UAS Weather Needs – Sensurion Perspective

Sensurion Background:

• 10-year company history
• Extensive manned aircraft experience
• Extensive weather experience
• Worked with NASA and NCAR in many areas, for many years
• Extensive UAS Experience

We understand how hard it is to operate aircraft safely and reliably – and yet profitably –

...and what it takes to do that, and how the manned aviation industry achieved those goals.

The UAS industry still has a long way to go in all three of those areas, and can learn a lot from the manned aviation industry – but also has specialized needs that are very different.
UAS Weather Needs – Sensurion Perspective

Sensurion Background:

• Airline weather requirements, systems, & solutions
• GA weather & flight planning systems
  • R&D, deployment and long-term ops of national systems
  • Preflight & in-flight
  • Dissemination and Collection Systems
• R&D
  • TAMDAR, MDCARS, etc.
  • Weather Radar Systems
  • Weather uplink, downlink, and cockpit displays
  • Turbulence, Icing, Winds, Deicing

We can take advantage of experience in “traditional” weather & aviation, but must also avoid “default thinking”
Typical sUAS Aircraft

**TYPICAL Fixed-Wing sUAS:**
- Conventional Fixed Wing Design
- Hand, rail, or gear takeoff
- Flight durations 60-120 mins
- Multiple Payload options
- Working toward BLOS
- 0-60 kts, stall speeds 10 kts
- 20 kt max l/d
- Full autoflight avionics
- Variety of recovery systems

**Sensurion Magpie MP-1**

**TYPICAL Multirotor sUAS**
- Ease of launch and flight
- Flight duration <15-45 min
- Visual/EO sensors
- 0-20 kts speed
- Strong reliance on GPS
- Manual & Limited Autoflight
- Sensurion Sentinel also has tethered configuration

**Sensurion MP-4**
How is “Weather” Relevant to sUAS Operations?

• Planning
  • Can I successfully conduct the mission? Safely?
  • Can I stay within required altitude, geofencing, and other limits for entire mission?
  • Can I successfully recover aircraft at the end of the mission period?
  • What impact will weather have on my mission duration capability?

• Direct Operational Impacts
  • Scheduling jobs, personnel, and logistics
  • Managing challenging or near-limit conditions
  • Reacting to changing conditions

• Contributing Data Back Into the Weather System
  • Alert other operators of changing conditions
  • TAMDAR-type observation input to forecast models
Weather Impacts on Practical sUAS Operations

- Scale Factors of sUAS vs Part 23 Aircraft Make Them Much More Susceptible to Turbulence and Wind Shear:
  - Wing loading is much lower
  - Mass is much lower
  - Wing/Rotor Spans are Much Shorter
- Stall and cruise speeds much lower than Part 23 and Part 25 – winds have a dramatically increased impact
  - Very compressed range of “V Speeds”
  - Cruise speeds top out about where Part 23 begins
  - Approach speeds 8-10 Kts
- Many lower boundary wind speeds can exceed forward flight speeds – thus creating a no-return scenario
- Many sUAS have Precipitation Restrictions
Weather Impacts on Practical sUAS Operations

• Most sUAS are not intended for flight into IMC
  • Icing, precip, loss of Vis/CAVOK all potential issues
  • Ability to maintain VLOS is key to planning and executing many missions
  • How do we characterize ground-to-air “visibility”

• Effects of weather on ground-based (versus aircraft-based) operators themselves

• Temperature effects on Li-Ion battery packs

• Effects of turbulence & winds on mission duration
  • Deviation limits and stabilization energy cost can significantly impact mission duration

• Increasing levels of sUAS autonomy will require reduced weather uncertainty
So... What Weather Information Will Be Needed - *Specifically*?

- Currently available WX information, tailored for sUAS users
- New products that provide much higher spatial and temporal resolution in the boundary layer area, including:
  - Winds, Turbulence and “Gustiness Factors”
    - We need to look at “Gusts” differently than classical turbulence in low-altitude, sUAS Ops contexts
    - Indexing Gusts/Turbulence to a radically different scale of airframe/limits
  - Visibility – referenced to VLOS-type operations
  - Envelope Protection: Probability of exceeding specific limit factors including:
    - Max Winds versus aircraft return speeds
    - Gusts, Turbulence, Shear – Controllability AND Battery Life
    - Temperature & Density Altitude
    - Visibility variations
    - Precipitation / Icing
    - Variations in altimeter setting during a mission
    - Lightning/Static Buildup
So... What Weather Information Will Be Needed - *Specifically?*

- **BLOS Weather Needs**
  - Downrange landing and diversion site forecasts / nowcasts
  - Long-duration operation forecasts / nowcasts
  - Corridor-oriented products

- **Tethered operations**
  - Very long duration operations
  - Electrical considerations – e.g., static and lightning
Weather Sources for sUAS

Will there be a single authoritative source for weather data and translated data for operators?
- Yes and No…
  - FAA Will always be a source of regulatory requirements
  - Sheer volume of operations & pace of industry/technology growth/change – and low per-ops capital value – will make it very hard for government to take on “primary source” role
  - Government is more likely to define trade space, and pedigree/reporting requirements
  - Industry may be better positioned to fill the high-volume, low-cost, rapidly evolving direct service needs
  - **INSURERS** may be a critical part of defining and approving WX and other safety-assurance components of this industry
Weather Sources for sUAS

• Leverage the UAS platforms themselves as a key part of the solution
  • Flight stabilization / control systems inherently have turbulence and other atmospheric data
  • Real-time observations of boundary layer conditions
    • Nowcasting
    • Research & modeling
    • Calibrate model metrics for individual aircraft types
  • Interaction between turbulence, deviation limits/range, and vehicle performance
  • Terrain and vegetation database updates
UAVs as a Weather-Collection Platform – “Micro” AMDAR/TAMDAR/MDCRS

Sensurion MP-1 or MP-4
Thank you!

6300 34th Ave South
Minneapolis, MN 55450
1-877-222-1599

www.sensurion.com