COMMERCIALLY AVAILABLE WEATHER SOLUTIONS & ASSOCIATED CHALLENGES

PRESENTED BY: ANUJ AGRAWAL & MARK HOEKZEMA

ABOUT EARTH NETWORKS

Founded - 1993

Headquarters - Germantown, Maryland, USA

Largest Global Environmental Observation Networks - 12,000+ global weather stations | 1,600+ lightning sensors | 2,000+ cameras

Global Presence - Offices in EU and Asia | Partner Network in Africa | Public-Private Partnerships with Multiple Governments

Creators of WeatherBug Applications - Sold Brand in November 2016 | Continue to Serve as Weather Data Provider

LIVE HD CAMERA NETWORK

TOTAL LIGHTNING NETWORK

WEATHER NETWORK

GREENHOUSE GAS NETWORK

BOUNDARY LAYER NETWORK

WHAT WE DO

We automate decisions to help global organizations **mitigate financial, operational, and human risk** by integrating **environmental intelligence** into their operations.

Powered by the world's largest, most hyperlocal, proprietary data network

DRONE MARKET: U.S. & GLOBAL SPENDING BY VERTICAL (BY 2020)

End Market	Average Price	US		Global	
		Units	TAM ($mn)	Units	TAM ($mn)
Construction	$30,000	44,300	$1,329	372,120	$11,164
Agriculture	$30,000	47,000	$1,410	197,400	$5,922
Insurance Claims	$1,500	315,000	$473	945,000	$1,418
Offshore O&G and refining	$50,000	2,465	$123	22,204	$1,110
Journalism	$50,000	2,400	$120	9,600	$480
Real Estate	$1,000	67,600	$68	264,860	$265
Utilities	$50,000	350	$18	1,855	$93
Pipelines	$80,000	259	$21	518	$41
Mining	$40,000	--	--	1,000	$40
Clean Energy	$10,000	1,467	$4	8,213	$25
Cinematography	$30,000	452	$14	707	$21
Delivery	--	--	--	--	--
Total Commercial Manufacturing Opportunity:		**481,293**	**$3,580**	**1,823,477**	**$20,579**

Industry estimates vary widely (PWC estimates a $127B market by 2020), however the vertical markets of Inspection (including Construction, Insurance, Utilities) and Agriculture are generally seen as the initial high growth markets

COMMERCIAL APPLICATIONS & INVESTMENT TRENDS

Jobs for Drones

As more industries look at drone technology, the list of jobs drones can do—or could do—is growing. But what's real?

DEVELOPMENT STAGE

Early

Mail/small package delivery

Mid

Construction/ real estate images and monitoring

Emergency management

Filmmaking/ other media

Infrastructure monitoring

Oil and gas exploration

Weather forecasting/ meteorological research

Wildlife/ environmental monitoring

Late

Aerial photography

Border patrol

Precision agriculture

Public safety

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Money Is Moving to Software

Drone investments are moving away from the hardware and operators and toward the software and services. Autonomous drones will push this trend even further.
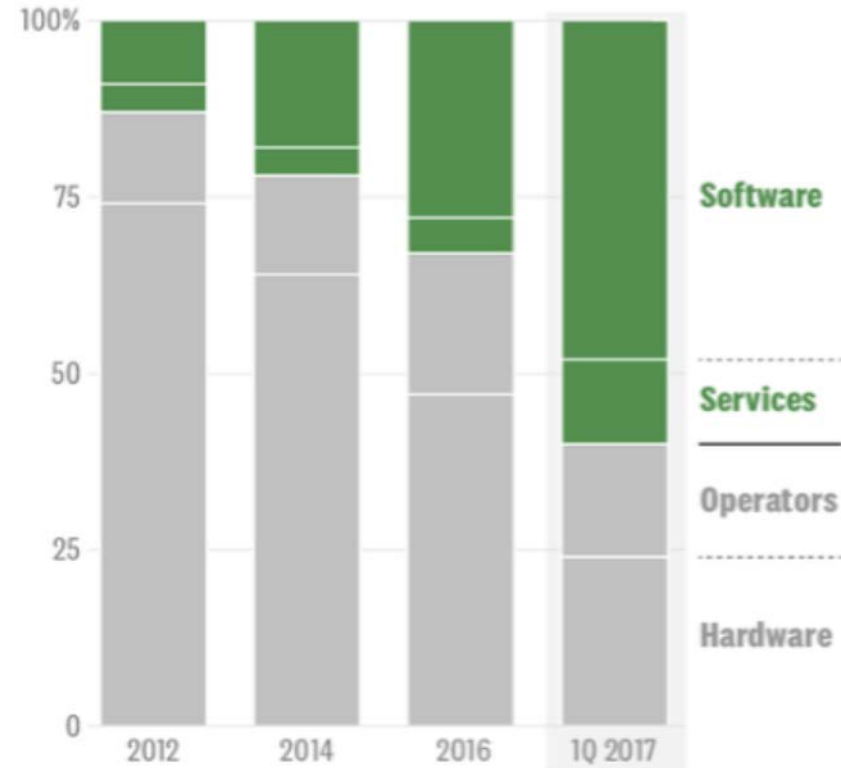
Software
Services
Operators
Hardware

2012   2014   2016   1Q 2017

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EARTH NETWORKS

HOW WEATHER AFFECTS DRONE OPERATIONS

Pre-Flight Planning

- Forecasted Clear Days
- Optimal Time of Day

In-Flight

- Path Direction
- Flight Elevation
- Mission Duration
- Image Capture Overlap
- Geo-fencing
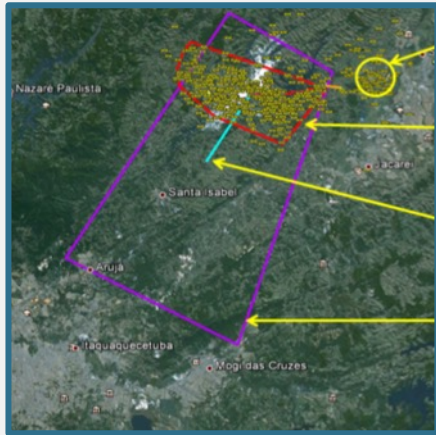- Minimize Loss of Connectivity Impact

Post-Flight Analysis

- Weather & Damage Correlation
- Insurance Claim Verification

EARTH NETWORKS®

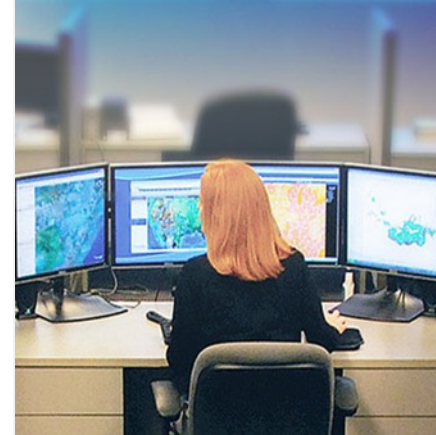# EARTH NETWORKS DATA & TOOLS FOR DRONE OPERATIONAL EFFICIENCY

Pre-Flight Planning → In-Flight → Post-Flight Analysis

SEVERE WEATHER DETECTION

- Professionally managed and operated weather networks

- Automated Dangerous Thunderstorm Alerts for mission locations

HOURLY FORECASTING

- 6-Day and 15-Day

- Point-Based (Lat/Long)

- Forecasted metrics include wind speed and direction up to 400 feet, temperature, visibility, etc.

WEATHER VISUALIZATION

- Track incoming storms

- Make go/no-go mission decisions
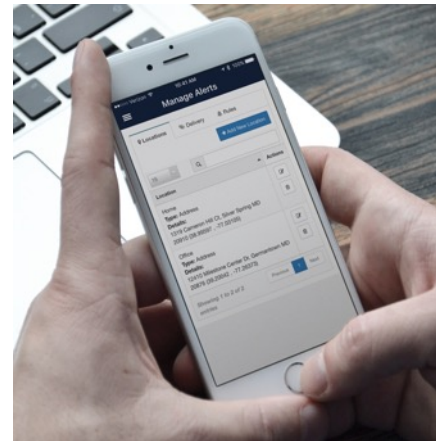
MOBILE ALERTING

- Alerts based on location and threat

- Access to weather visualization on-the-go

ADDITIONAL WEATHER APPLICATIONS FOR DRONE OPERATORS

Apps and Websites

Does available data provide the necessary information for flight planning and operations?

UNIQUE WEATHER THREATS

Drones have unique weather dangers which make most available surface and aviation observations and forecasts less than optimal inputs for flight planning

- Much greater sensitivity to turbulence and shear than what NOAA aviation products address

- Operations in lower Planetary Boundary Layer (10 – 400 feet) where current forecast and observation data is not widely available

- Flights in unique geographic environments – urban and mountainous regions are poorly modeled and observation data is of poor resolution
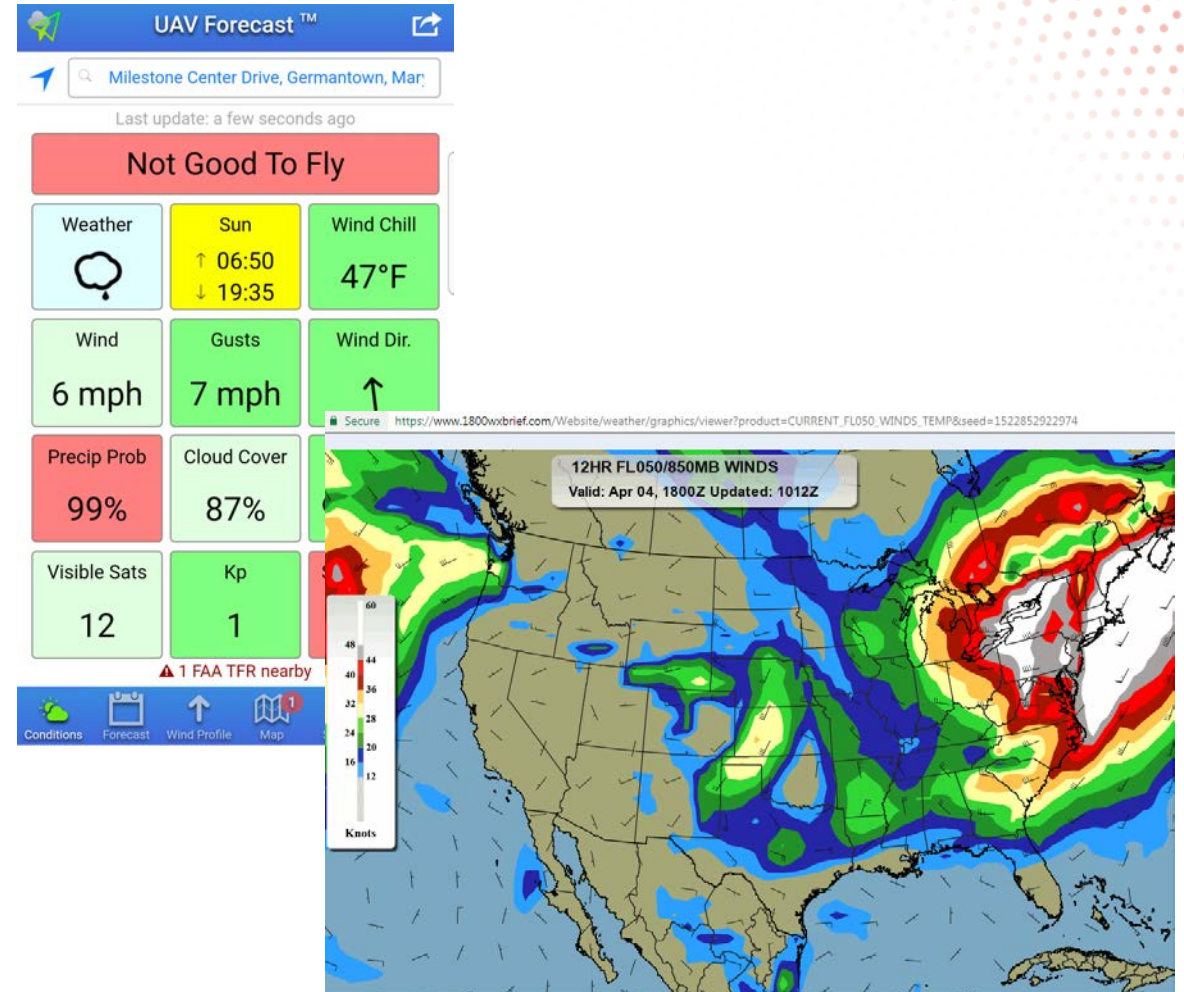
WEATHER AND FORECAST CHALLENGES FOR DRONE OPERATORS

WIND, CLOUD LEVELS, VISIBILITY, LIGHTNING, RADAR, WIND SHEAR, TURBULENCE

Current Conditions

Surface
- Sparse Observations Points
- Irrelevant Observation Points
- Delayed/Old Observations

Boundary Layer/Flight Level
- Very Few Observations
- Delayed/Old Observations
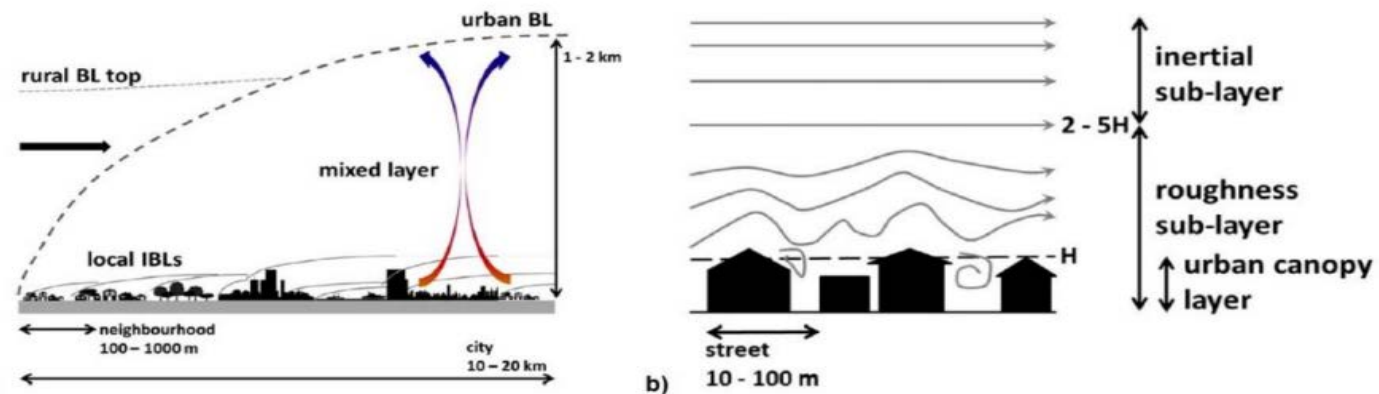- Low Resolution

Forecast Conditions

Surface
- Low Model Resolution
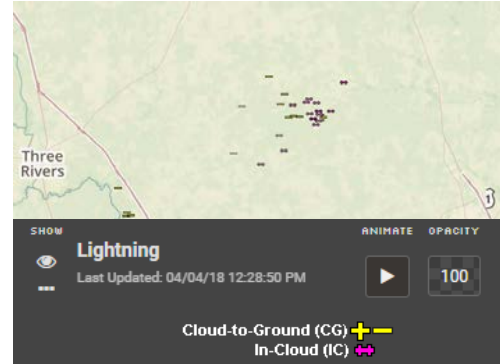- Low Resolution Topography
- Urban Detail

Boundary Layer/Flight Level
- Insufficient Vertical Resolution
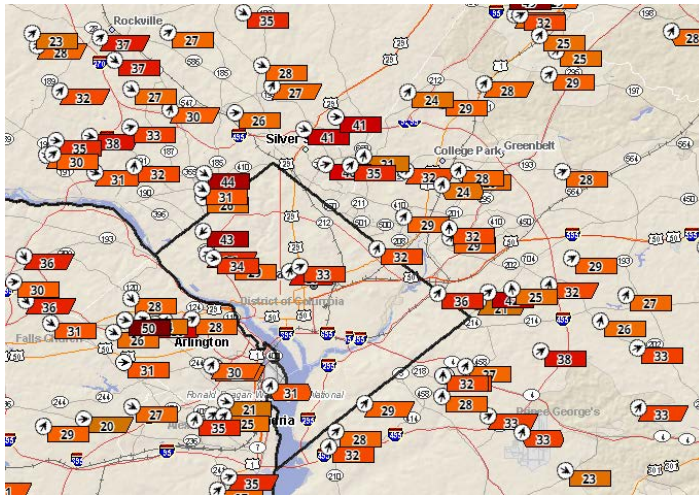- Lack of Verification
- Temporal Resolution

WEATHER AND FORECAST CHALLENGES – SOLUTIONS?

Current Conditions

- On-site observations – real time access to weather data, radar, lightning
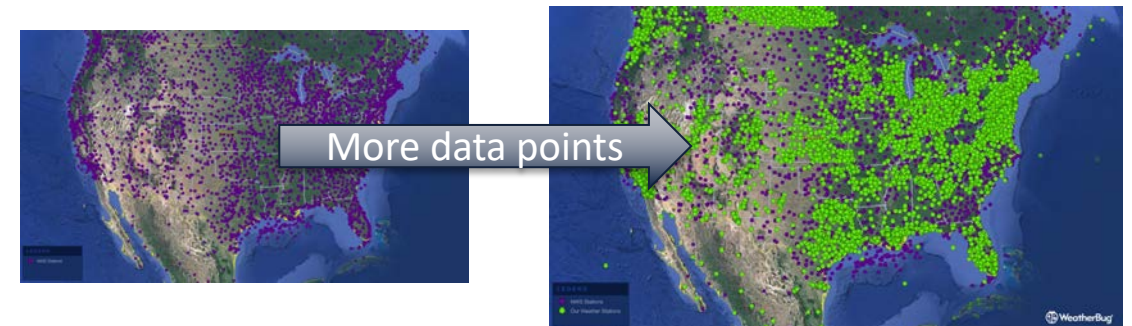

- Access to more relevant observation points

- In-flight measurements – confirming forecasts and flight safety

Forecast Conditions

- Custom, high-resolution models – high resolution output for boundary layer

- High-resolution data inputs to models – more data points

More data points

- Flight observations feed back into models to improve accuracy

THANK YOU

QUESTIONS AND COMMENTS?