Getting Micro Weather Detection and Prediction Right for UAS Industry

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How can a weather person be right 50% of the time and keep their job?

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"They are 70-77% accurate to 3 days out."

Source: Forecast Advisor – Chicago, IL

The Solution to Gain Full Value of Weather Services

Right Data

Right Location

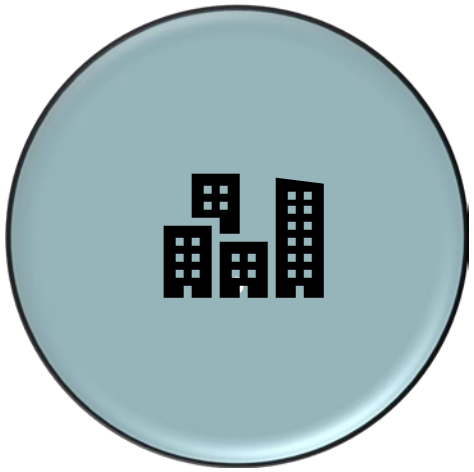
Right Time

Right Application

Near Earth Prediction Challenges

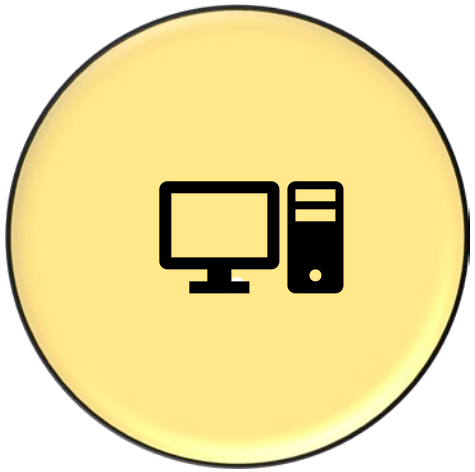
Terrain/Thermal Effects

Sub-1,000 Meters



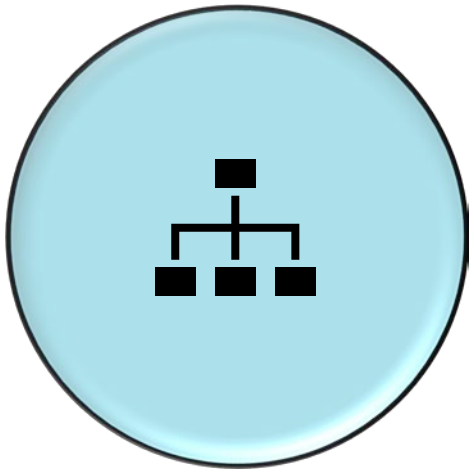
Cities

100-meter data



Computing

LIMFAC in Affordable Science Integration



Data

Data Density

Limits in Observations and Predictability
ANSI Standardization Roadmap

Gap

Gap O5: UAS Operations and Weather. **No** published or in-development standards have been identified that adequately fill the need for flight planning, forecasting, and operating UAS (including data link and cockpit/flight deck displays), particularly in low altitude and/or boundary layer airspace.

"**Weather data standards themselves.** Currently, published weather data standards by National Oceanic and Atmospheric Administration (NOAA), World Meteorological Organization (WMO), ICAO, and others **do not have sufficient resolution** (spatial and/or temporal) for certain types of UAS operations and have gaps in low altitude and boundary layer airspaces. "

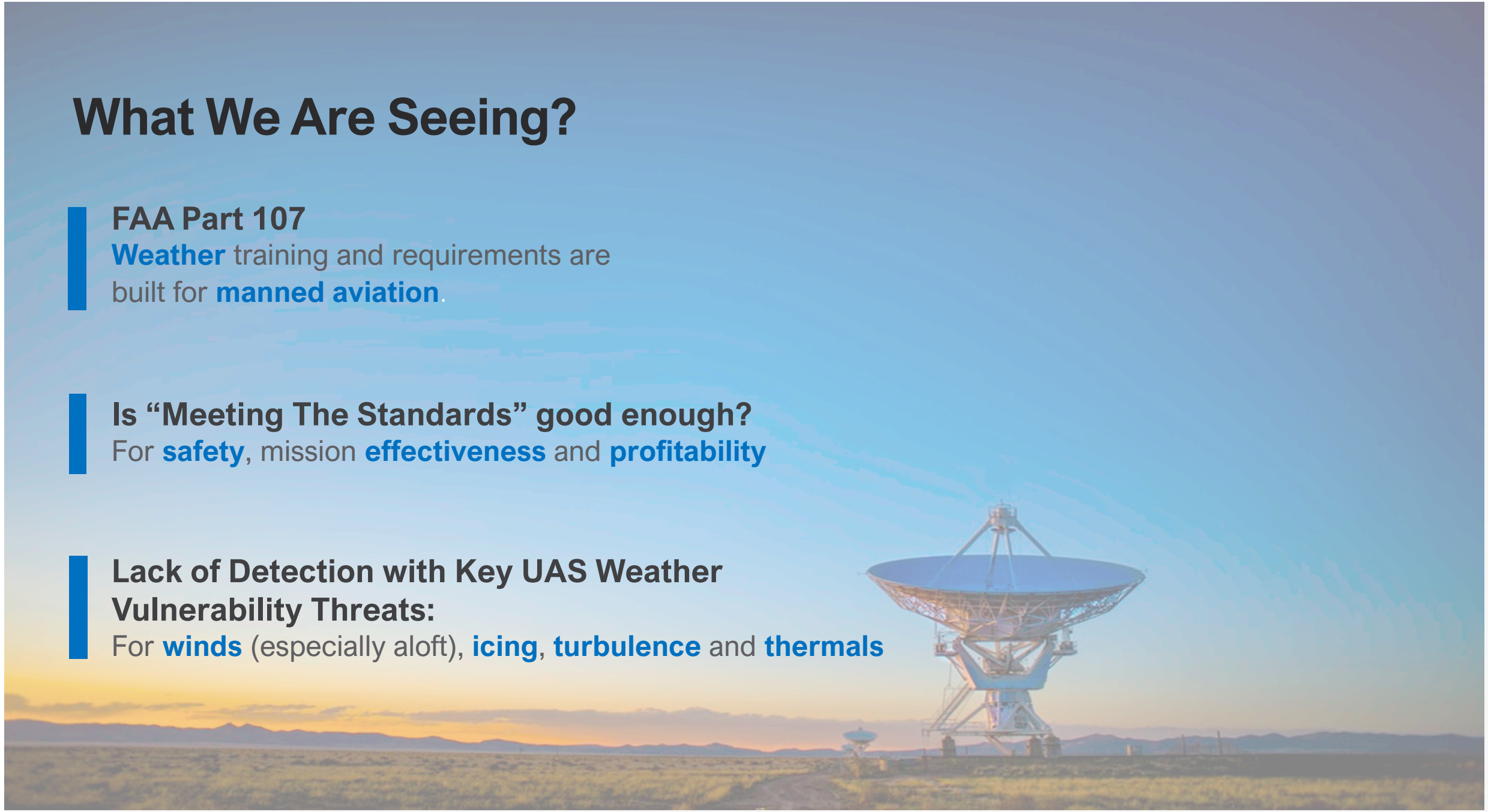
ANSI Unmanned Aircraft Systems Standardization Collaborative (UASSC), December 2018

What We Are Seeing?

FAA Part 107
Weather training and requirements are built for **manned aviation**.

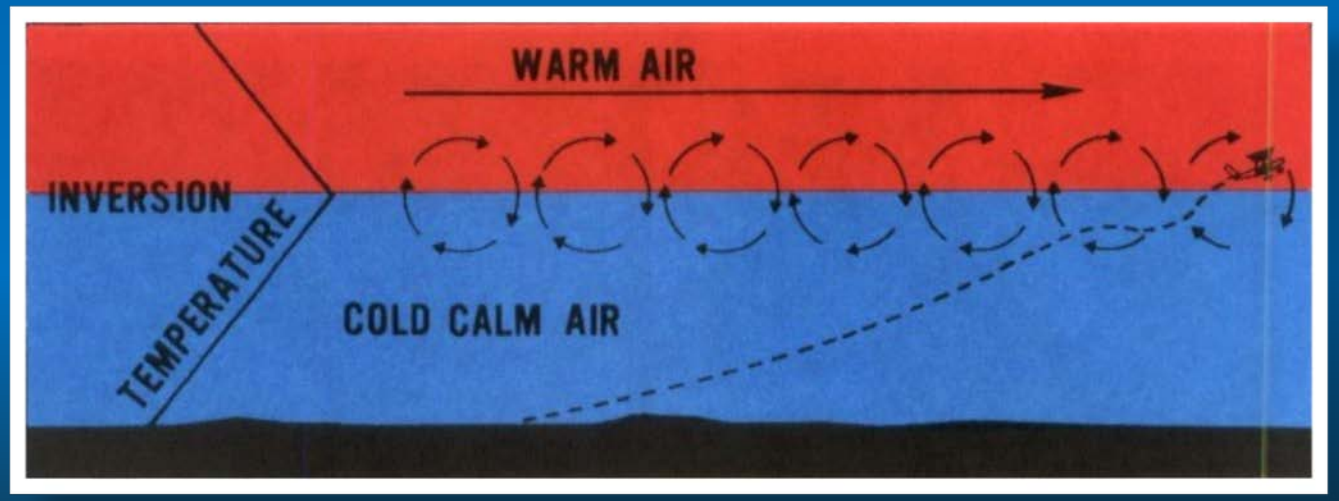
Is “Meeting The Standards” good enough?
For **safety**, mission **effectiveness** and **profitability**

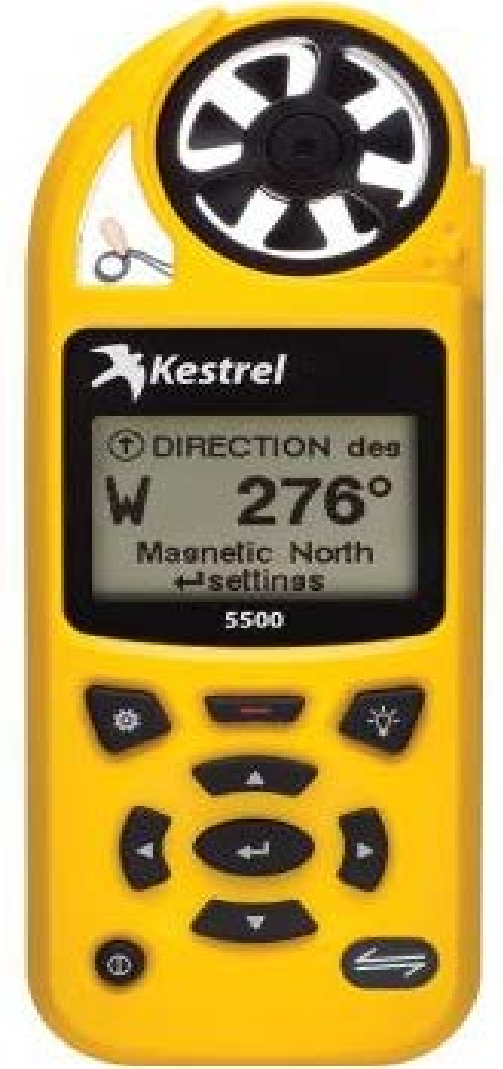
Lack of Detection with Key UAS Weather Vulnerability Threats:
For **winds** (especially aloft), **icing**, **turbulence** and **thermals**



Real World Safety Incident

- Lack of wind measurements aloft
- Situation: VLOS – Loss of Control at 100 Feet AGI
- Followed the standard - hand held anemometer, TAF, METAR
- Result: Crash due to invisible threat lurking above
- Real Data Versus Inference - great deal of inference requiring knowledge of how the atmosphere works





Key Attributes of Sophisticated UAS Weather Services

Real-Time Observations for Detect and Avoid

Government Weather

Commercial Weather & IOT

Micro-Weather From Proprietary Sources

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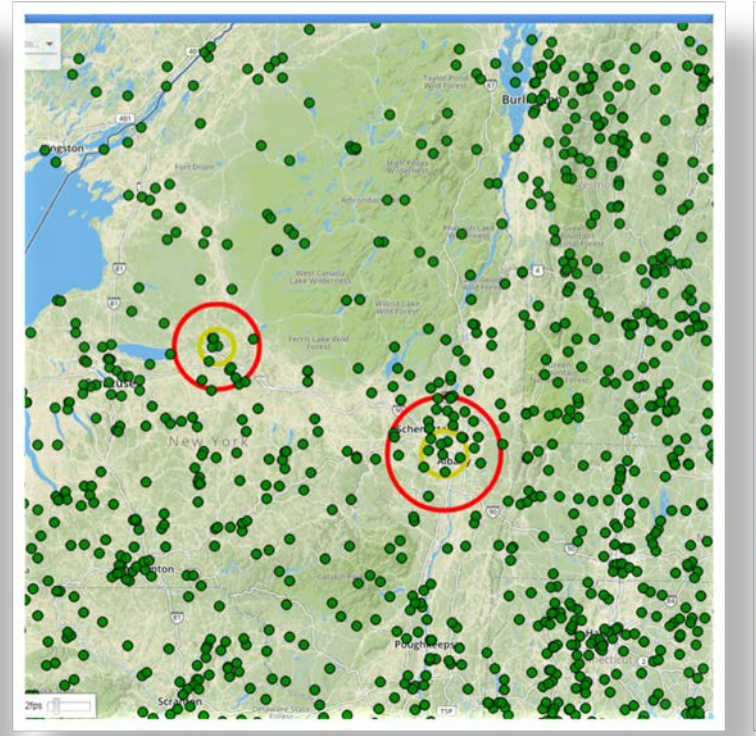
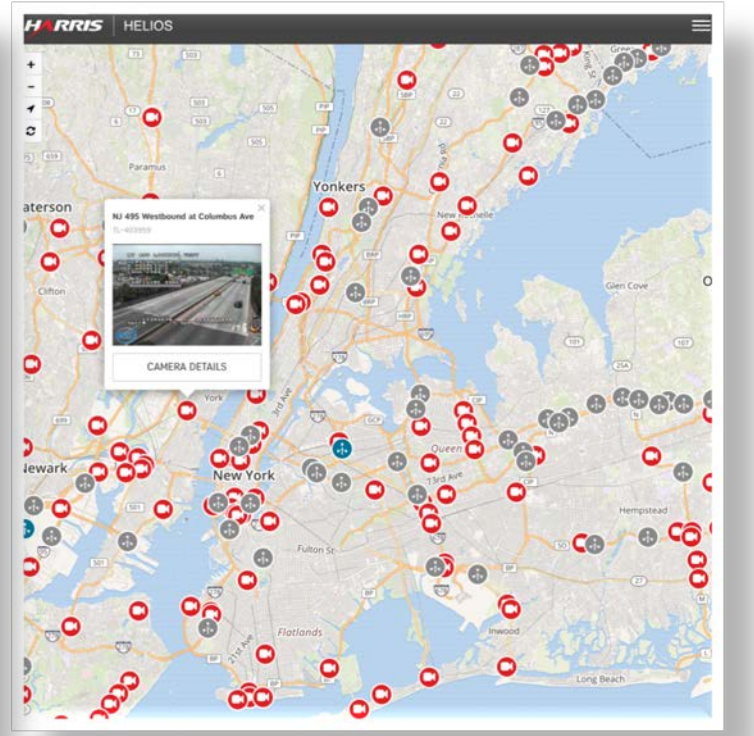
Examples: Weather Data Collection Today

Government Data Sets and Airfield ASOS



Surface Weather Reports (not open source)



Harris Helios

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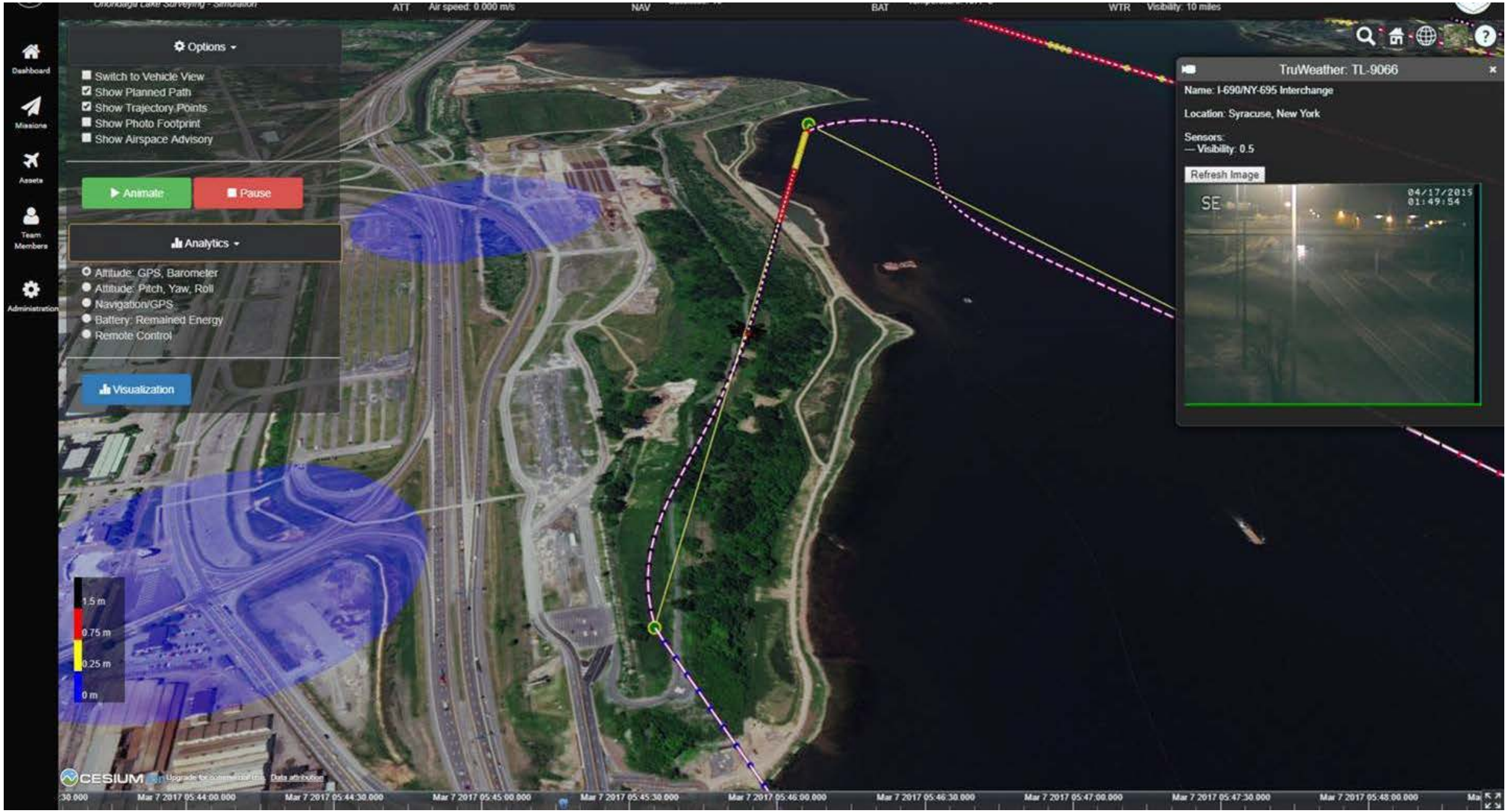
ATT
Air speed: 0.000 m/s
NAV
BAT
WTR
Visibility: 10 miles
Dashboard
Missions
Assets
Team Members
Administration
Options
Switch to Vehicle View
Show Planned Path
Show Trajectory Points
Show Photo Footprint
Show Airspace Advisory
Animate
Pause
Analytics
Altitude: GPS, Barometer
Attitude: Pitch, Yaw, Roll
Navigation/GPS
Battery: Remained Energy
Remote Control
Visualization
1.5 m
0.75 m
0.25 m
0 m
TruWeather: TL-9066
Name: I-690/NY-695 Interchange
Location: Syracuse, New York
Sensors:
--- Visibility: 0.5
Refresh Image
SE
04/17/2015
01:49:54
CESIUM
Mar 7 2017 05:44:00.000
Mar 7 2017 05:44:30.000
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Weather Data Collection – The Vision

X-Band Radar Data

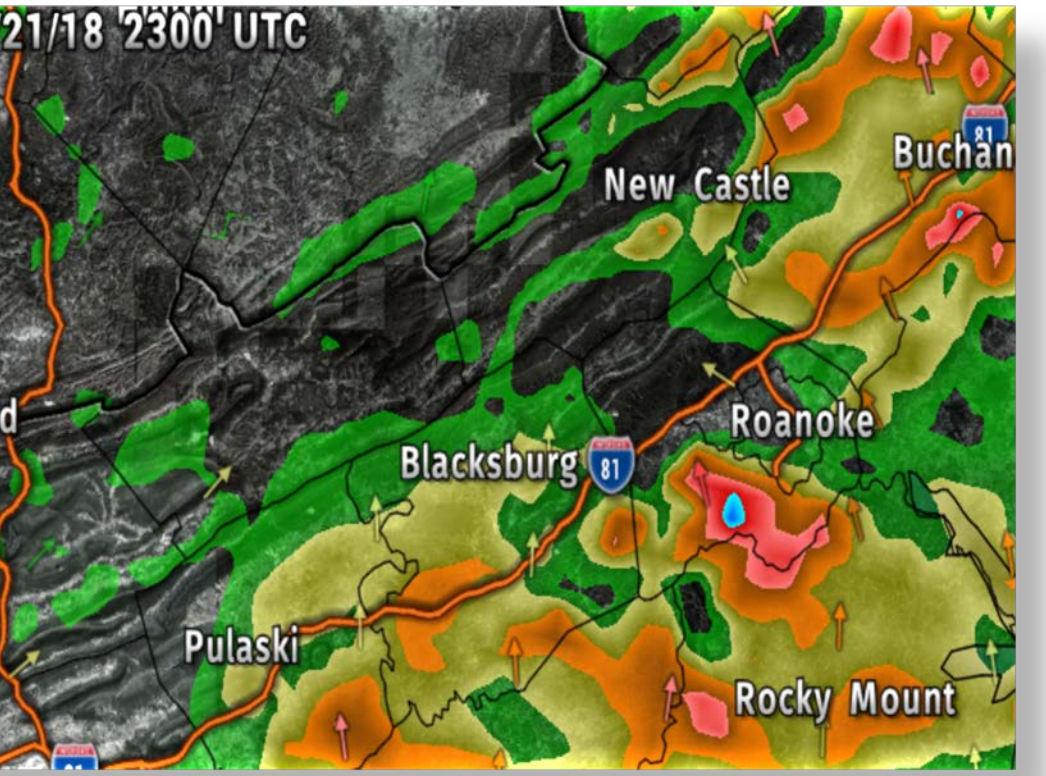
Data Off Drones

Cell Towers Sensors

Key to Improving Detect, Predict and Avoid

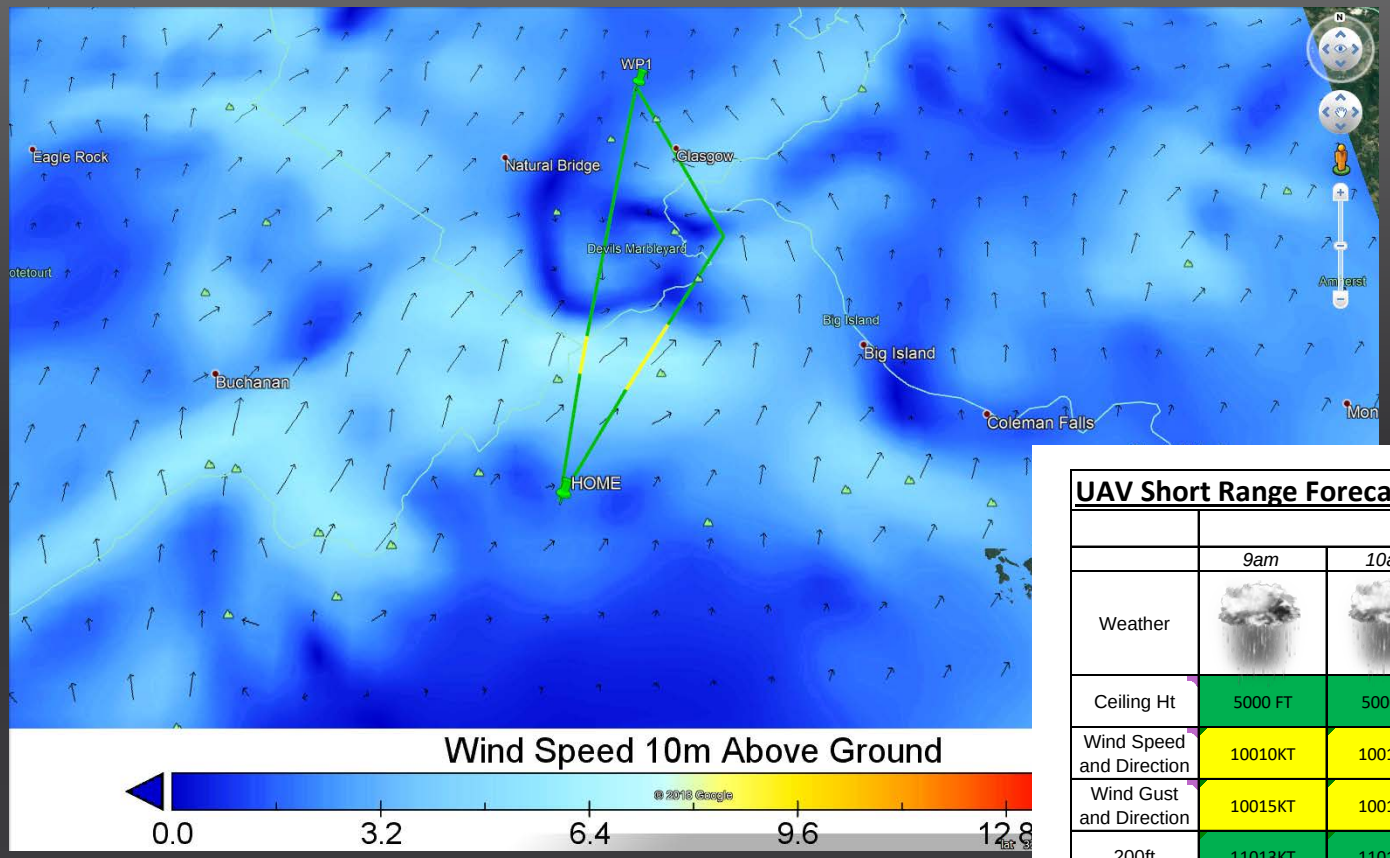
Micro Weather Numerical Prediction Model

3KM Resolution
Wind Speed and Direction



1KM Resolution
Wind Speed and Direction

DATA FUSION FOR UAS OPERATIONAL INSIGHTS



RouteCAST

MissionCAST

UAV Short Range Forecast(Day 1) **Griffiss Airfield**

	Thursday, June 13, 2019									
	9am	*10am*	*11am*	*12pm*	*1pm*	*2pm*	*3pm*	*4pm*	*5pm*	*6pm*
Weather										
Ceiling Ht	5000 FT	5000 FT	4000 FT	2500 FT	2500 FT	2000 FT	2000 FT	2000 FT	1500 FT	1500 FT
Wind Speed and Direction	10010KT	10010KT	12012KT	12012KT	12012KT	11015KT	11015KT	11015KT	12010KT	12010KT
Wind Gust and Direction	10015KT	10015KT	12018KT	12018KT	12018KT	11022KT	11022KT	11022KT	12015KT	12015KT
200ft	11013KT	11013KT	13015KT	13015KT	13015KT	12018KT	12018KT	12018KT	13014KT	13014KT
400ft	12018KT	12018KT	14019KT	14019KT	14019KT	13021KT	13021KT	13021KT	14017KT	14017KT
Sfc Temp	54 F	56 F	59 F	61 F	61 F	61 F	61 F	61 F	60 F	59 F
Sfc Visibility	3mi	4mi	4mi	7mi	7mi	7mi	7mi	5mi	3mi	3mi
Chc of Precip	90%	70%	60%	40%	30%	30%	30%	50%	70%	70%
Lightning Risk	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Future - City Scale Challenges In Detection And Prediction

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Role of Artificial Intelligence In Weather Data Collection and Prediction (Examples)

- Through pattern recognition and heuristics, produce rapid weather hazard insights fusing multitudes of weather data sources—radar, satellite, cameras, instruments, etc.
  - Meteorologist has traditionally done via pattern recognition
  - Big data flows now overwhelming
  - Neural system identifies the pattern through “self-learning” more rapidly
- Improve predictions comparing weather prediction model outputs against observed
  - Learn the strengths and weaknesses of the models
  - Apply those lessons to improve the forecasts over time
- Improve predictions identifying similar weather patterns from the past
  - Match up with similar weather regime
  - Use those patterns to predict what will happen in the future

VIRGINIA/ WASHINGTON DC (HEADQUARTERS)
Reston, VA

NEW YORK (INNOVATION CENTER)
Albany, NY

THE TECH GARDEN (OPERATIONS CENTER)
Syracuse, NY

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