Weather Intelligence For Next-Gen Cities

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TruWeather Solutions
BEYOND ORDINARY

Our Mission

Build the high-fidelity weather intelligence solution

To provide transformational micro-weather data, analytics, and services to safely move people and goods across a new frontier of air and ground journeys, while generating greater economic value for our clients.

- Founded in 2015 – 30 employees
- 40+ years of experience
- Multi-discipline expertise – in weather, aviation, logistics and supply-chain
- We partner with the best companies in weather science and technology
- We offer a one stop shop weather ecosystem with unparallel customer support

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The future of weather monitoring and forecasting

Predicting the exact future of weather is challenging. Current apps and tools can make weather information appear precise, but we need to ensure weather data is also accurate.

latest advancements in technology

diverse sensor data collection

comprehensive monitoring ecosystem

development of urban scale models

human-in-the-loop (meteorologist)

Transformational weather policies and standards

global harmonization

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Interconnected intermodal transportation requires precise AND accurate weather intelligence

TruWeather is shaping Weather Industry 4.0

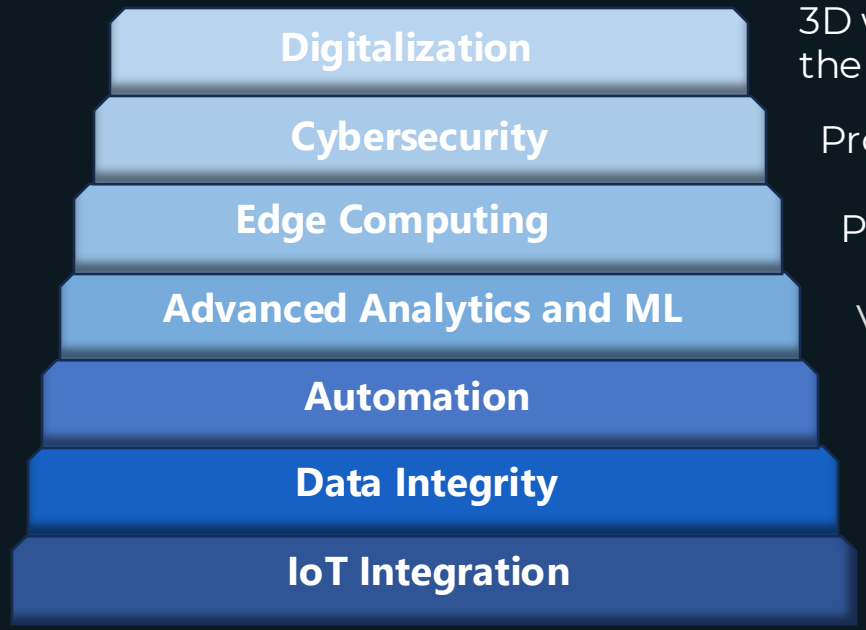
Industry 4.0 puts forward the Fourth Industrial Revolution, defined by the integration of advanced digital technologies, the Internet of Things (IoT), artificial intelligence (AI), and big data analytics. This era is revolutionizing industries through enhanced automation, connectivity, and intelligent decision-making.

Weather Industry 4.0 is an application supercharged by Industry 4.0

Weather 4.0 is a fusion of advanced weather information and communication technology – generating an end-to-end micro-weather information stream on multiple levels across the value chain that will enable new services and transform business models.

Key Aspects of Weather 4.0

supported by The ASTM F3673 – 23 leading to aviation approval



3D weather precision for multiple levels and applications across the client value chain

Protection of critical information

Processing data closer to where it is collected to ensure rapid refresh

Vast amounts of data turned into decision insights

Reduce human error, increase reliability and efficiency

Quality input leads to quality output (ASTM F38)

Enables real-time monitoring and fusion

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The Weather Status Quo

Weather predictions rely on many variables and limited measurements that creates uncertainty. This affects users' confidence and decision-making.

- Impacts user’s ability to plan, schedule and operate efficiently
- Users only know the weather system they know
  - Better looking graphics do not coincide with increased accuracy
- Military and commercial aviation struggle with an imperfect system
- Users hesitant to invest in promised service precision and accuracy
- TruWeather believes Industrial Base 4.0 may swing the pendulum

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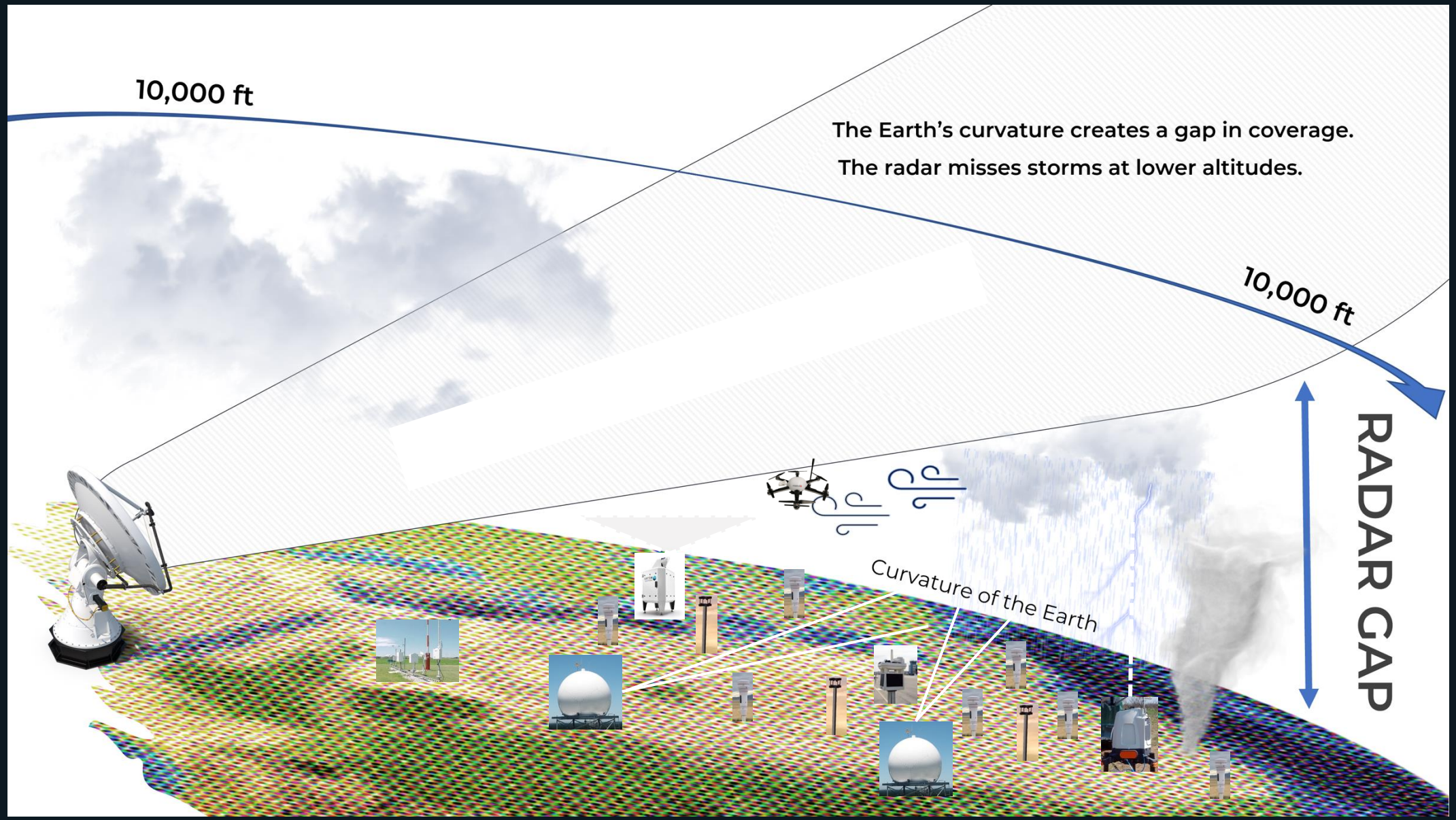

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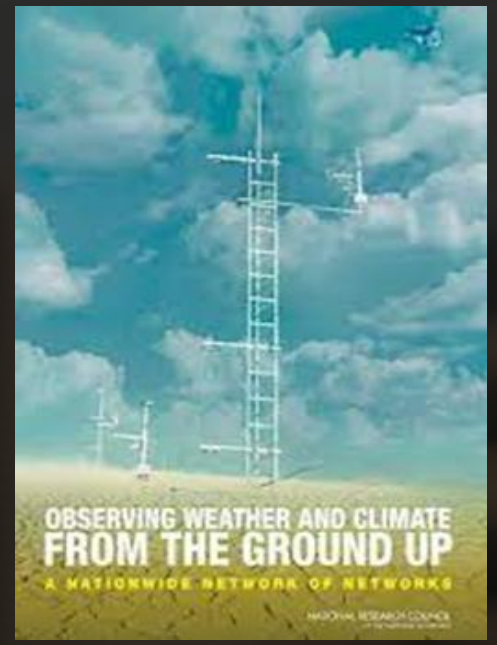
Innovation Based in Science

- Satellites-oriented approach will not resolve low altitude and local weather challenges
- A **ground-up augmented** approach is required
- Advancements in machine learning weather prediction requires robust training/testing data
- Targeted low-altitude aviation weather solutions will come from private sector
- Need policy to unlock full potential of innovative weather observation technology



"Observing Weather and Climate from the Ground Up"

Anemoment
Surface Wind

NRG Wind Lidar
Low-altitude Winds

Barani
Surface Weather Data

Tempest
Surface Weather Data

Intellisense MWS
Surface Weather, Ceiling, Visibility

Leadership in Ensuring Trusted Weather Data

The ASTM standard will allow for the **trusted** use of lower cost, novel science and technology to collect more ubiquitous weather data.

- Will move from requiring instrument certifications to sensor performance-based qualification
- Incentivizes private sector investment and access to reliable weather data
- Provides a 3PWP path to approval and integration

F3673 – 23

TABLE 1 Tiered Weather Data Categories and Thresholds[A]

Observed Element	Tier 1			Tier 2			Tier 3		
	Range	Accuracy	Confidence Level	Range	Accuracy	Confidence Level	Range	Accuracy	Confidence Level
Ceiling/Cloud Height	Surface to 800 ft	-200 ft /+300 ft	90 %	Surface to 800 ft	-100 ft /+200 ft	90 %	Surface to 2000 ft	±100 ft	90 %
	>800 ft to 3000 ft	-300 ft /+500 ft		> 800 ft to 3000 ft	-200 ft /+400 ft		>2000 ft to 12 500 ft	5 %	
	> 3000 ft to unlimited	-700 ft /+1200 ft		> 3000 ft to unlimited	-500 ft /+1000 ft				
Visibility	0 miles to 1 mile	±¼ mile	90 %	0 miles to 1 mile	±¼ mile	90 %	0 miles to 1¼ miles	±¼ mile	90 %
	>1 mile to 3 miles	-½ mile to +1 mile		>1 mile to 3 miles	±½ mile		1½ miles to 1¾ miles	+¼ mile to -½ mile	
	>3 miles to unlimited miles	±1.5 miles		>3 miles to unlimited miles	± 1 mile		2 miles to 2½ miles 3 miles to 3½ miles 4 miles to 10 miles	±½ mile +½ mile to -1 mile ±1 mile	
Temperature	-40 °C to 50 °C	± 2 °C	90 %	-40 °C to 50 °C	± 1 °C	90 %	-50 °C to 50 °C	± 0.6 °C	90 %
Wind Speed	2 knots to 10 knots	±3 knots	90 %	2 to 10 knots	± 2 knots	90 %	2 knots to 10 knots	±1 knots	90 %
	>10 knots to 20 knots	±4 knots		>10 to 20 knots	± 3 knots		>10 knots to 20 knots	±2 knots	
	>20 knots to 40 knots	±6 knots		>20 to 40 knots	± 5 knots		>20 knots to 40 knots	±2 knots	
	>40 knots to 85 knots	±8 knots		>40 to 85 knots	± 6 knots		>40 knots to 85 knots	RMSE ± 5 %	
Wind Direction	45° increments	±20°	90 %	45° increments	±10°	90 %	10° increments	± 5° when wind is greater than or equal to 5 knots	90 %
Pressure	28.5 in. to 31.5 in. of mercury	±0.2 in. of mercury	90 %	28.5 in. to 31.5 in. of mercury	±0.1 in. of mercury	90 %	16.9 in. Hg to 31.5 in. Hg	± 0.02 in. of mercury	90 %
Dew Point	-40 °C to 50 °C	±3 °C	90 %	-40 °C to 50 °C	± 2 °C	90 %	-34 °C to -24 °C	±2.2 °C	90 %
							-24 °C to -01 °C	±1.7 °C	
							-01 °C to +30 °C	±1.1 °C	

[A] 1 ft = 0.3 m, 1 knot = 0.5 m/s, and 1 mile = 1.6 km.

3PWP – 3rd Party Weather Provider
WIP – Weather Information Provider

A Vision for Consistent Intermodal Air and Ground Weather

A. REAL-TIME WEATHER

Mobile Weather Observations

In-situ Weather Observations & Cameras

Weather Forecast

B. PREDICTED ROAD WEATHER

Road Weather Model

Historic Weather Observations

Geographic Domain for Operational Coverage

C. TRUWEATHER

V360 Data Platform

V360 Dispatch Rapid Update Probabilistic Forecasts Impact Analysis Model

Artificial Intelligence & Machine Learning

D. DISPATCH OPERATIONS

Dispatch System

Tolerance & Risk Metrics

Route Optimization

V360 Dispatch API

Impact Calculation
Simulation
Alerts
Visualizations
Reports
Information Valuation

User-defined tolerance and risk metrics

Static and dynamic routes impact assessment

E. INTERMODAL DISPATCH FLEET

Delivery Vehicle

Autonomous Delivery Vehicle

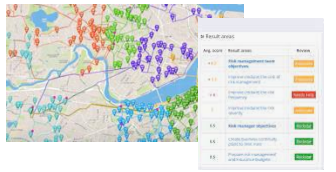
Drone

Enroute and stationary

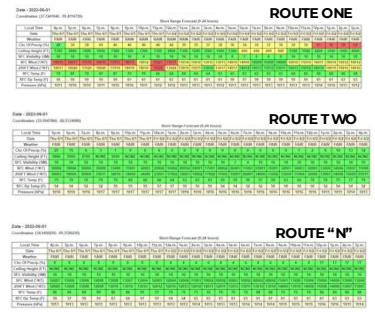
Multiple delivery platform assessment

F. WEATHER IMPACT DECISION PRODUCTS

Operational Impact



Route Impact



Operation-wide and each route assessment

5 Minute Rapid Update
48 hr Weather Window

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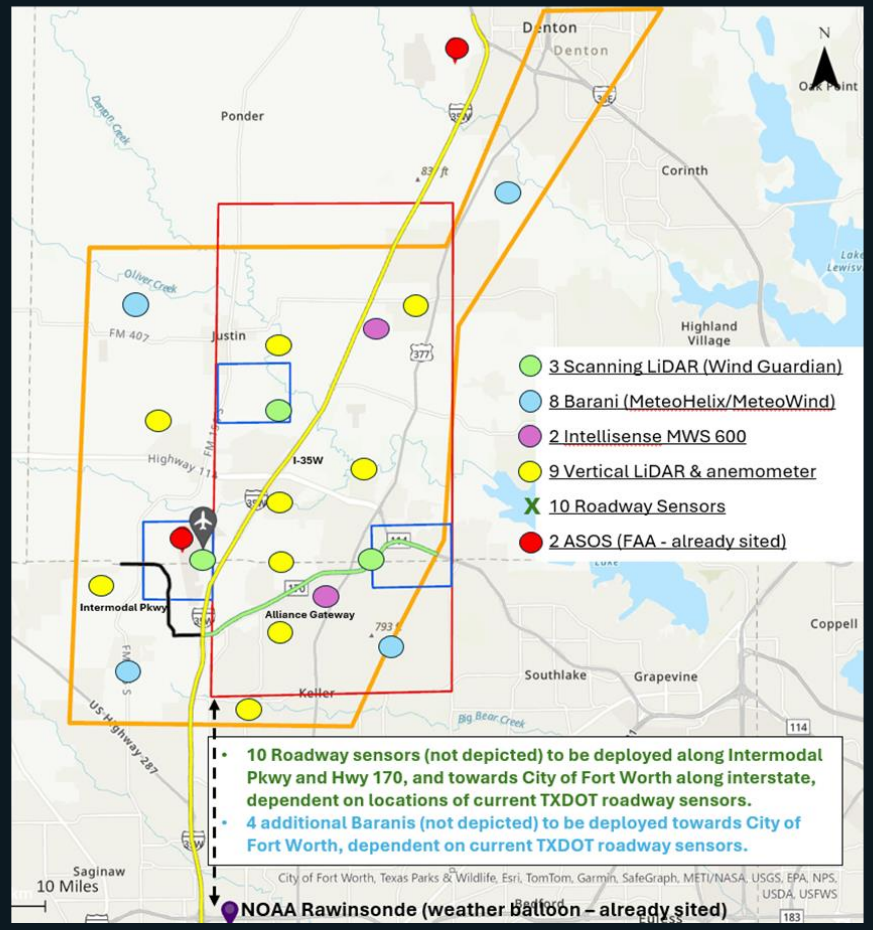
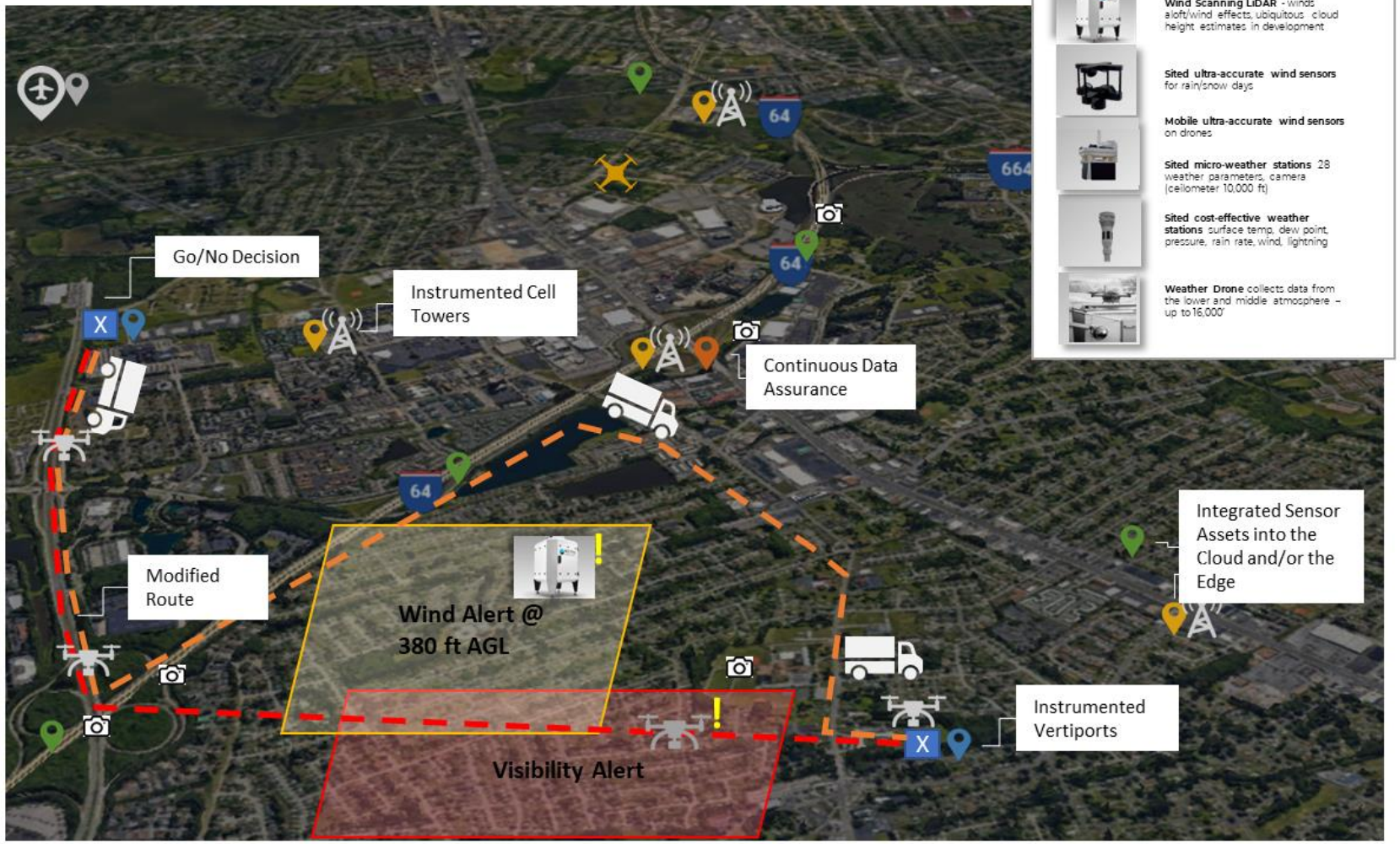
Weather Working for Smart Transportation

Phase III and SMART Grant -- Northern Fort Worth - Alliance



Weather Working for Smart Transportation

Phase III and SMART Grant -- Northern Fort Worth - Alliance



NextGen Mobility Requires NextGen Weather

In order for drones, eVTOLs, and all components of Smart Transportation to operate safely, efficiently, and cost-effectively, a major transformation must occur with weather data and information, services, and sustainable infrastructure.

It is estimated that nearly 20% of the U.S. economy is directly affected by the weather, and the uncertainty in what weather is or will occur below 5,000 Feet is a primary cause.
-Weather And Business: Insights And Ideas For Weathering The Storms, Forbes Magazine, 2019

More satellites will NOT resolve low-altitude weather challenges.

More advanced machine learning techniques using the same old data will NOT provide more accurate micro-scale forecasts.

Forecasting micro weather requires a ground-up approach that leverages novel observation networks coupled with advanced meteorological modeling and machine learning.
"Observing Weather and Climate from the Ground Up"

Lincoln Lab MIT Study - Preliminary Weather Information Gap Analysis for UAS Operations

FAA Inclement Weather Report

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Thank You

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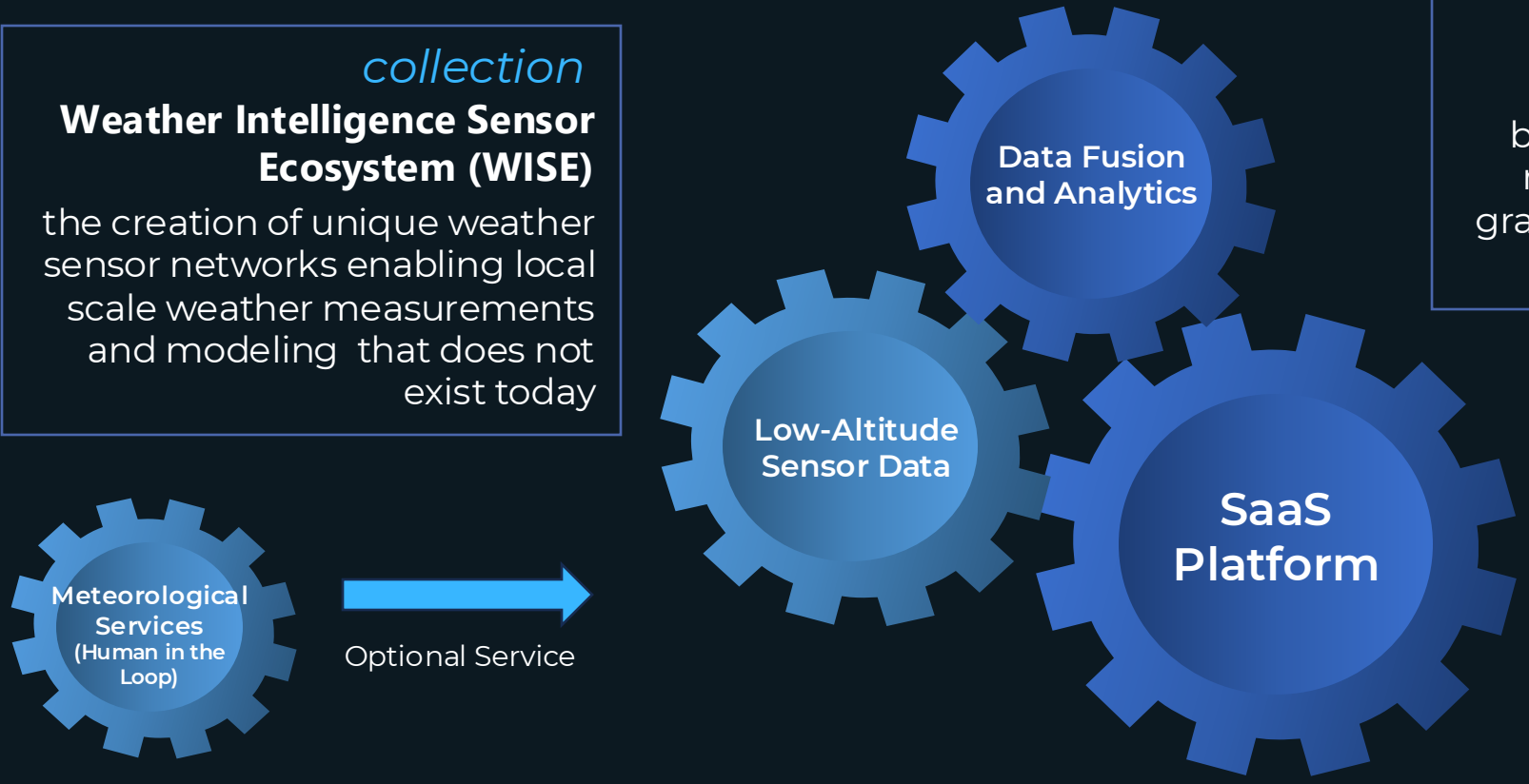
Changing the Way Data Works for You

Provide *local scale collection*, *analysis*, and *visualization* of high resolution and accurate low-altitude weather data enables safe and efficient autonomous digital flight to support aircraft specific performance and routing.

collection

Weather Intelligence Sensor Ecosystem (WISE)

the creation of unique weather sensor networks enabling local scale weather measurements and modeling that does not exist today



analysis

Proprietary ML Analytics and Modeling

building toward probabilistic micro models at street scale granularity, with 15 min refresh and 6-hour forecasts

visualization

Vertical 360 Visualization Platform or APIs

an all-in-one translation and communication platform or al-a-carte API integration architecture

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