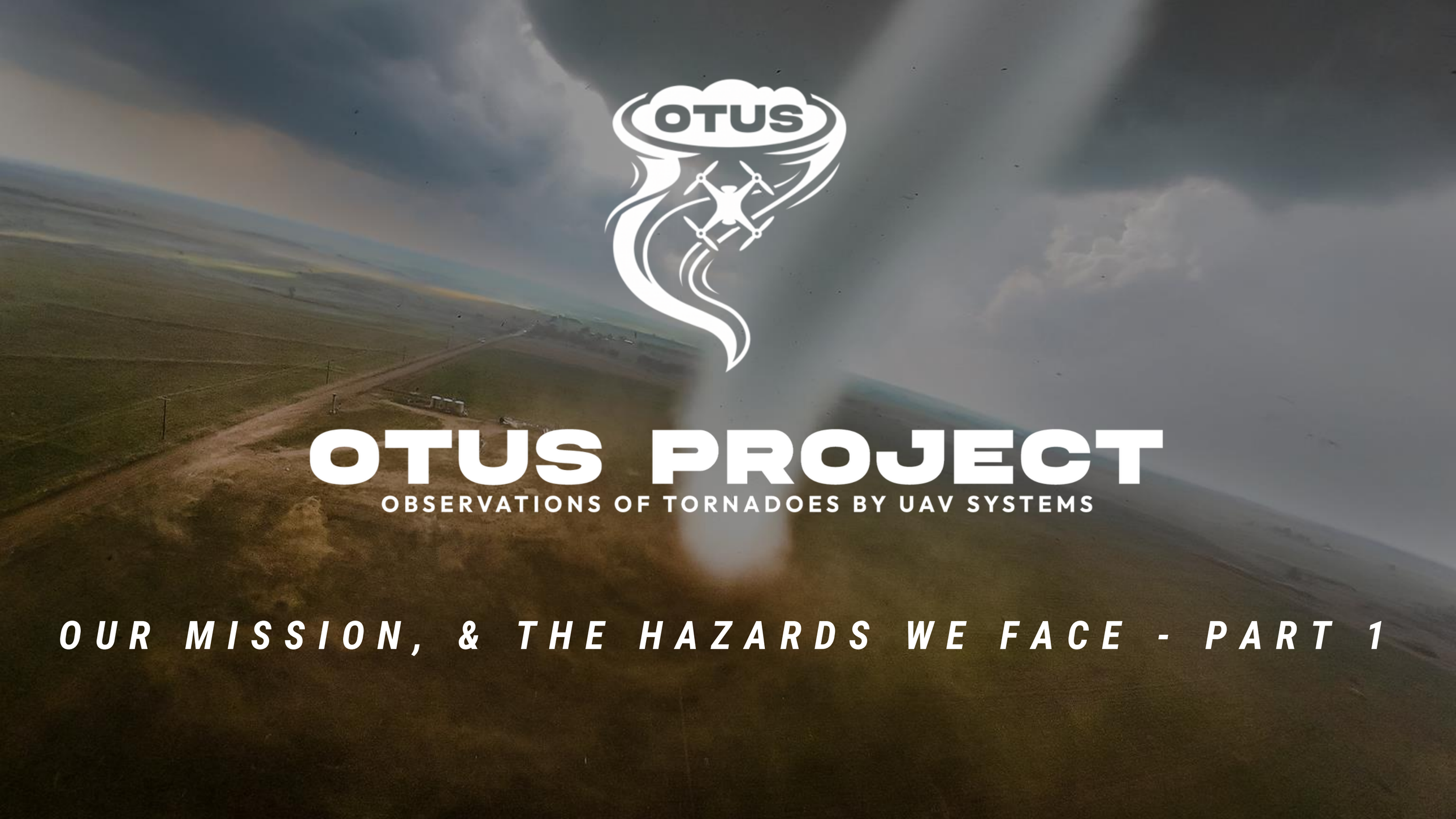
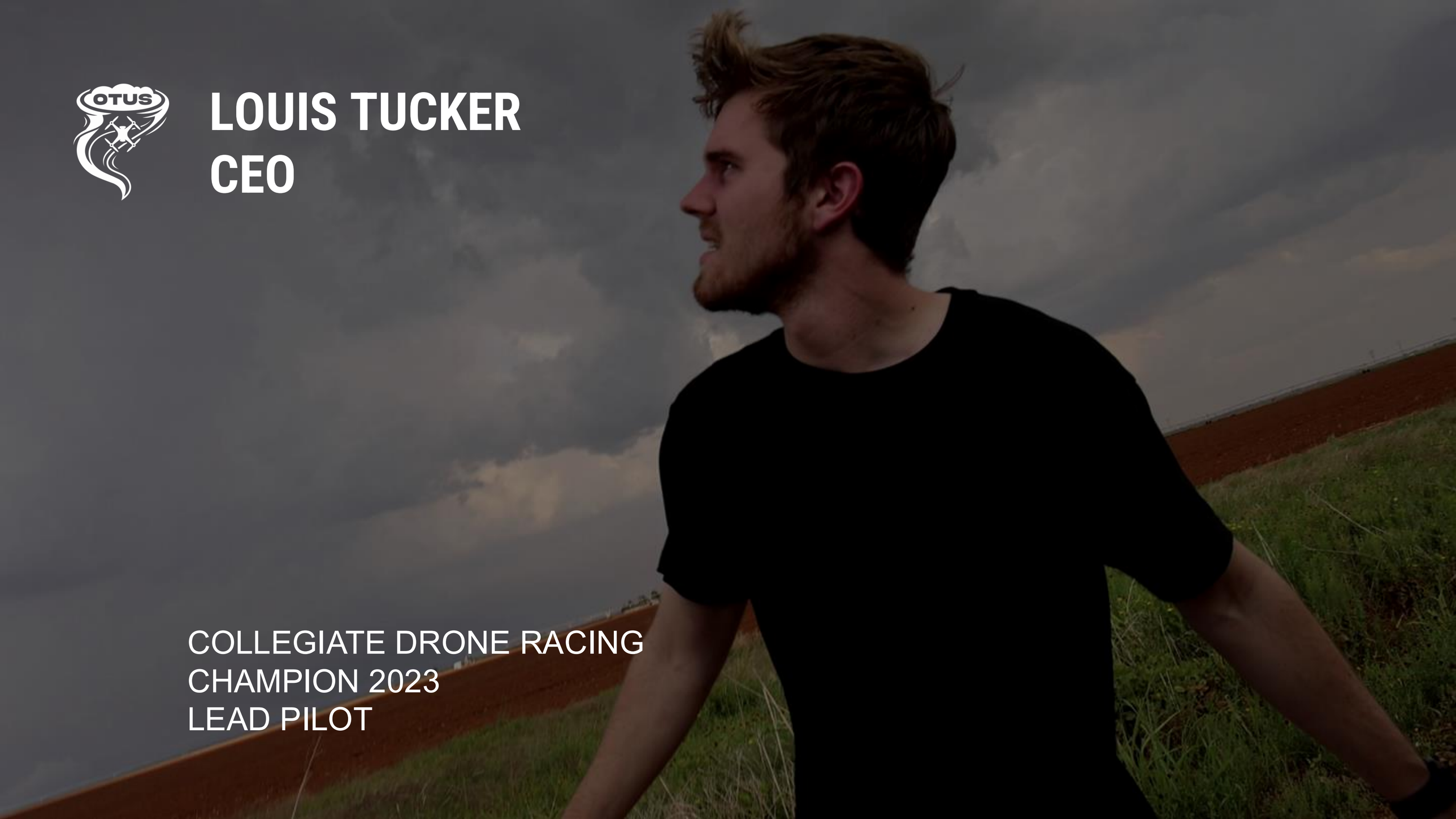


OTUS PROJECT

OBSERVATIONS OF TORNADOES BY UAV SYSTEMS

OUR MISSION, & THE HAZARDS WE FACE - PART 1



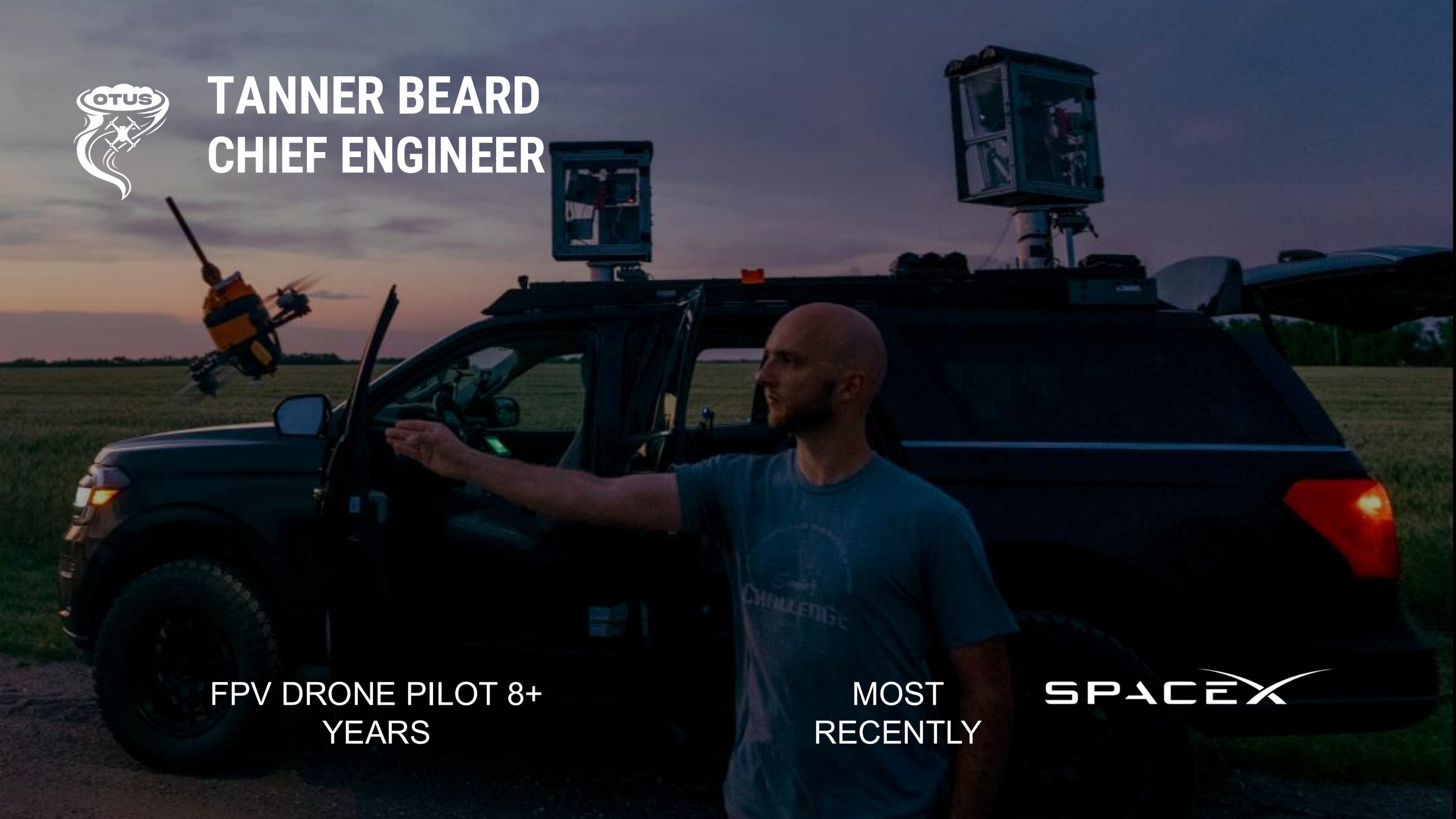
LOUIS TUCKER
CEO

COLLEGIATE DRONE RACING
CHAMPION 2023
LEAD PILOT



NELSON TUCKER
PRESIDENT

NIST TORNADO RESEARCH (SURF)
TORNADO TALK WRITER
TEXAS TECH GRADUATE STUDENT


OTUS
TANNER BEARD
CHIEF ENGINEER
FPV DRONE PILOT 8+
YEARS
MOST
RECENTLY
SPACEX


ERIK FOX
METEOROLOGIST
NSCS FOUNDER
25 YEAR CHASING
VETERAN
WEATHER NATION TV

LOUIS “CDR LOU” TUCKER
SENIOR ADVISOR

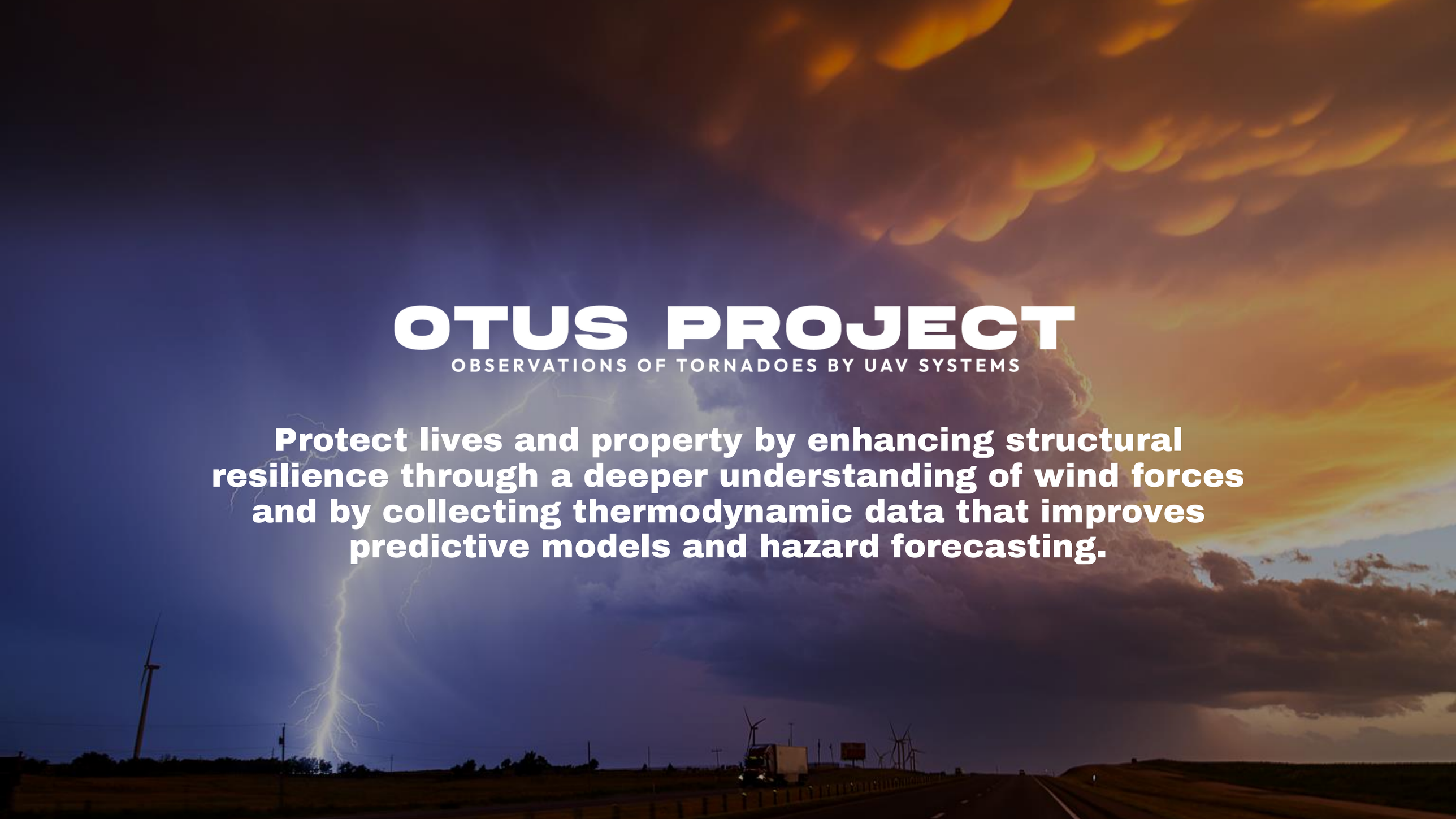


FATHER TO LOUIS AND NELSON
FORMER US NAVY SEAL



INDEX (Part 1)

1. Introductions
2. Purpose of OTUS
3. Integration with existing research
4. Uncut deployment on tornado (video)
5. Other intercepts & findings


OTUS PROJECT
OBSERVATIONS OF TORNADOES BY UAV SYSTEMS
Protect lives and property by enhancing structural resilience through a deeper understanding of wind forces and by collecting thermodynamic data that improves predictive models and hazard forecasting.

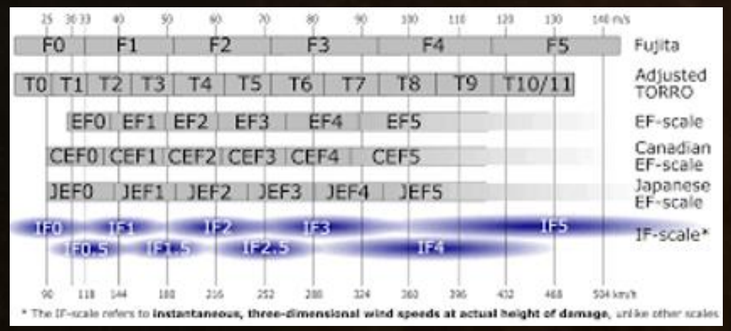
What are we investigating?



Kosiba and Wurman, 2023: “Quantifying tornado winds near the surface is critical to characterizing tornado hazards. Direct measurements of tornado winds are rare and are usually obtained at least >100 m above the ground, well above building height, by proximate mobile radars.”

1st Recommendation NIST Joplin report: “Reliable measurements of near–surface wind speed and other information in tornadoes, especially in the most intense portions of them, are lacking or nonexistent due to both the scarcity and durability of measuring devices. This lack of measurements makes it extremely difficult to understand the relationship between damage and wind speed. Improved characterization of the tornado hazards at elevations that are meaningful for engineering design can be achieved by development and use of ruggedized, tornado– and tornado debris–resistant technology capable of directly measuring near–surface wind speeds, wind pressure, impact loading, and turbulence produced by tornadoes and other extreme wind events.”



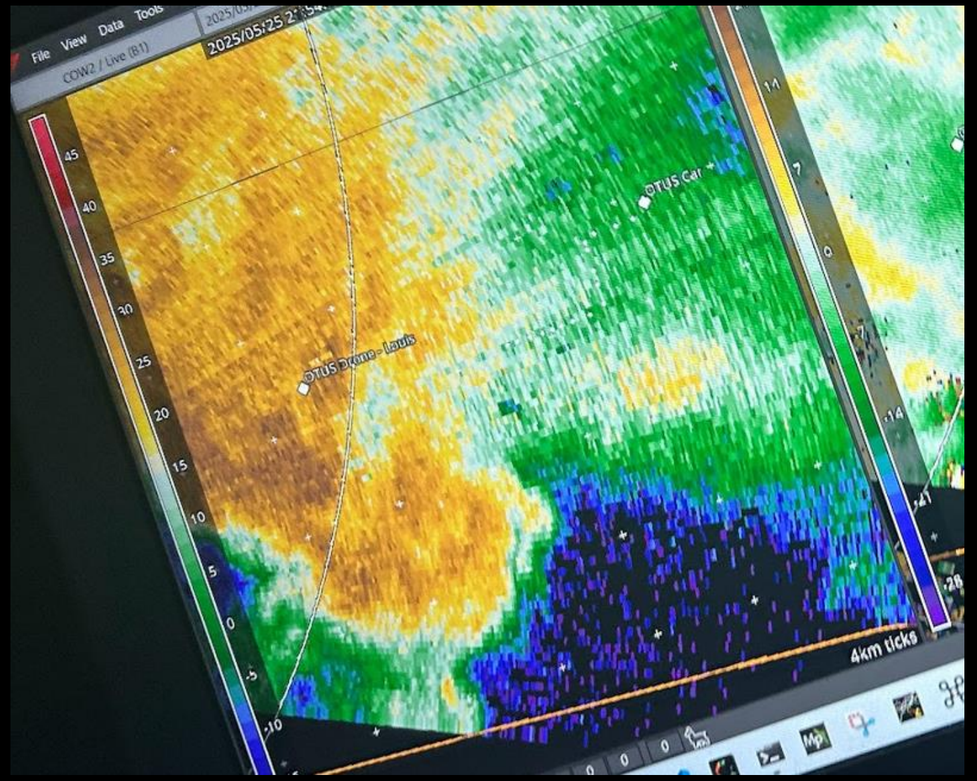


ESSL’s International Fujita Scale: “There is currently no full scientific understanding of whether similar wind speeds would lead to differing levels of damage in tornadoes and in downbursts. This is why the working hypothesis of the IF scale approach is that they can be treated equally.”

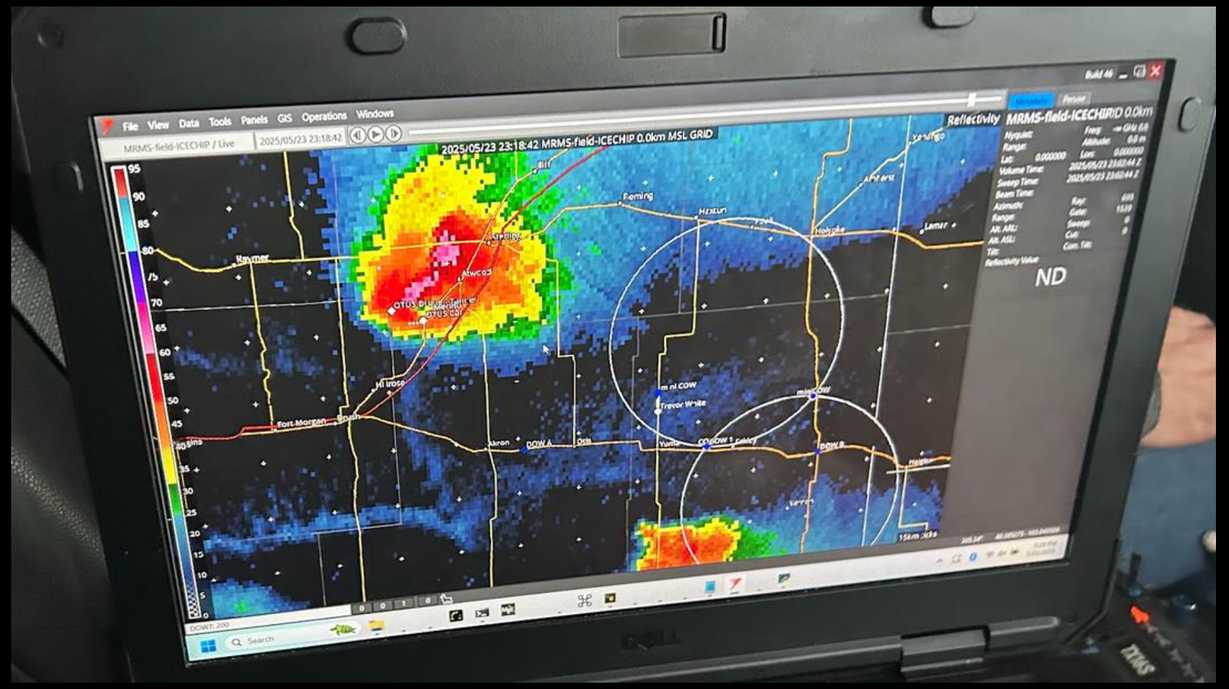
OTUS Drones as the safe Data Collection Alternative

- Ground probes were first implemented in 1980, with limited success to this day and minimal measurements inside the Radius of Maximum Winds (RMW).
- It can be deadly; loss of life in the past due to the research requiring a close human proximity to the tornado
- OTUS can put drones in locations otherwise difficult or impossible to safely reach for direct atmospheric measurements.
- Collecting full 3D wind data and thermodynamic measurements (temperature, pressure, humidity)

Collaboration: Integration with ICECHIP (2025)







NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
U.S. DEPARTMENT OF COMMERCE

- Important request in windstorm programs is new tornado specific sensors to directly measure wind speeds, turbulence, and characteristics with height
- Partnership for development of a new 3D wind sensor specifically designed for tornado measurements on drones



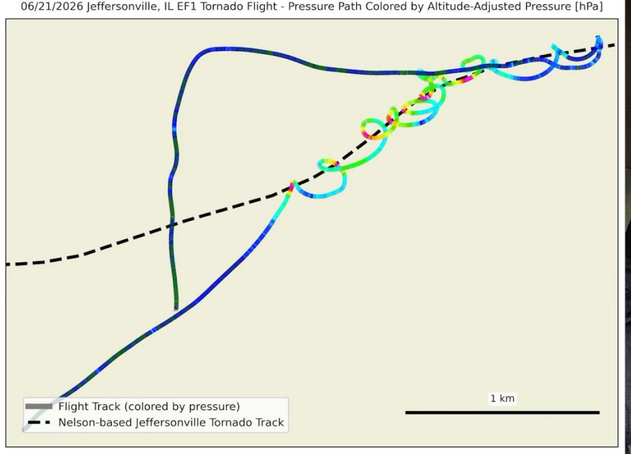
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
U.S. DEPARTMENT OF COMMERCE

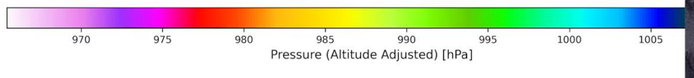
- Delays and funding issues have currently delayed NIST calibrations
- Operated in 2025/6 tornado season with a partial 3D wind sensor
- Current planning is post-calibration of exact sensor used in prior flights inside tornadoes, and calibration of improved sensor design for near-omnidirectional wind measurement in 2027

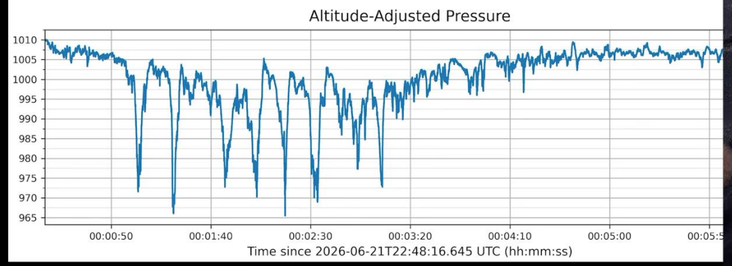




FULL DEPLOYMENT: VIDEO


06/21/2026 Jeffersonville, IL EF1 Tornado Flight - Pressure Path Colored by Altitude-Adjusted Pressure [hPa]
Flight Track (colored by pressure)
Nelson-based Jeffersonville Tornado Track
1 km

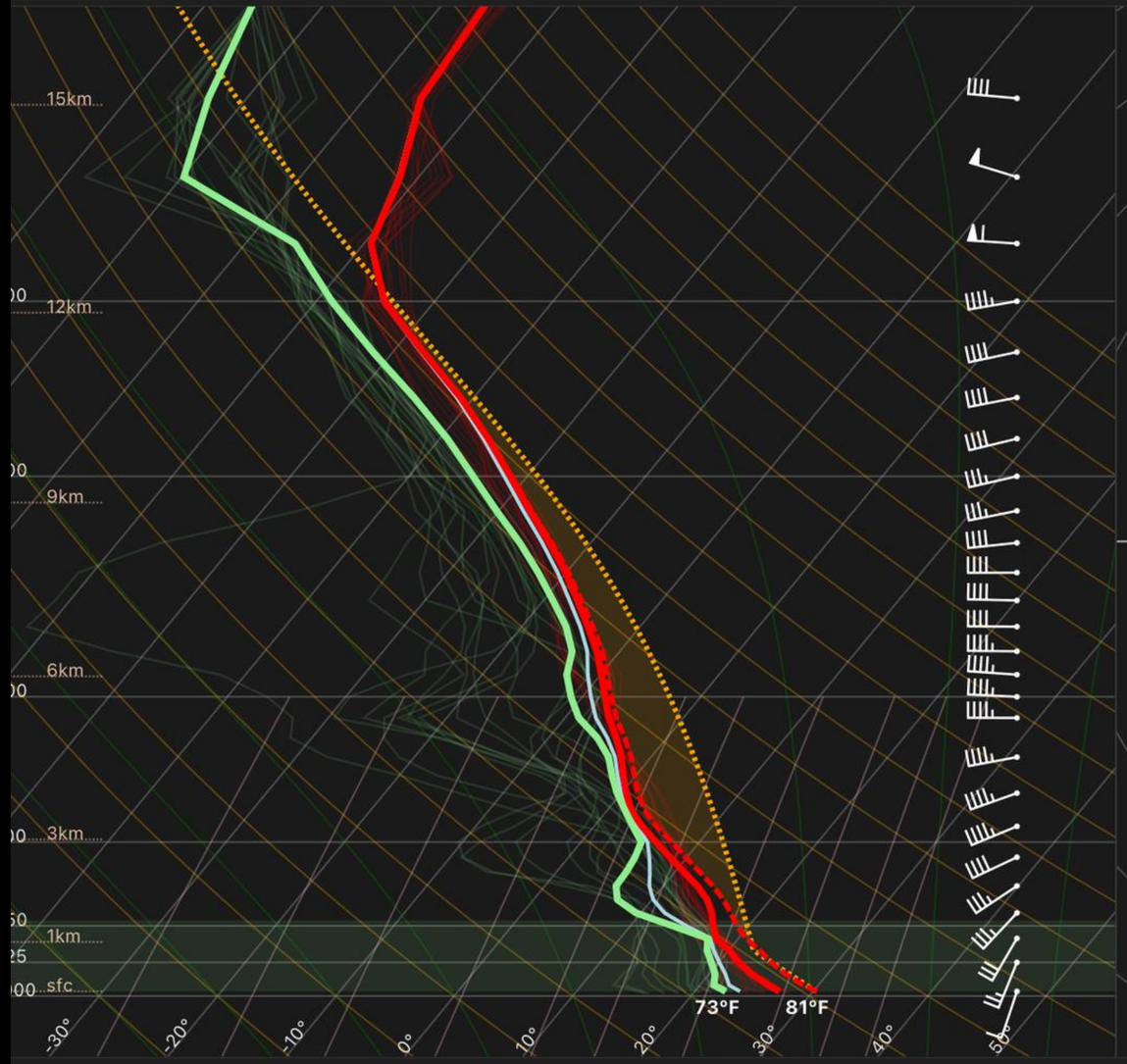

970
975
980
985
990
995
1000
1005
Pressure (Altitude Adjusted) [hPa]

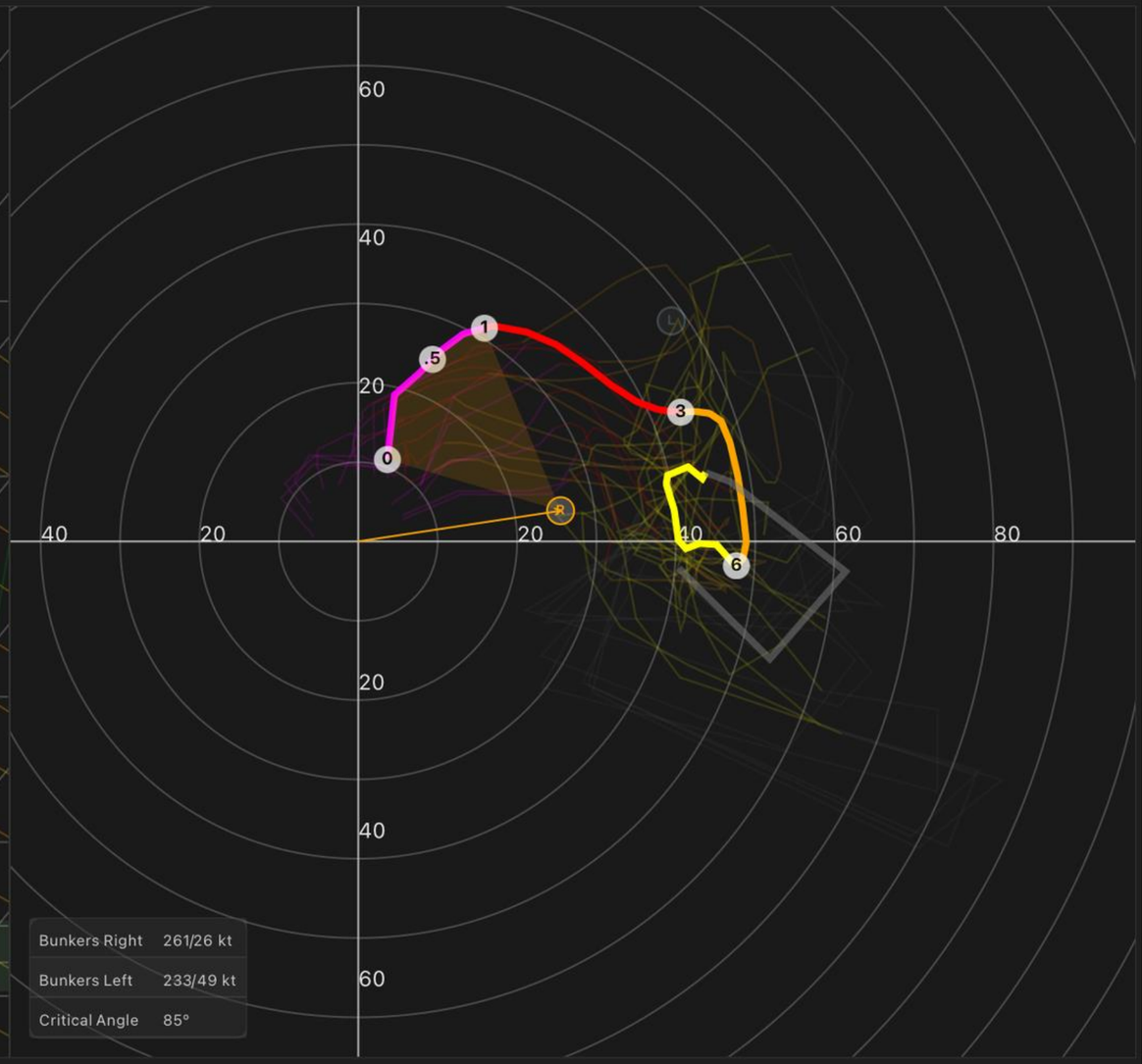

Altitude-Adjusted Pressure
1010
1005
1000
995
990
985
980
975
970
965
00:00:50
00:01:40
00:02:30
00:03:20
00:04:10
00:05:00
Time since 2026-06-21T22:48:16.645 UTC (hh:mm:ss)





Dix/Mt. Vernon-Sims/Wayne City/Jeffersonville, IL · 2026-06-21 21:00Z · RAP · (38.41, -88.86)





arcel	CAPE	CIN	LCL	LFC	EL	LI	3CAPE
FC (989 mb)	2380 J/kg	0 J/kg	582m	582m	13125m	-7	261 J/kg
IXED LAYER	1298 J/kg	-3 J/kg	835m	971m	12368m	-5	144 J/kg
U (989 mb)	2380 J/kg	0 J/kg	582m	582m	13125m	-7	261 J/kg
f Inflow	907 J/kg	-2 J/kg	1030m	1182m	10545m	-5	99 J/kg

Layer	Shear	SRH	Mean Wind	SR Wind	SW ζ	SW ζ %
0-0.5 km	15kt	98m²/s²	198/21 kt	129/25 kt	0.013s⁻¹	98%
0-1 km	22kt	153m²/s²	202/24 kt	139/25 kt	0.011s⁻¹	99%
0-3 km	37kt	292m²/s²	226/32 kt	171/18 kt	0.008s⁻¹	94%
0-6 km	46kt	439m²/s²	243/36 kt	207/14 kt	0.007s⁻¹	94%
Eff Inflow	25kt	196m²/s²	208/27 kt	147/24 kt	0.010s⁻¹	97%
Eff Bulk Wind	42kt	440m²/s²	245/36 kt	214/13 kt	0.006s⁻¹	91%

Layer	Lapse Rate	Mean RH
0-3km	7.7°C/km	79.5%
3-6km	5.5°C/km	89.9%
500-700mb	5.7°C/km	90.8%
Eff Inflow (0–1427m)	8.4°C/km	82.5%
DGZ (6454–7318m)	5.9°C/km	84.8%
HGZ (6044–9229m)	6.4°C/km	81.2%

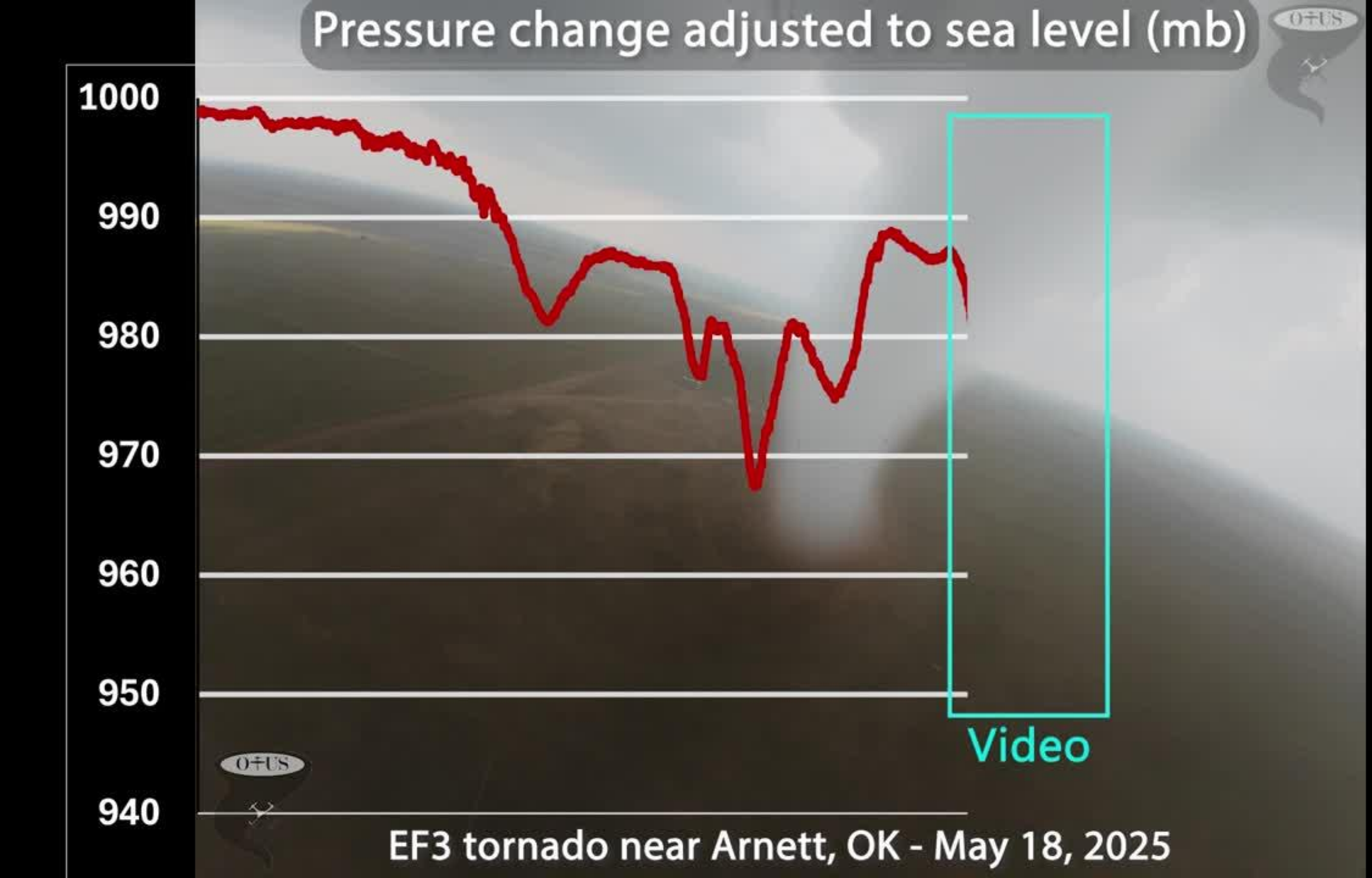
PWAT	1.91"
Conv Temp	28°C
TT Index	47
K Index	37
DCAPE	377 J/kg
Frz Level	3959 m



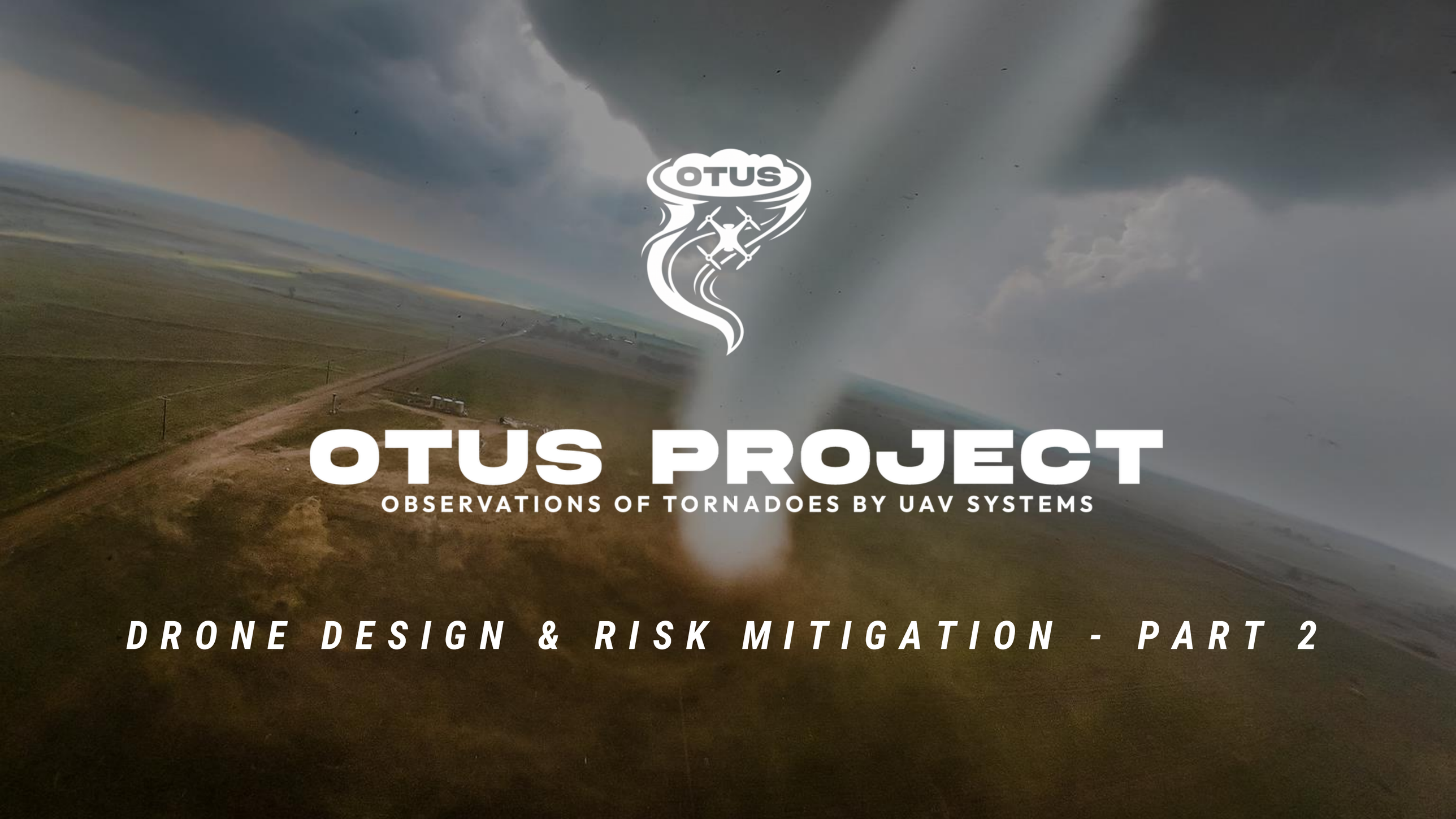
Other Observations:




0.5x speed


Pressure change adjusted to sea level (mb)
1000
990
980
970
960
950
940
Video
EF3 tornado near Arnett, OK - May 18, 2025


Lunch Break



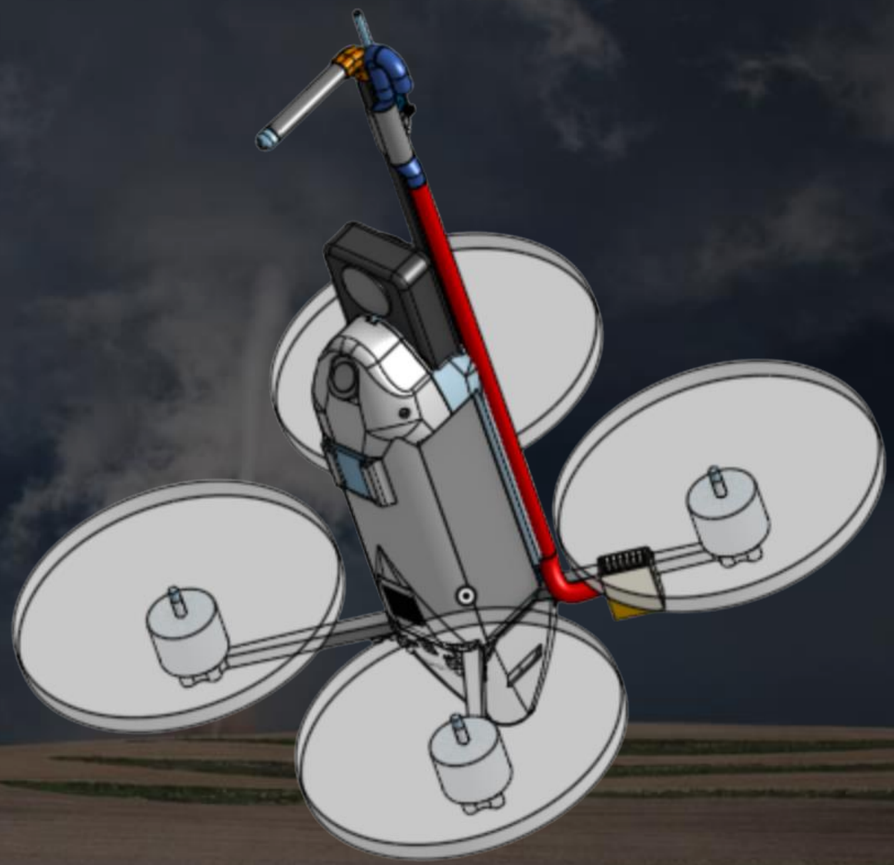
OTUS PROJECT

OBSERVATIONS OF TORNADOES BY UAV SYSTEMS

DRONE DESIGN & RISK MITIGATION - PART 2

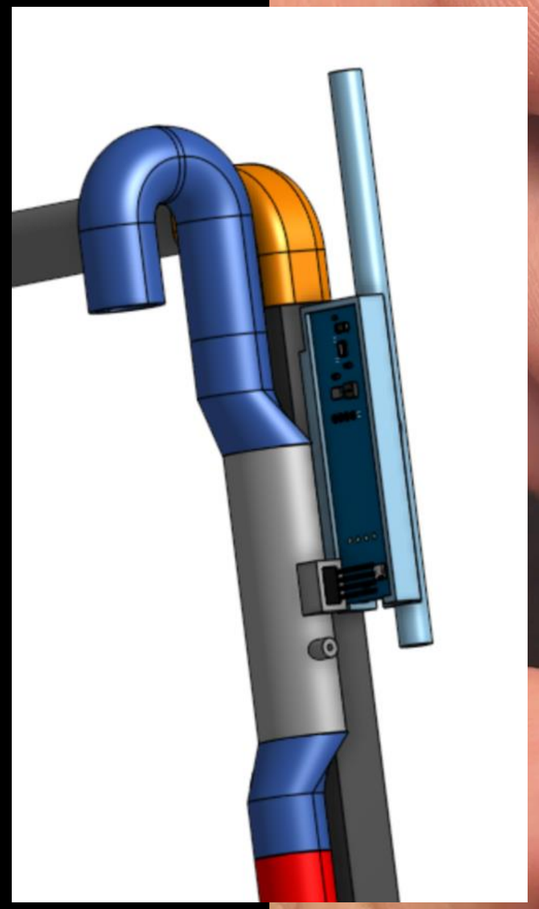
2026 Drone Redesign

- Higher payload capacity
  - New wind probe
  - 360 camera
- Lightweight modular probe and camera pods
- Reduce desync
  - Propeller is hit by intense winds and overcomes the force of the induced magnetic field → sensorless ESC loses track of the position of the rotor
- 42V architecture

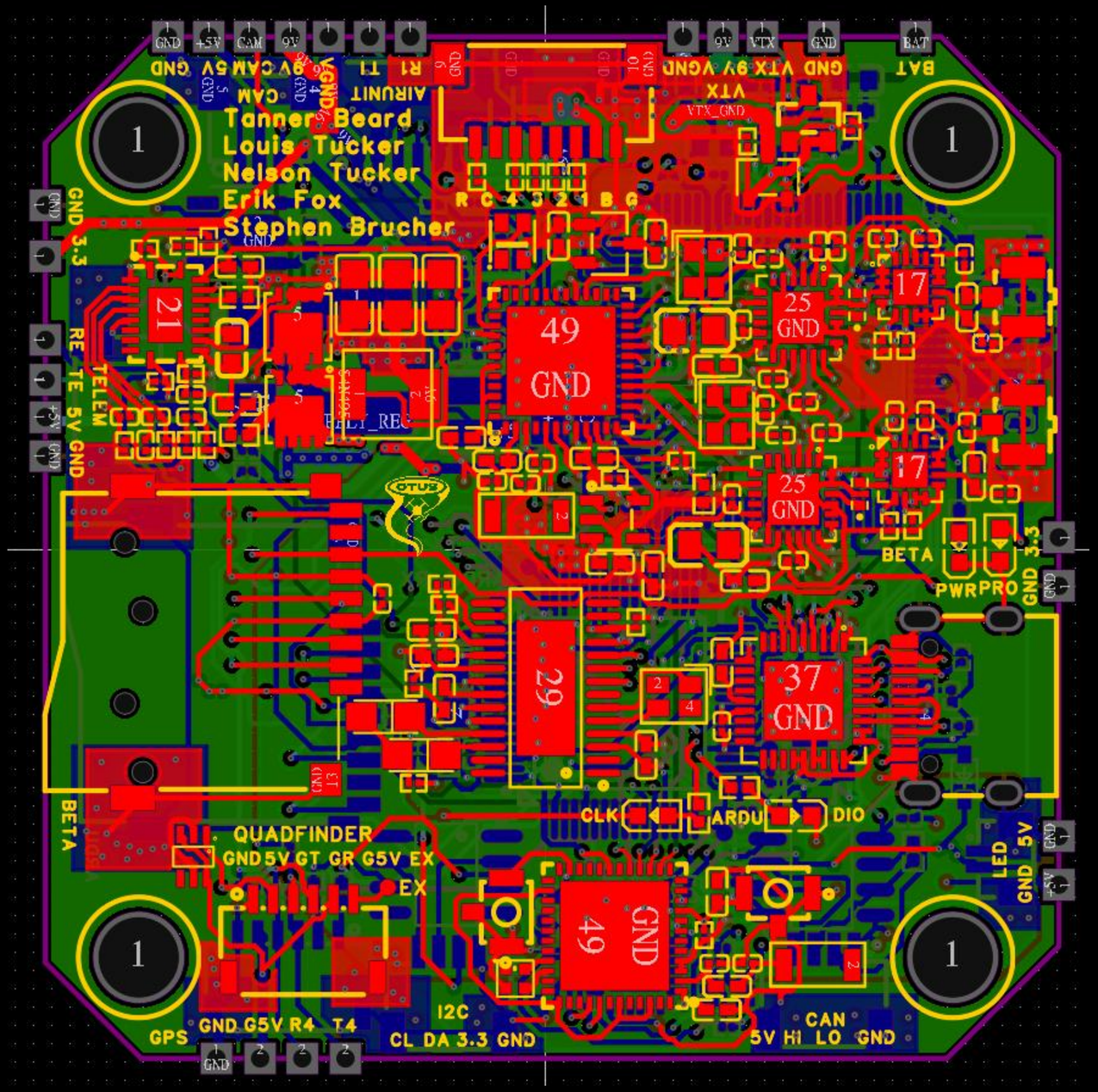


2026 Thermo Probe Design and Challenges

- Difficult to remove the effects of dynamic pressure
- Multi-stage static port
- Allows fast response time to pressure changes while being omnidirectional
- Temperature and humidity need droplets to be separated from air
- Improving separation while having high aspiration rate

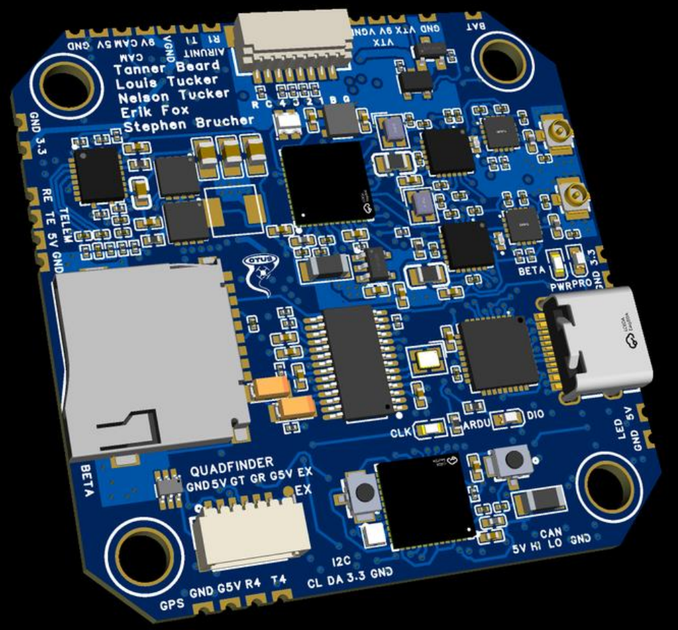


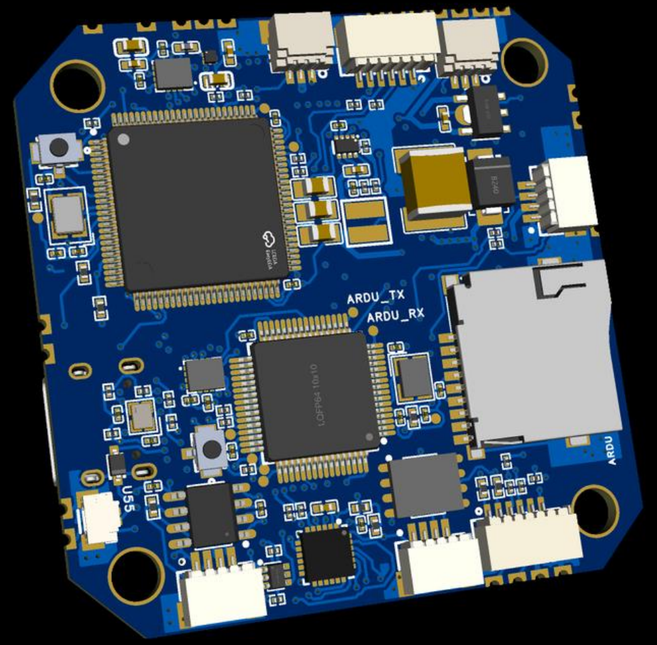
2026 Flight Controller



2026 Flight Controller

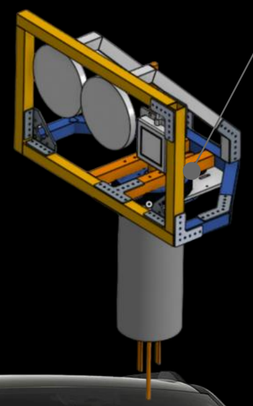
- Capable to 100V
- Plugs for all connections, no soldering in the car required
- Built in video off switch
- H743 primary Betaflight processor
- H7A3 secondary Ardupilot processor for autonomous features and sensor logging - UART connection to primary processor
- Low noise power supply for IMU
- Built in diversity ELRS receiver with TXCO oscillator
- Built in ESP-32 telemetry coordinator with wifi and bluetooth for quickly interfacing with drone fleets
- Built in USB-C hub (both qt py and Betaflight will show up as serial ports when fc is plugged in)
- Video pit switch compatible with analog and digital
- Plugs for all external components, no soldered needed
- 3A 9V supply sized to withstand 100V, designed to operate at 12s or below
- 2A 5V supply





Full Setup

2026 ANTENNA TRACKER
Mobile capability to fly drone while inside the protection of car from debri, hail, and other hazards.







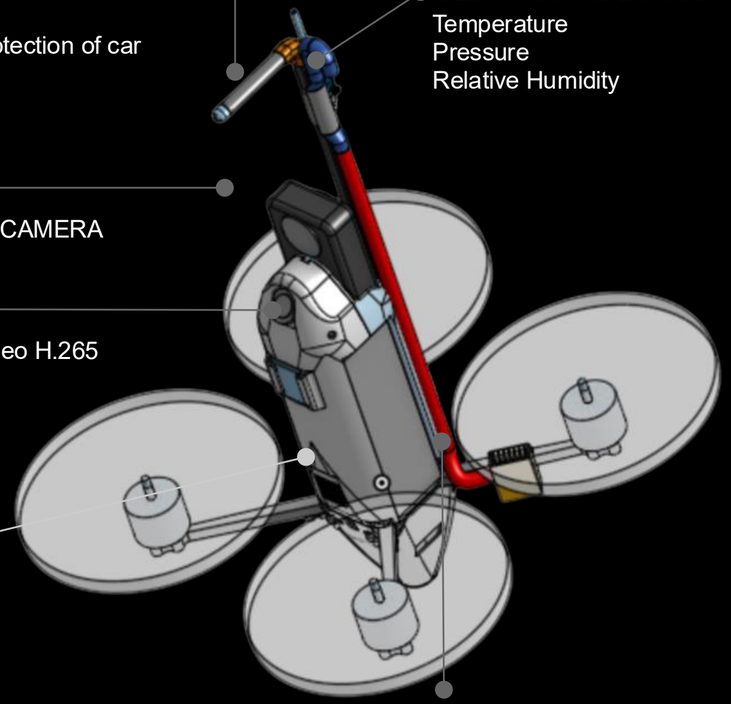
RESEARCH VEHICLE
CREW OF 5
- NAVIGATOR/DRIVER
- METEOROLOGIST
- DRONE OP/BUILDER
- DRONE OP/ENGINEER
- FIELD DOCUMENTATION LEAD

NIST NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY U.S. DEPARTMENT OF COMMERCE
Vertical Wind Speed Sensor

SENSORS & DATA
Temperature
Pressure
Relative Humidity

VIDEO
INSTA360 CAMERA

VIDEO
½” CMOS 4K 60fps video H.265



VIDEO
½” CMOS 4K 60fps video H.265

Custom 3D Printed
Aerodynamic Canopy

Risk Mitigation: Top Tier Pilots

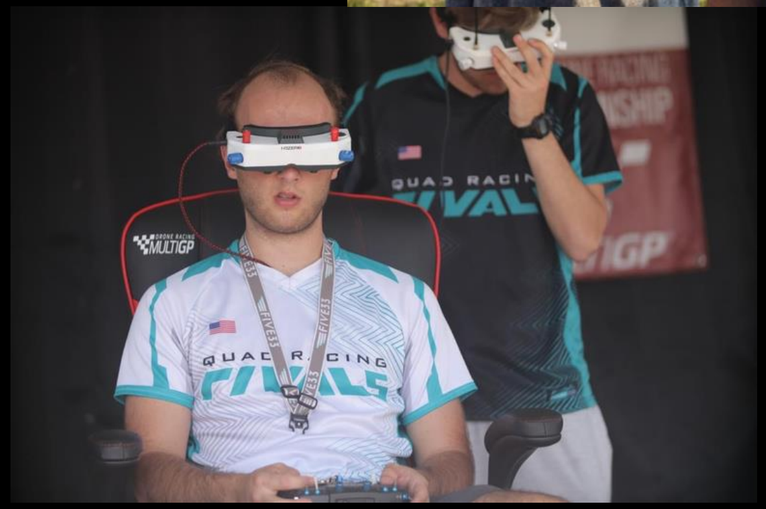
- Nearly 10,000 hours of drone experience between Louis & Tanner

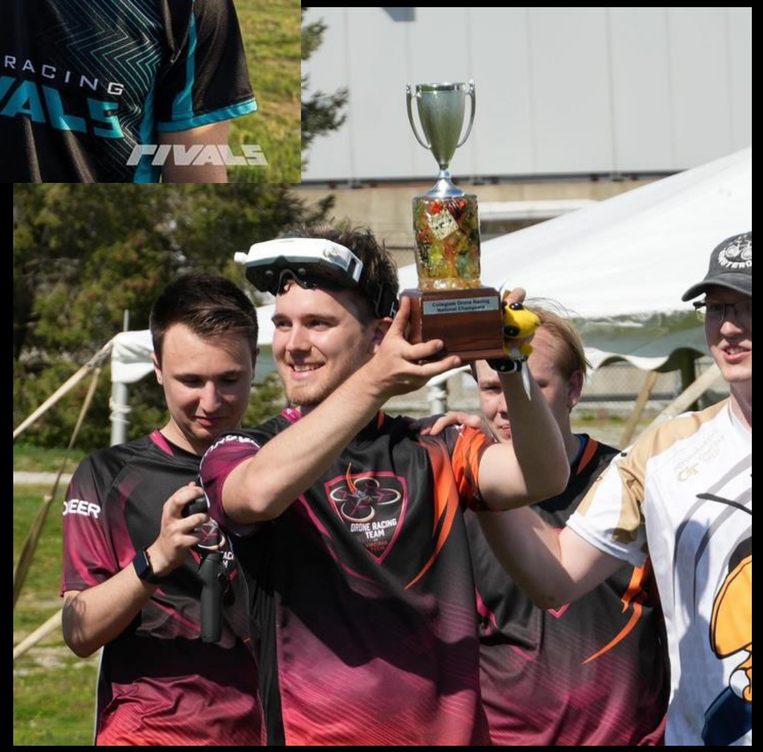
- OTUS Pilots must demonstrate mastery through high placement at National & International Drone Racing Competitions

Able to:

- Diagnose drone issues mid-flight
- Fly in low-visibility environments
- Analog fpv flying
- Maintain awareness of surroundings







Risk Mitigation: Top Tier Pilots





Current OTUS Status & Goals

OTUS STATUS

- 19 drone intercepts to date, 15 tornadoes intercepted, 1 night vision drone intercept. OTUS concept has been proven to be a reliable and “safe” way to measure the environment within and surrounding tornadoes.

- Self-funded to date, through life savings and social media sponsors

- Ultimate goal is grant funding, but that has been a challenge (many research organizations that want our data are in a survival state of their own)

- Currently in “limbo” until science-level funding or further commercial partnerships can be attained; we are committed to making limited deployments in 2027.

Focus of OTUS: 2026 & Beyond

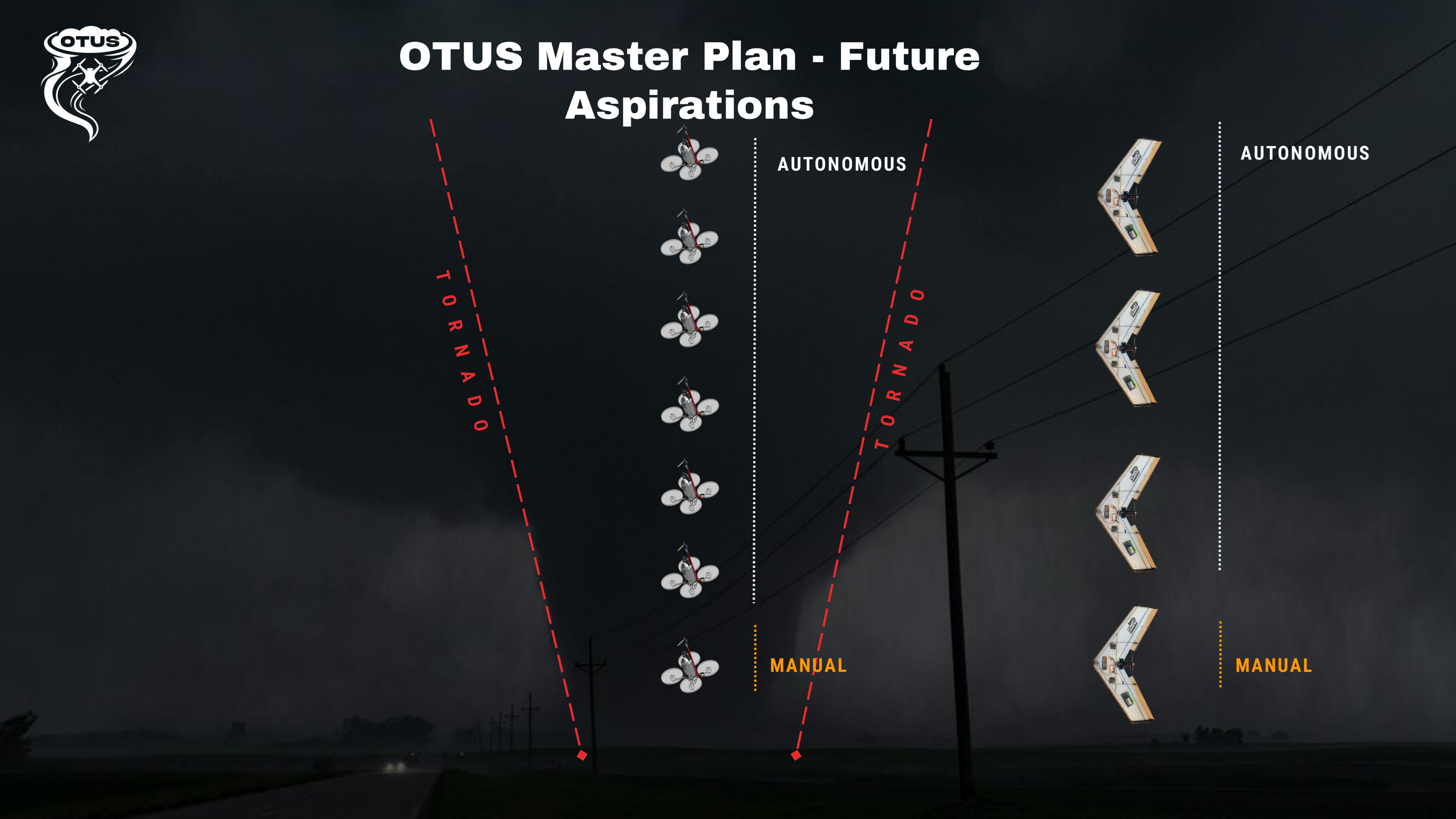
Objectives:

- Informed structural resilience, improved building standards
- Definitive understanding of tornado intensity/structure/evolution

To do this:

- Measure 3D winds and accompanying thermodynamics within tornadoes at near-surface level (<50 m)
- Simultaneously deploy multiple drones at different heights in tornadoes to gather vertical wind profiles
- Formal collaboration with Flexible Array of Radars and Mesonets (FARM) and other groups
- Complete calibrations, validations
- Publish collaborative report with NIST on wind sensor development
- Publish findings from datasets

OTUS Master Plan - Future Aspirations





Thank you!