

# Optimizing Ubiquity, Iridium Cutdown, and RFD 900 for High-Altitude Balloon Solar Eclipse Missions.



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PennState

## Introduction:

Success of high-altitude balloon missions relies on optimizing communication and ground systems and maintaining consistent contact with ground stations.



Penn State, Lincoln University, University of North Texas NEBP teams during the total eclipse.

## Methods:

- Test separately the RFD900, ubiquity network, and cut down systems
- Tethered flight with all system integrated into a balloon
- Provide an idea of factors that might affect our equipment
- Compare the data received from the RFD900
- Monitor the connection of the Ubiquity radio.
- Send commands to the cut down system

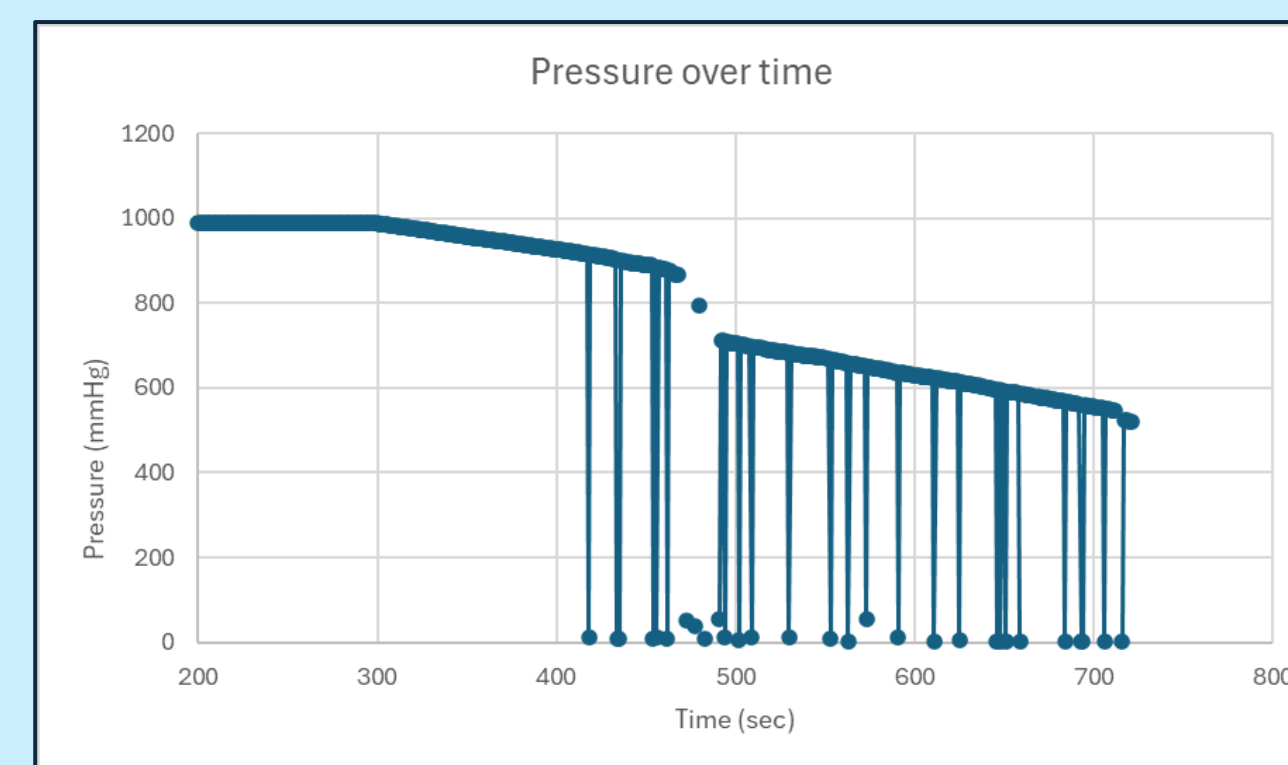
## Result

- Ubiquity Stream successfully streamed for an estimated 20 minutes for the total eclipse, with the 2023 solar eclipse lasting for less than that (figure 1).
- Communication with the vent and cutdown system had very inconsistent success in lab environment, and no communication occurred during the total eclipse (figure 2).
- RFD data transmitted functionally, however, connection was continually lost and had to be manually adjusted.



## Conclusion

- Ubiquity cannot handle streaming capabilities with cloud cover and increasing height, the strength and connection needs to be improved before being a viable consistent option for high altitude ballooning.
- Satellite communication cannot be counted on reliable, iridium system that we used was not able to communicate during flights and highlights the necessity for a separate redundancy system on a ballooning mission.
- We theorize that due to the conditions of the launch, and fluctuating connection the reading is inconsistent and is unreadable. RFD should be a compatible with ubiquity software and should be motorized to be able to perform consistent recording of data.

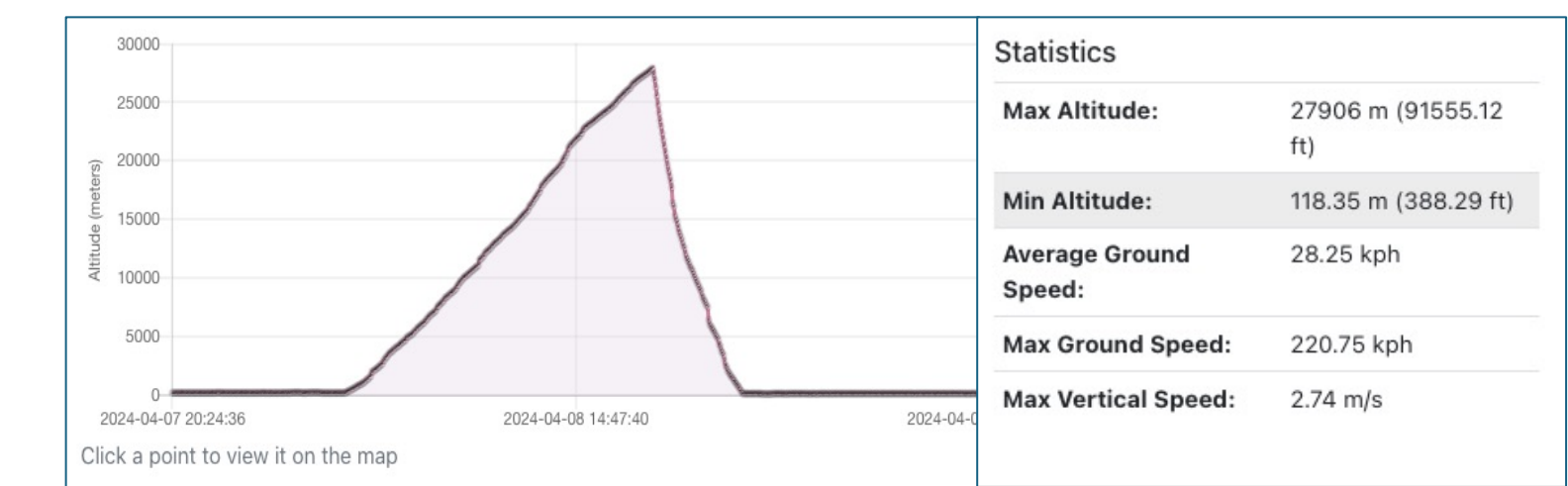


Pressure decreasing as the balloon rises. The inconsistency is due connection error

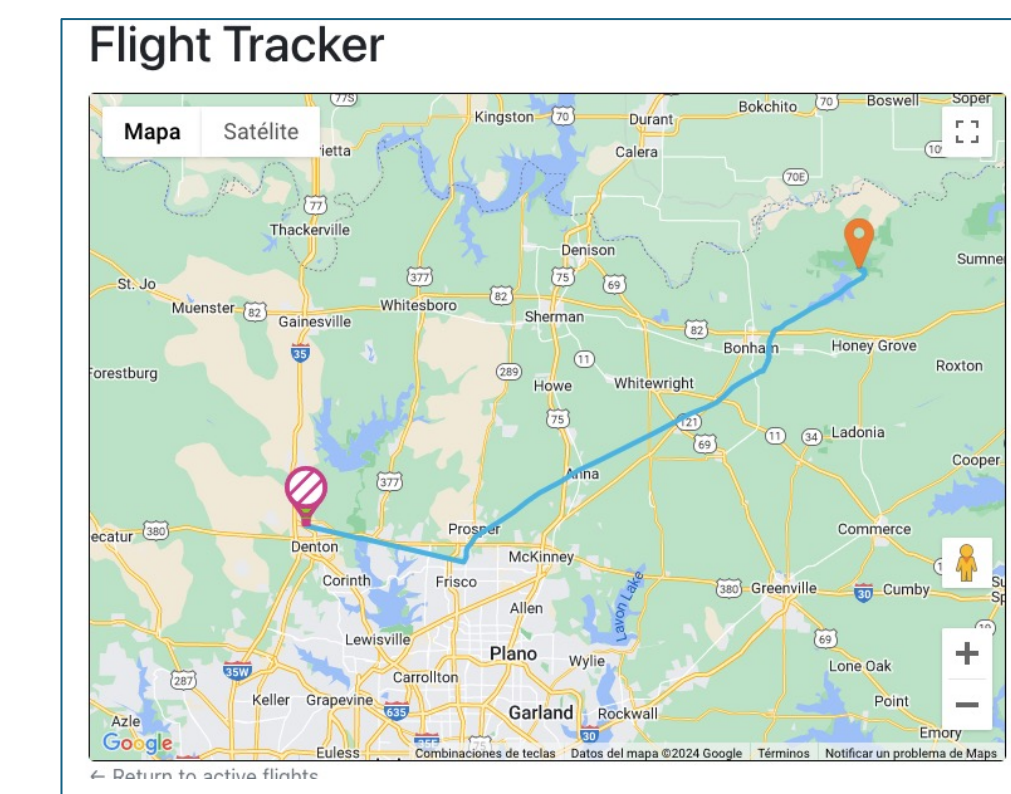
Inconsistent data

Latitude	Longitude	Altitude	Year	Month	Day	Hour	Min	Sec	NNV	NEV	NDV	Battery	3-3 Supply	3v Suppl	Radio	Supp	Analogy	Analogy	Altimeter	Digital In	Digital	Pressure	Accel A	Accel Y	Accel Z	Pitch	Roll	Yaw			
33.195906	-86.001307	120496	2024	4	8	10	5	4	5964	-605	-981	3.9	3.29	4.97	4.99	70.69	52.58	50.16	57.72	48.78	97.49	-2.45	-2.48	9.03	-13.57	-13.79	-54.82				
33.195311	-86.001011	1264209	2024	4	8	10	5	4	5964	-605	-981	3.9	3.29	4.97	4.99	70.69	52.58	50.16	57.72	48.78	97.49	-2.45	-2.48	9.03	-13.57	-13.79	-54.82				
33.1957693	-86.001666	1295090	2024	4	8	10	5	9	1062	6979	-5982	3.89	3.29	4.97	4.99	69.32	53.3	50.17	57.77	48.78	98.95	-1.9	9.76	11.47	-4.7	37.21	-126.68				
33.1956511	-86.001607	1301743	2024	4	8	10	5	10	6296	4430	-6255	3.9	3.29	4.97	4.99	69.68	52.71	50.16	57.72	48.78	97.73	3.52	14.12	2.75	13.42	-42.25					
33.1955923	-86.001762	1307339	2024	4	8	10	5	11	9022	1787	-7084	3.9	3.29	4.97	4.99	69.63	52.88	50.16	57.71	48.8	98.708	2.45	-1.07	12.01	11.39	-8.69	-85.09				
3	381	861.99	2237	7	3	38.82	861.2224	7	3	348.94	860.224	7	3	348.86	859.224	8	3	36.85	859.2												
3	38.89	860.0243	5	3	3.84	857.92244	5	3	38.86	856.6																					
3	254	10	3	2251	10	3	50.28	57.2252	10	3																					
3	3.97	841.02268	8	3	33987326	-868103970	377903	2004	4	8	10	5	91	1892	2888	-6962	3.89	3.29	4.97	4.99	69.88	52.9	50.33	57.95	42.69	8	3	33988960			
3	29	4.98	4.34	1132	-2273	7	3	38.89	837.3																						
3	3481.88	836.2275	7	3	348.88	836.2275	7	3	38.89	835.1																					
3	39.01	832.02262	9	3	821.42263	9	3	39.01	830.05	2394	7	3	3.04	830.212	7	3	301	829.28													
3	3.11	813.82281	9	3	3.11	813.82281	9	3	3.11	813.82281	9	3	3.11	813.82281	9	3	3.11	813.82281	9	3	3.11	813.82281	9	3	3.11	813.82281	9	3	3.11	813.82281	9
3	3.16	806.86219	7	3	3.16	806.86219	7	3	3.16	806.86219	7	3	3.16	806.86219	7	3	3.16	806.86219	7	3	3.16	806.86219	7	3	3.16	806.86219	7	3	3.16	806.86219	7
3	3.17	802.46235	9	3	3.17	802.46235	9	3	3.17	802.46235	9	3	3.17	802.46235	9	3	3.17	802.46235	9	3	3.17	802.46235	9	3	3.17	802.46235	9	3	3.17	802.46235	9
3	9.19	799.02321	11	3	49.18	799.2332	11	3	49.19	797.2334	11	3	9.19	797.2334	10	3	49.2	796.234	9	3	3.22	795.772	9	3	3.21	795.25					
3	0.22	792.46241	11	3	9.21	791.02342	11	3																							
3	24	750.52	2344	10	3	7	3.9	3.2																							
3	3.36	767.96238	9	3	33207978	7	43	538.6742	3	89238	9	3	39.38	765.5238	9	3	348.38	765.238	9	3	3.36	765.172	9	3	39.38	764.61	-12.45	82385	10		
3	2360	11	3	2201	9	3	32282	9	3	32283	11	3	2364	11	3																
3	49.45	742.242	11	3	543	26286297	4.99	70.5	5	526242	11	3	5.47	740.6242	11	3	5.46	740													
3	9.46	739.22424	11	3	9.47	738.62425	11	3	9.46	738.1																					
3	9.49	737.22429	11	3	9.47	736.62429	11	3	9.48	736																					
3	2440	11	3	2441	11	3	2442	11	3																						
3	995	716.36	2462	8	3	995	715.55																								
3	995	715.17	2464	9	3	995	714.56																								
3	9.56	715.0467	10	3	33214381	-867910967	296783	2024	4	8	10	9	10	10984	2462	-7228	3.9	3.28	4.98	4.99	70.64	54.02	50.95	58.78	49.57	712.69	2.07	-2.07			
3	33214403	-867910978	297838	2024	4	8	10	9	12	5038	2775	-7346	3.89	3.29	4.97	4.99	70.84	53.52	50.95	58.78	49.58	714	-2.56	0.73	10.38	-10.95	3.89	-715			
3	33214409	-867910707	297835	2024	4	8	10	9	13	1951	9078	-4598	3.89	3.29	4.97	4.99	70.47	53.9	50.96	58.8	49.57	710.69	-2.75	1.01	12.09	-9.79	8.47	-52.74			
3	33214575	-867908818	299128	2024	4	8	10	9	15	4220	5223	-7126	3.89	3.29	4.97	4.99	70.72	53.7	50.96	58.78	42473	11	3	33214575	-867908950	2988229	2024	4			
3	33214647	-867907554	300568	2024	4	8	10	9	17	6295	4784	-7811	3.89	3.29	4.97	4.99	70.52	52.98	50.97	58.9	49.57	708.25	-1.9	11.24	-2.71	-4.59	-46.74				
3	33214790	-867907079	300360	2024	4	8	10	9	19	7903	4288	-7057	3.89	3.29	4.97	4.99	71.94	53.2	50.98	58.81	49.58	707.61	-1.53	1.38	13.18	-4.58	5.32	-80.61			

Table of the collected data from the RFD 900, showing the changes in pressure, orientation, coordinates, acceleration, etc.



Balloon altitude and speed statistics.



Total Eclipse High Altitude Balloon Flight Path



Figure 1: Ubiquity system used for solar eclipses.



2024 Total Solar Eclipse, picture taken by Jack Pierce

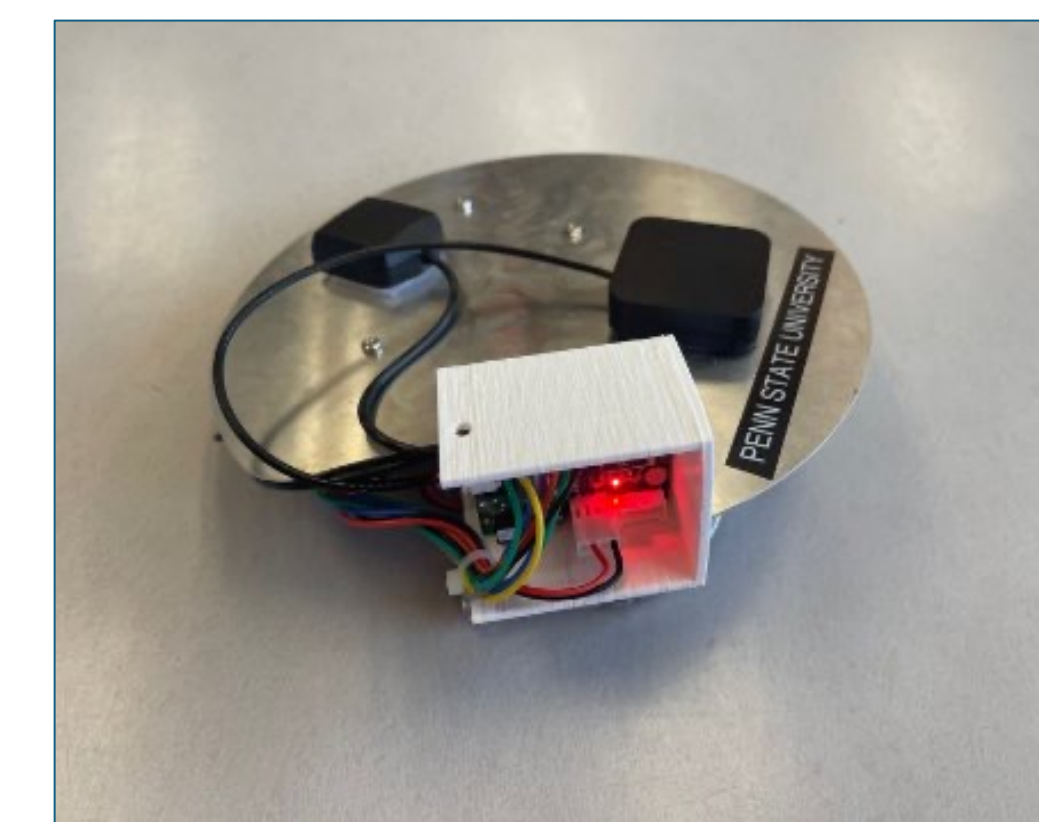


Figure 2: Iridium Modem used for satellite to balloon 1's communication to the cutdown and vent systems.

## Acknowledgments:

We would like to acknowledge the Penn State's NEBP team, Lincoln university and University of North Texas's NEBP as well for our founding and conclusion.