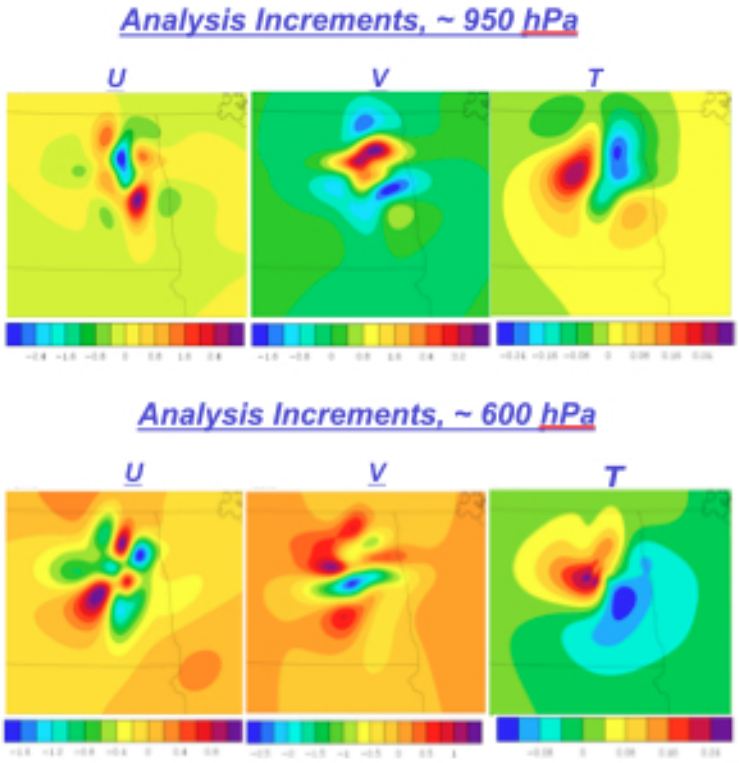
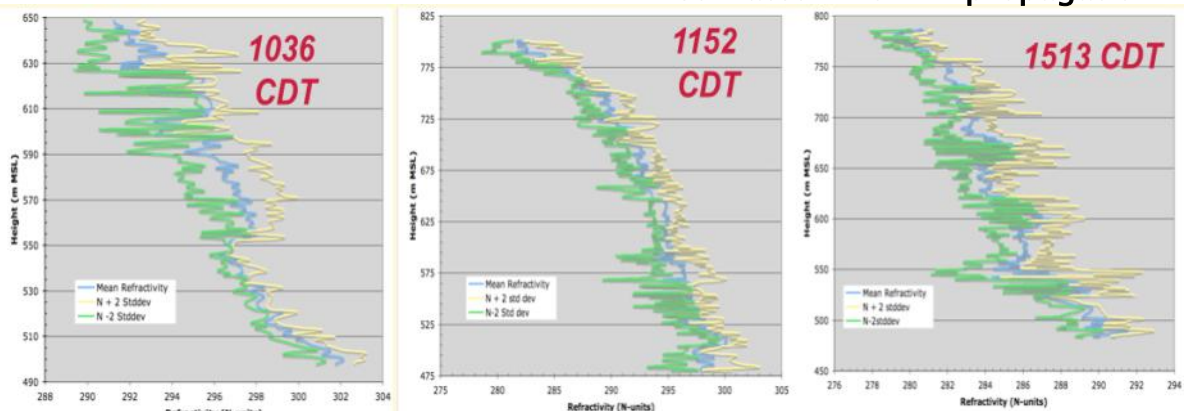
UAS and Weather – Priority Areas at UND

- 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)

Estimated *N* for EM propagation



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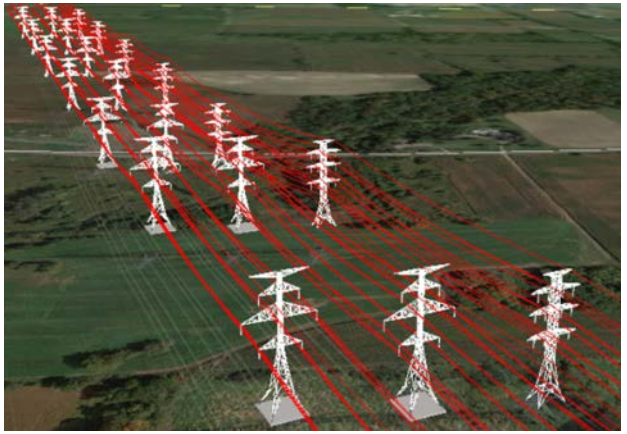
Closing Remarks

- 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.



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