

Author – Alex Clark
IERUS Technologies
Alex.Clark@IERUSTech.com

Second Author – Edward Trzcienski
AEgis Technologies
Edward@AEgistg.com

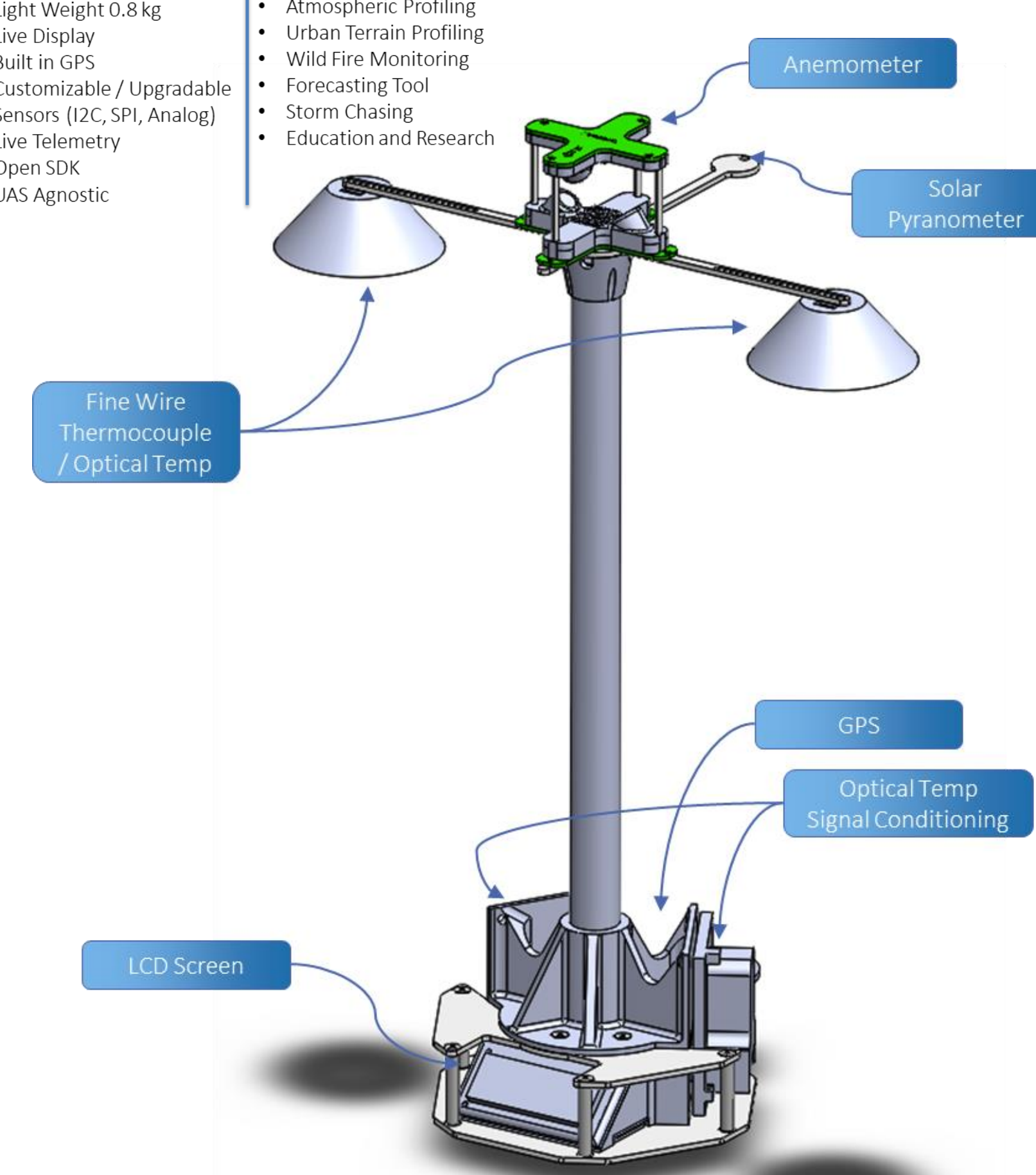
Features

- Light Weight 0.8 kg
- Live Display
- Built in GPS
- Customizable / Upgradable Sensors (I2C, SPI, Analog)
- Live Telemetry
- Open SDK
- UAS Agnostic

Applications

- Atmospheric Profiling
- Urban Terrain Profiling
- Wild Fire Monitoring
- Forecasting Tool
- Storm Chasing
- Education and Research

Payload (WP-V2)

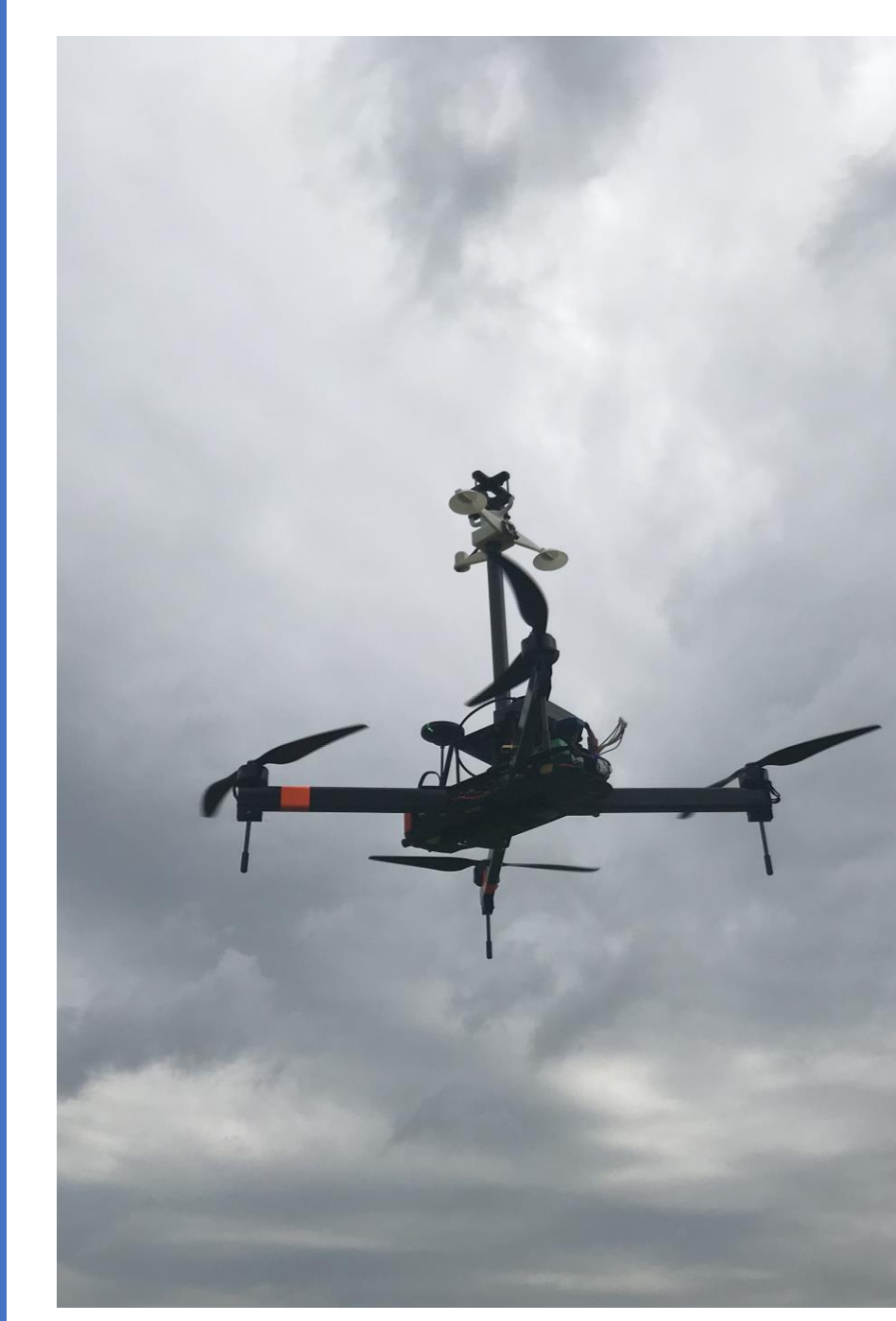


System Specifications

WP-V2				
Component	Feature	Specification	Unit	
Wind Speed	Range	0-50	m/s	
	Resolution	0.1	m/s	
	Accuracy (0-15 m/s)	+/- 0.1	m/s	
	Accuracy (15-30 m/s)	+/- 2	%	
Wind	Range (x/y)	360	Deg	
	Range (z)	+/- 30	Deg	
	Resolution	+/- 1	Deg	
	Accuracy	+/- 1	Deg	
Temperature	Range	-25 to 80	C	
	Resolution	0.1	C	
Humidity	Range	0-100	%	
	Accuracy	+/- 5	%	
Pressure	Range	50-115	kPa	
	Accuracy	+/- 1	kPa	
Tilt	Pitch and Roll	+/- 180	Deg	
	Accuracy	+/- 0.5	Deg	
Compass	Heading	360	Deg	
	Accuracy	+/- 5	Deg	
DTS	Range	-40 to 105	C	
	Resolution	0.003906625	C	
DAQ	Data Storage	SD Card		
	System Speed	Frequency	20	Hz
	UAS	Flight Time	30	Min

Platforms

IE-V2 (750mm)



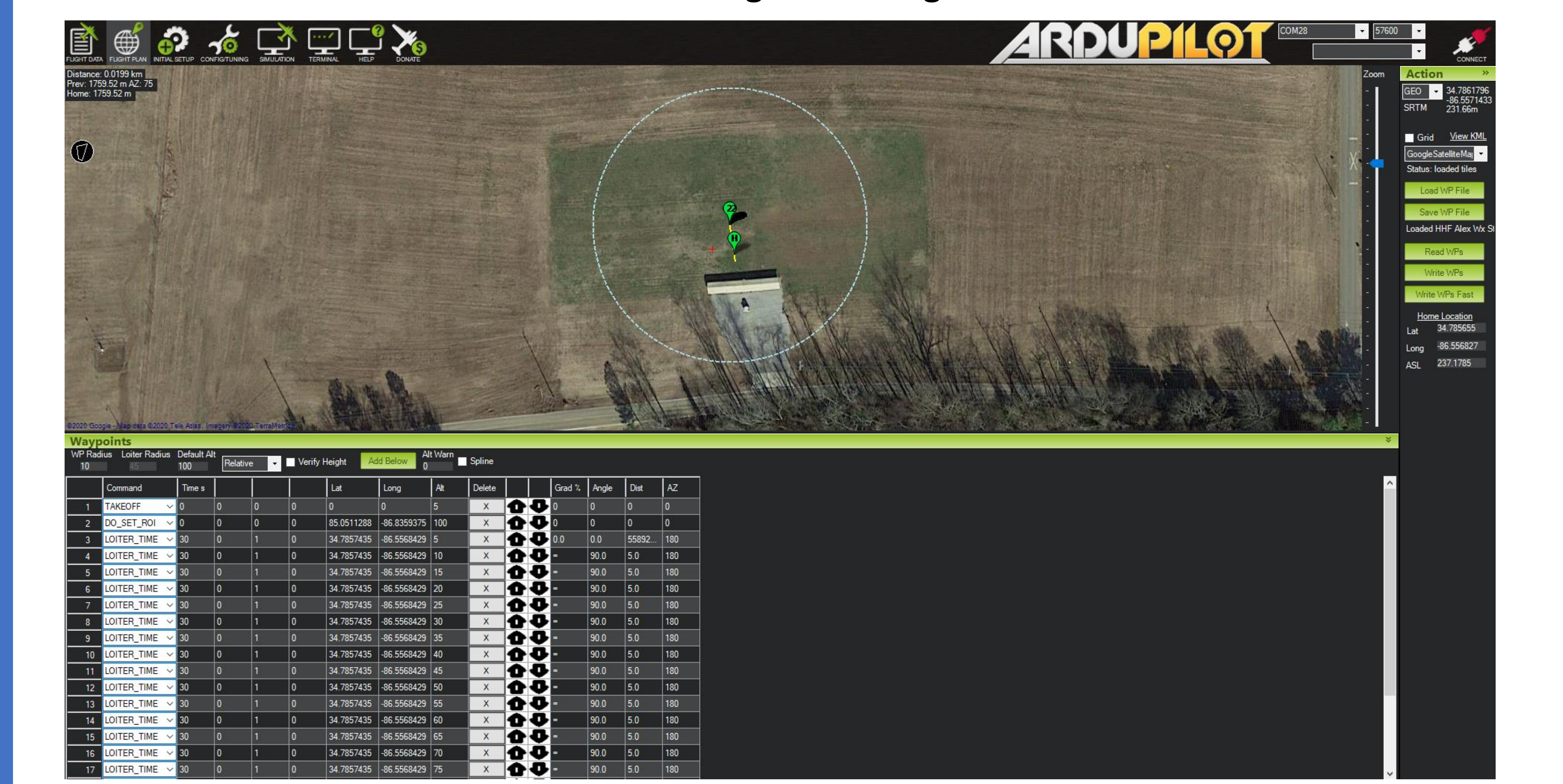
E900 (900mm)



DJI M600

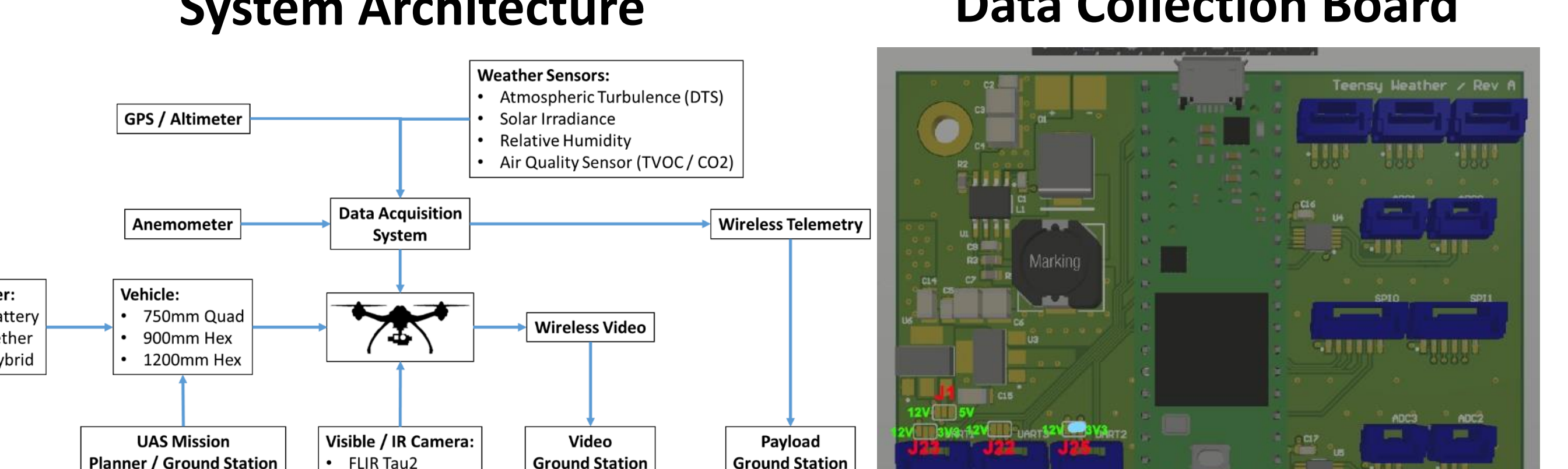


Flight Planning

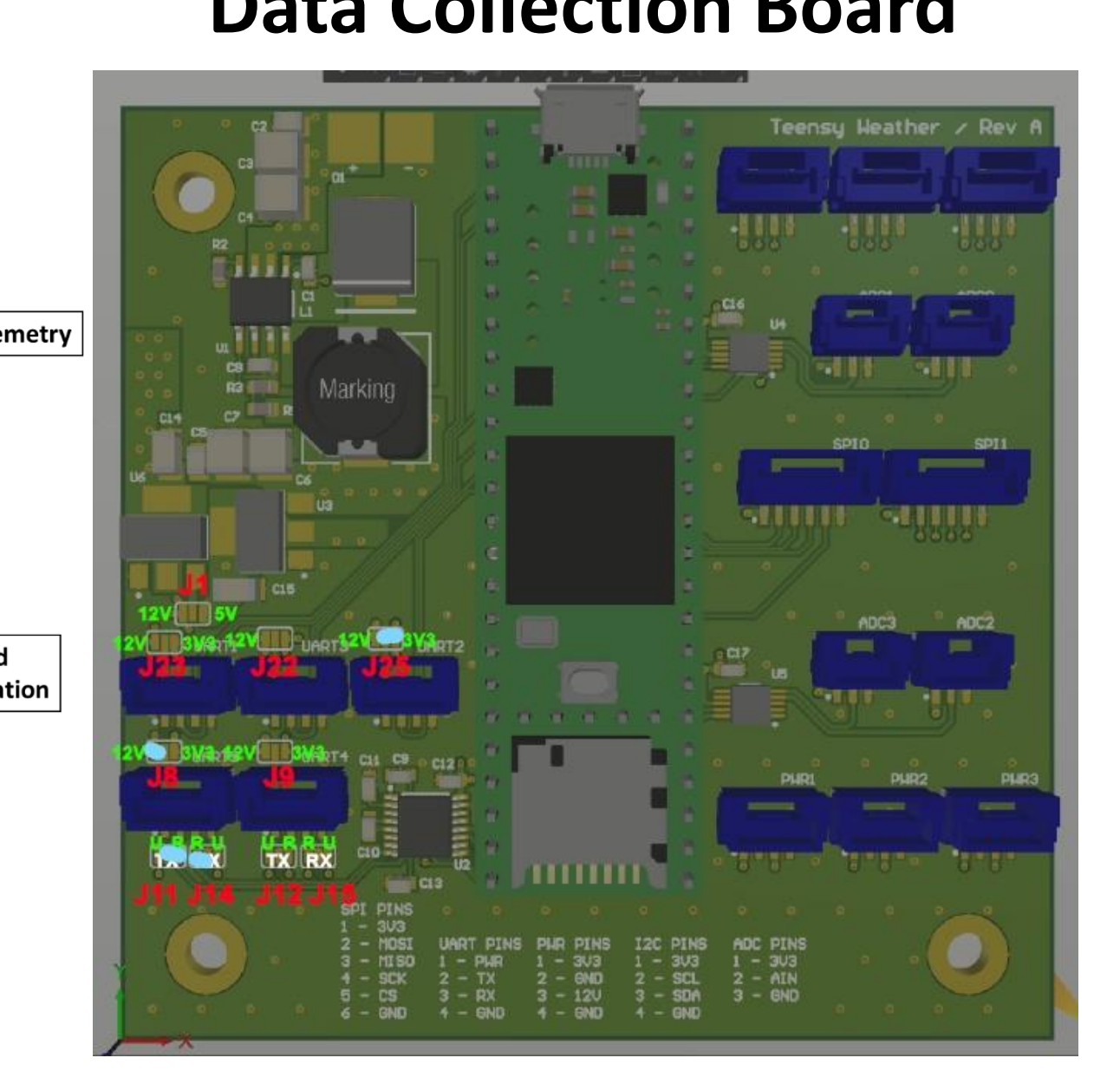


Waypoint	Command	Time s	Lat	Long	Alt	Delete	Grade	Angle	Dist	AZ
1	TAKEOFF	0	0	0	0	0	X	0	0	0
2	DO_SET_ROI	0	0	0	85.0511288	36.8350375	100	X	0	0
3	LOITER_TIME	30	0	1	0	34.7857435	36.5568429	5	X	0.0
4	LOITER_TIME	30	0	1	0	34.7857435	36.5568429	10	X	50.0
5	LOITER_TIME	30	0	1	0	34.7857435	36.5568429	15	X	20.0
6	LOITER_TIME	30	0	1	0	34.7857435	36.5568429	20	X	50.0
7	LOITER_TIME	30	0	1	0	34.7857435	36.5568429	25	X	50.0
8	LOITER_TIME	30	0	1	0	34.7857435	36.5568429	30	X	50.0
9	LOITER_TIME	30	0	1	0	34.7857435	36.5568429	35	X	50.0
10	LOITER_TIME	30	0	1	0	34.7857435	36.5568429	40	X	50.0
11	LOITER_TIME	30	0	1	0	34.7857435	36.5568429	45	X	50.0
12	LOITER_TIME	30	0	1	0	34.7857435	36.5568429	50	X	50.0
13	LOITER_TIME	30	0	1	0	34.7857435	36.5568429	55	X	50.0
14	LOITER_TIME	30	0	1	0	34.7857435	36.5568429	60	X	50.0
15	LOITER_TIME	30	0	1	0	34.7857435	36.5568429	65	X	50.0
16	LOITER_TIME	30	0	1	0	34.7857435	36.5568429	70	X	50.0
17	LOITER_TIME	30	0	1	0	34.7857435	36.5568429	75	X	50.0

System Architecture



Data Collection Board



Data Collection ~30Hz

I2C / SPI / UART / RS-232 / A2D

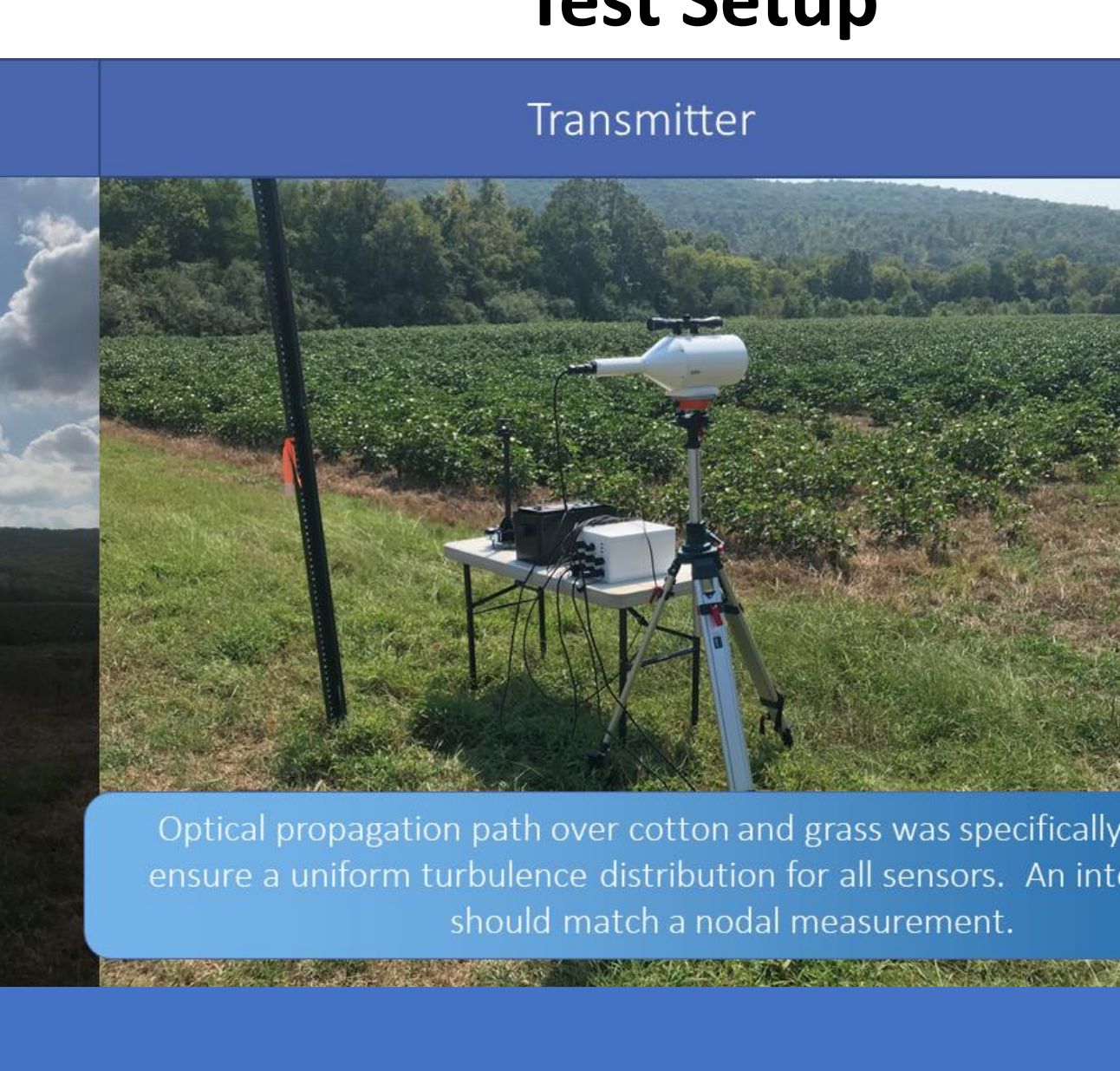
SD Card System Storage

Test Setup

Middle Path



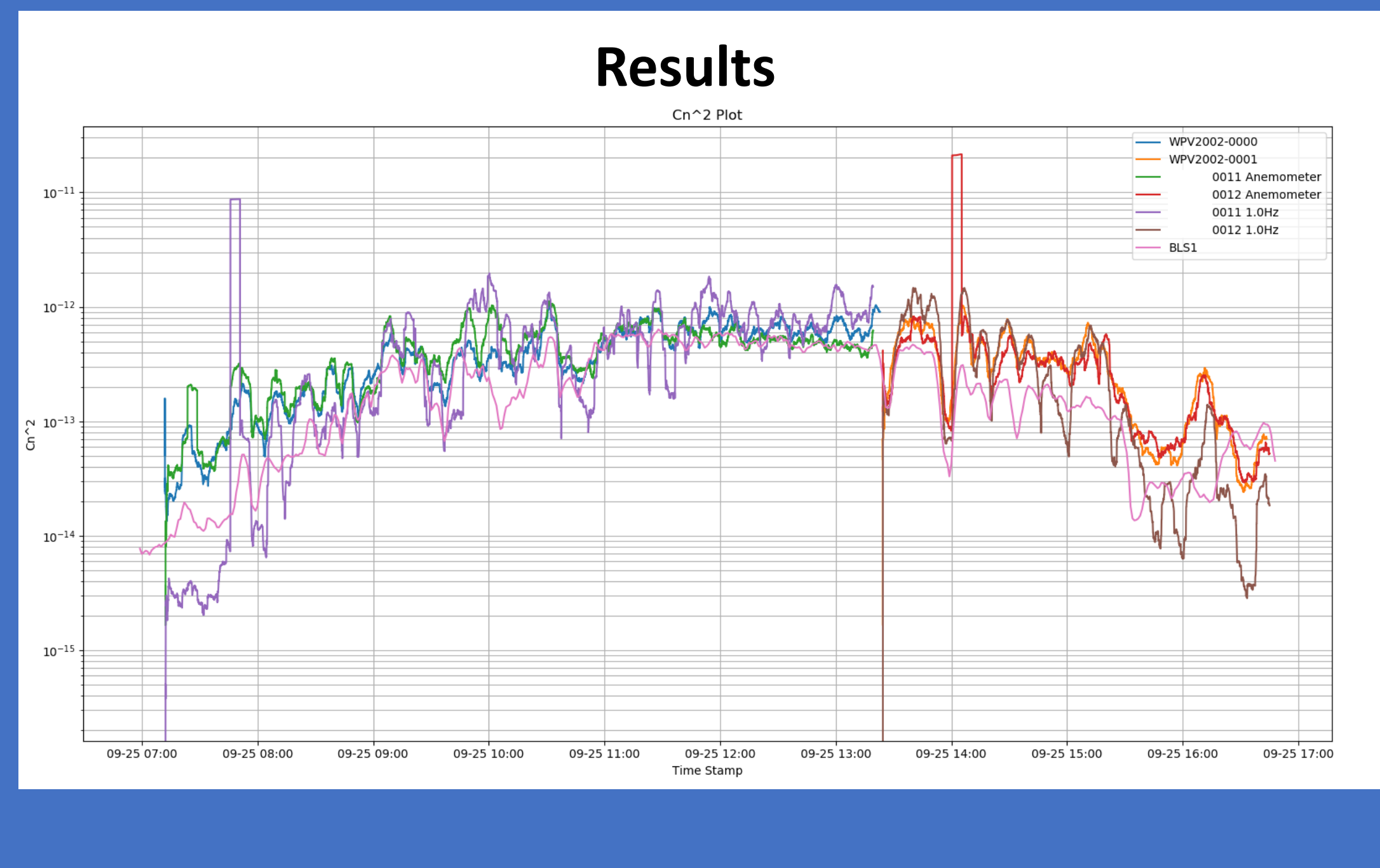
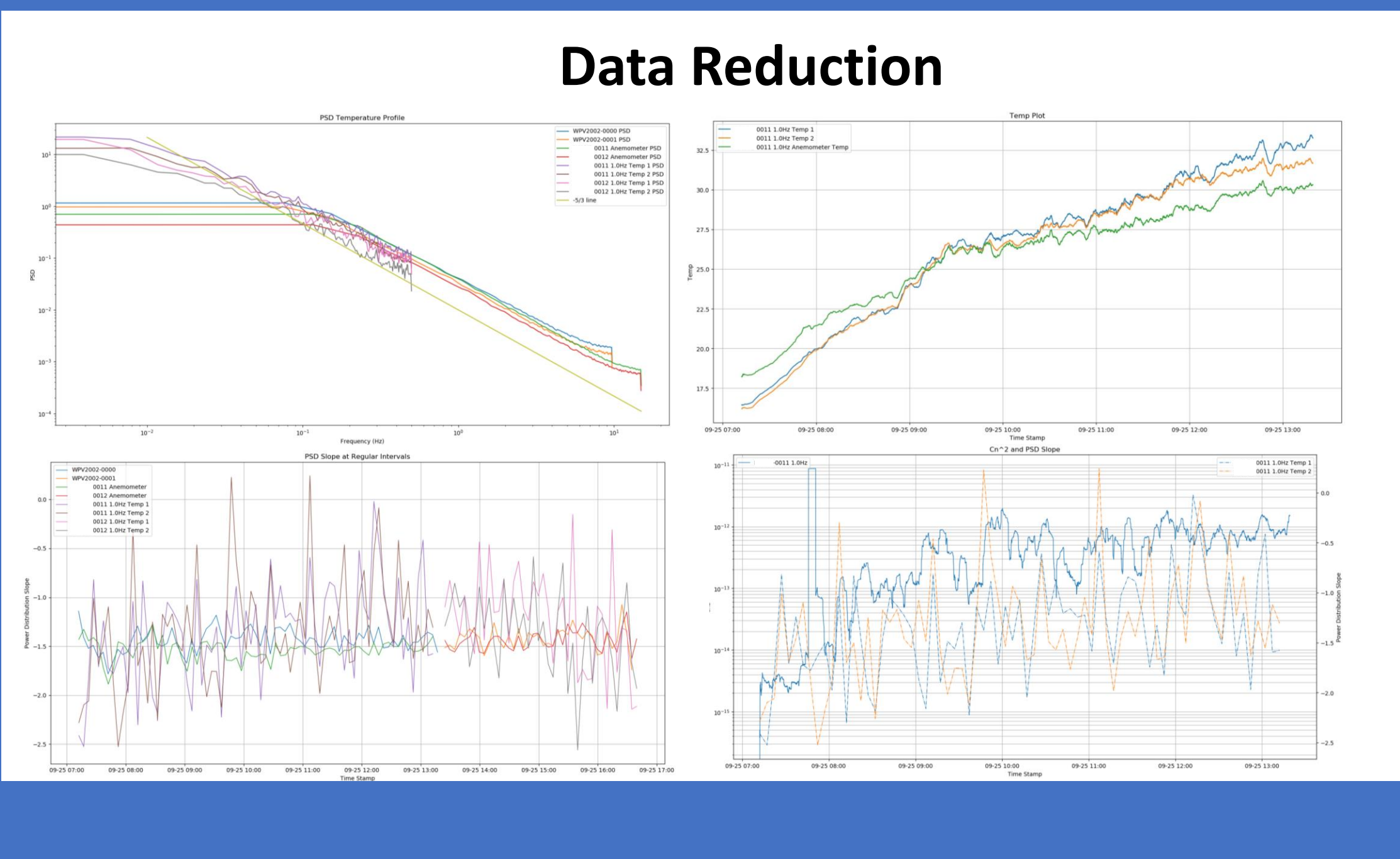
Transmitter



Receiver



Optical propagation path over cotton and grass was specifically selected to ensure a uniform turbulence distribution for all sensors. An integrated path should match a nodal measurement.



Governing Equations and References

¹ Anemometer Temperature Structure:

$$C_t^2 = \frac{[T_1(t_1) - T_2(t_2)]^2}{(U(t_2 - t_1))^{2/3}}$$

² DTS Temperature Structure:

$$C_T^2 = \langle \Delta T^2 \rangle / r^{2/3}$$

² Refractive Index Structure:

$$C_n^2 = [79 P / T^2]^2 \times 10^{-12} C_T^2$$

¹ Prasan Chintawongvanich, Robert Olsen, 1968, 'Measurements of temperature and velocity structure parameters from sonic anemometers', SPIE, Atmospheric Propagation and Remote Sensing II, 10.1117/12.154865

² S.F. Clifford, 1978, 'The Classic theory of Wave Propagation in a Turbulent Medium', Topics in Applied Physics Volume 25, Laser Beam Propagation in the Atmosphere, Pg 13.

Flight Tests



