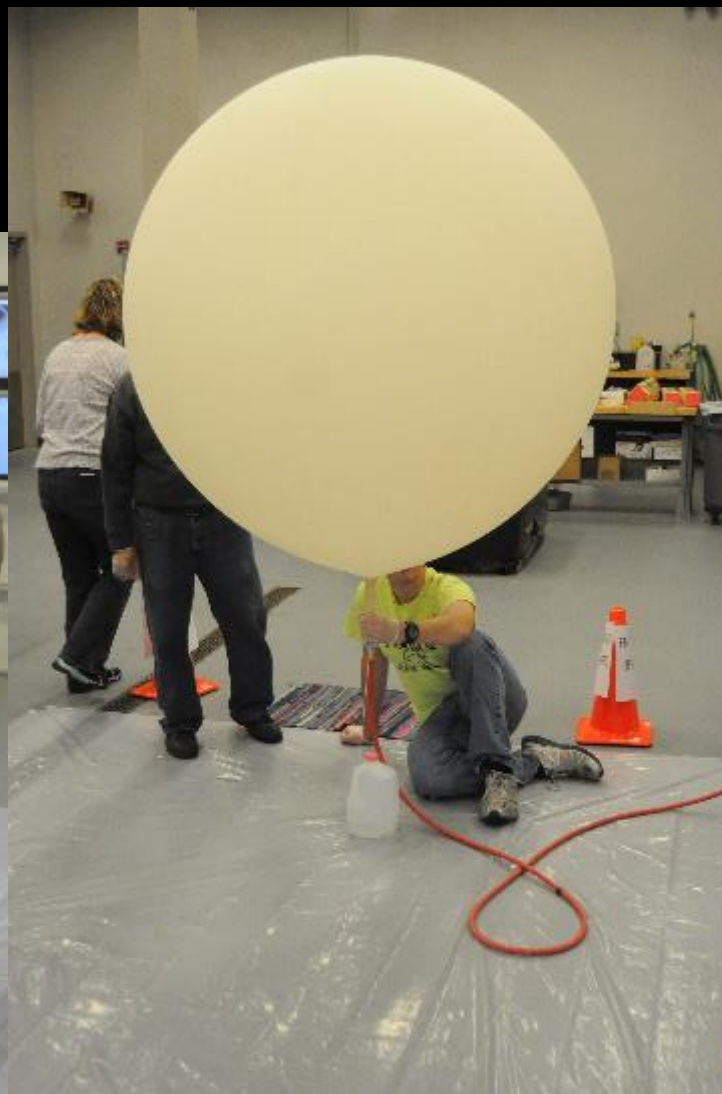
HIGH ALTITUDE BALLOONING PROJECT

STEPS OF PROJECT

- Planning – launch date, ordering supplies, designing payload, building payload.
- Payload components developed and/or ordered.
- Calculating launch parameters – weight of balloon, weight of parachute, weight of payload, amount of helium needed for launch, size of parachute needed for rate of descent.
- APRS Transmitter setup and testing
- APRS receiver setup and testing
- Mobile vehicle setup with receiver and antenna.
- Chase team to recover payload
- Analysis team to analyze the data after recovery.

SETUP OF BALLOON



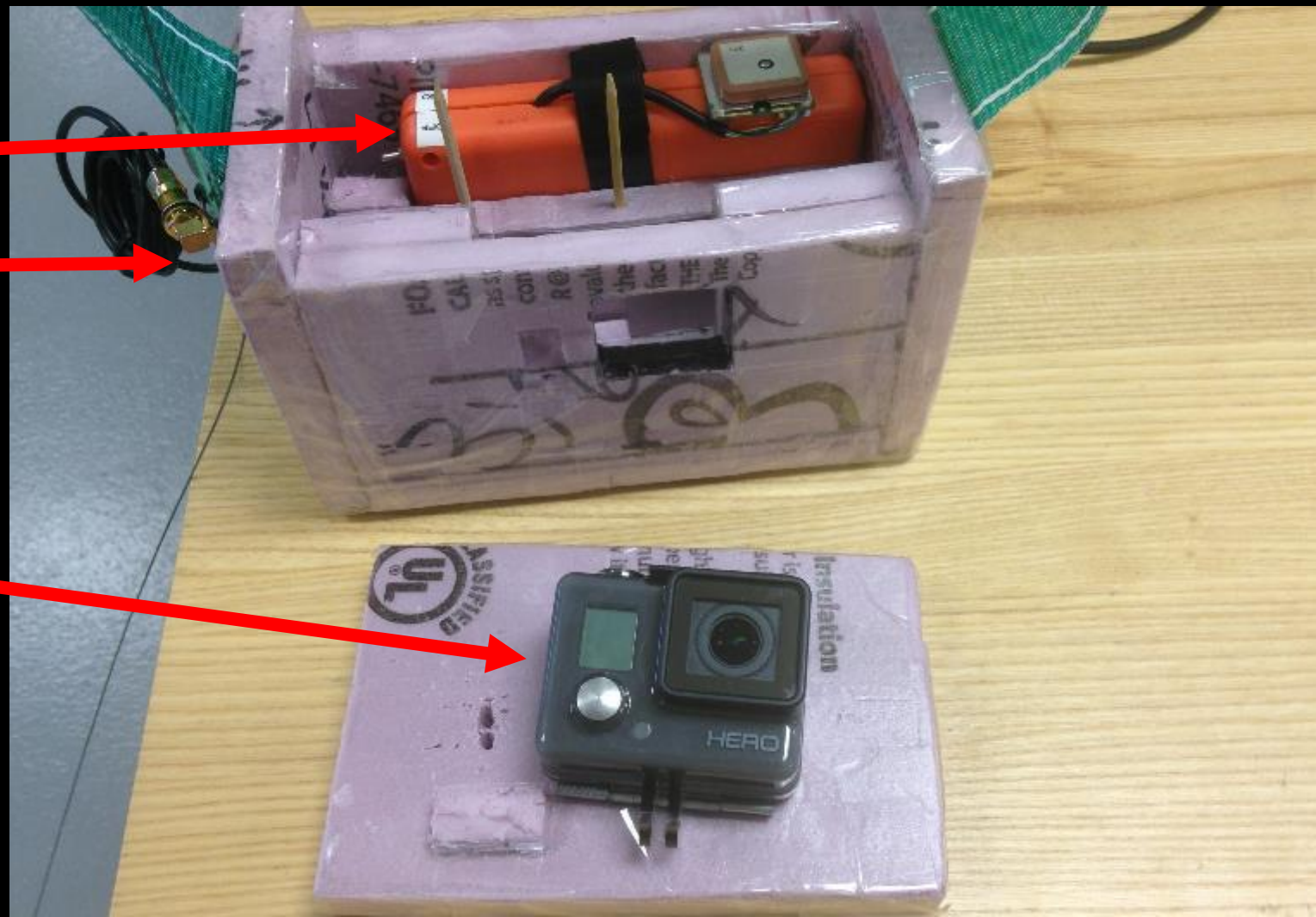
- Filled the balloon to a diameter of approx. 6 feet
- Balloon will burst by design at approx. 18 feet in diameter
- Estimated altitude to reach approx. 90,000 feet before bursting

THE PAYLOAD

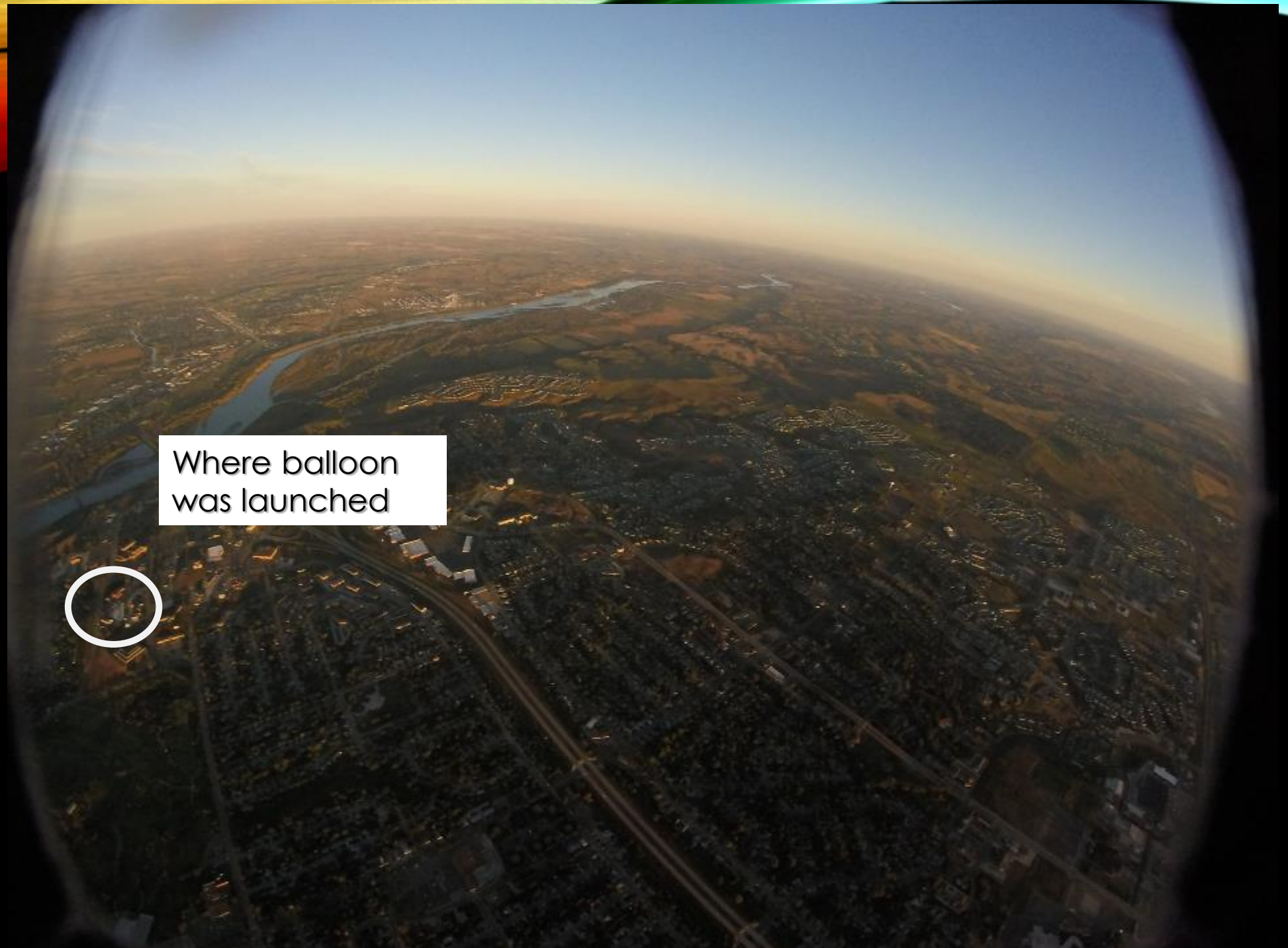
GPS Receiver and
APRS Transmitter

APRS Antenna

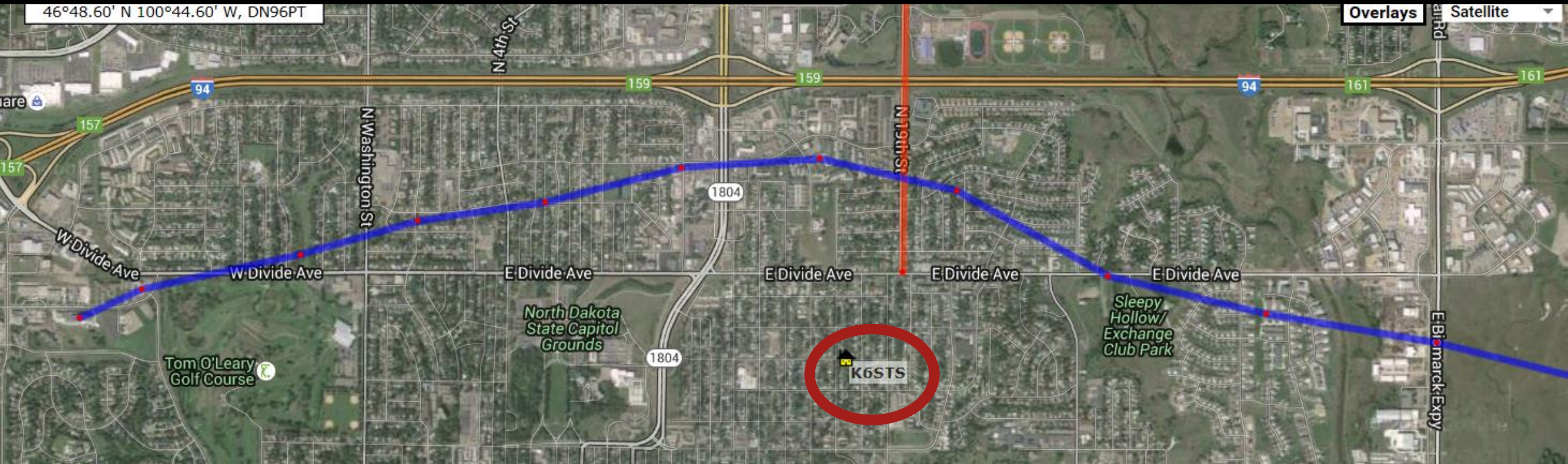
GoPro Camera



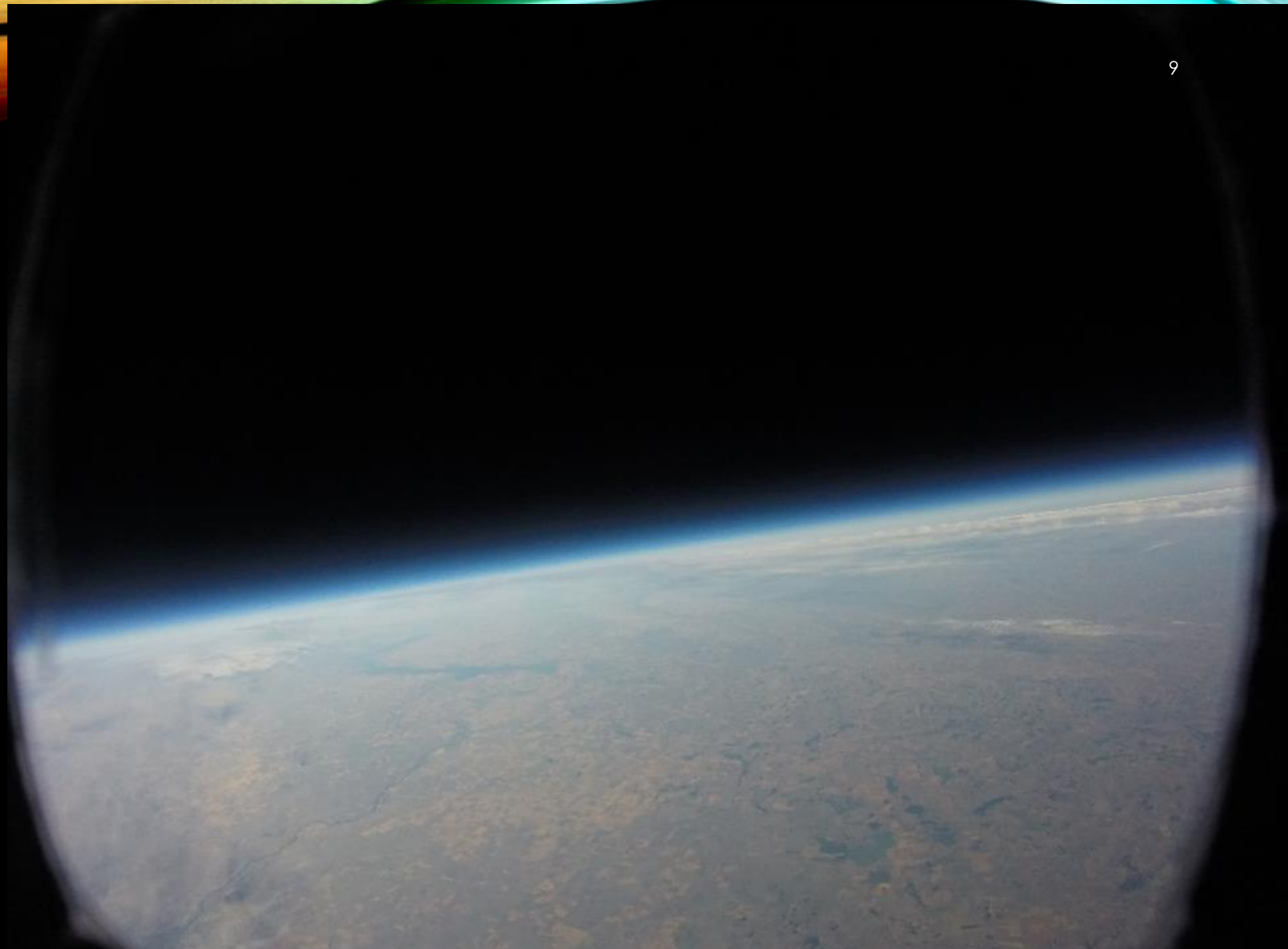
IMAGES FROM BALLOON

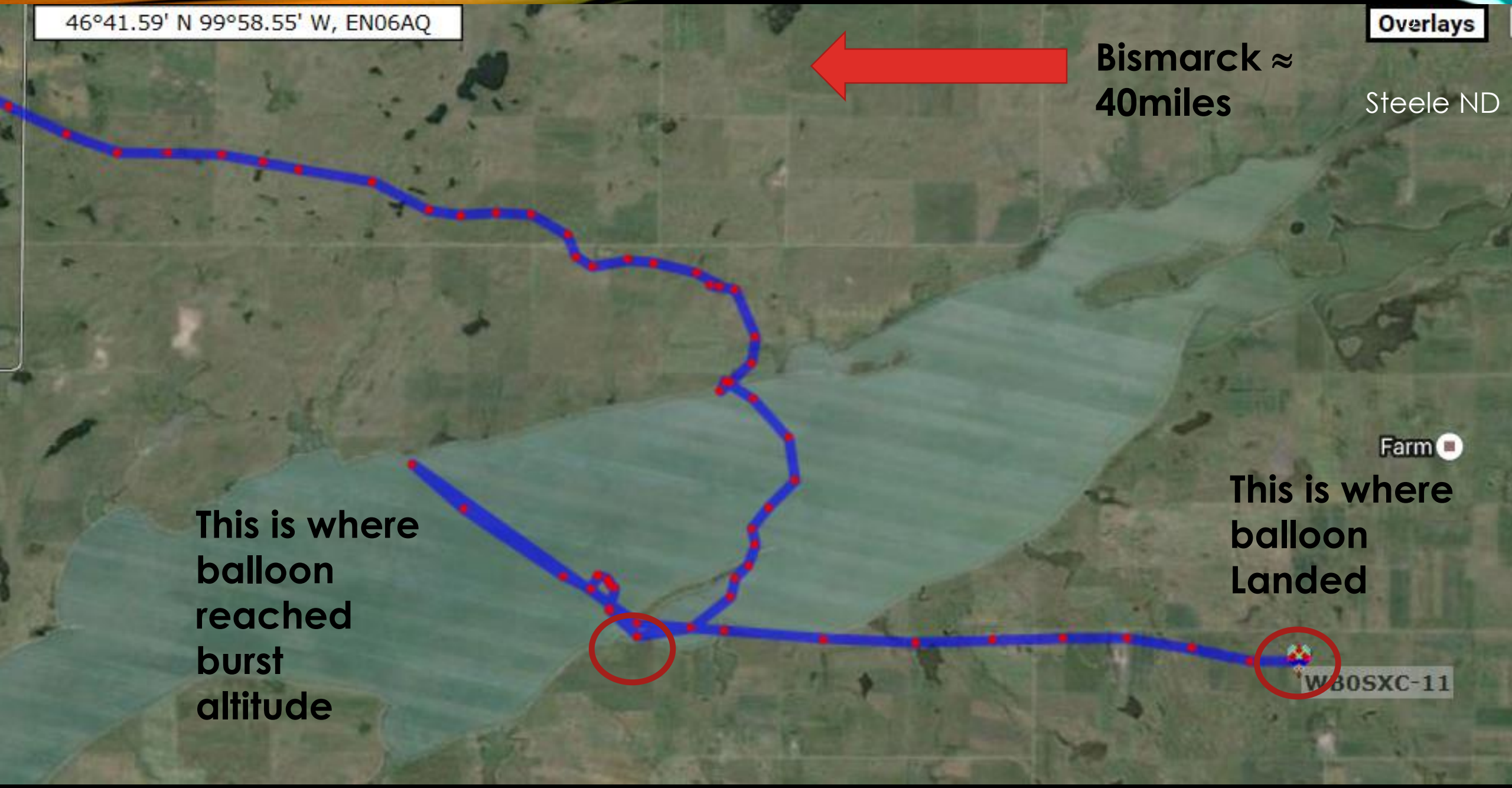

Where balloon was launched

PATH BALLOON TRAVELED OVER BISMARCK ALL TRANSMITTED DATA OF ENTIRE FLIGHT WAS COLLECTED FROM K6STS LOCATION THE NEXT LAUNCH, A BSC SITE WILL BE COLLECTING THE DATA OF THE ENTIRE FLIGHT



Altitude achieved reported by APRS system
107,064 feet.
Balloon over Long lake south of Steele, ND




46°41.59' N 99°58.55' W, EN06AQ
Overlays
Bismarck ≈ 40miles
Steele ND
Farm
This is where balloon reached burst altitude
This is where balloon Landed
W0SXC-11

Balloon bursting at approx. 107,064 feet and sheds of balloon coming apart. The Balloon is designed to shred for low environmental impact.

This image shows the parachute and balloon in picture.

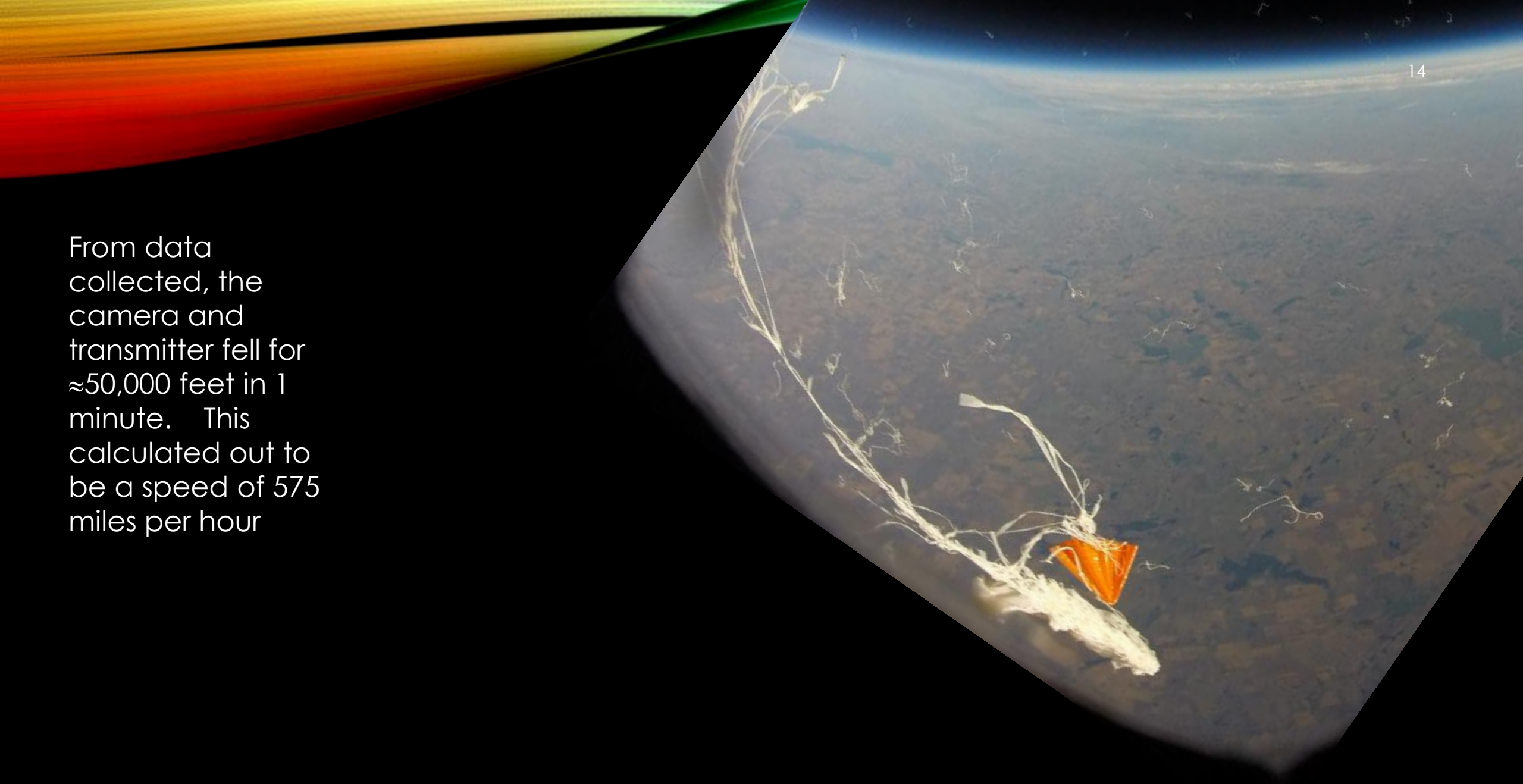
How did we get a picture of the parachute and balloon?

The parachute tore away from the camera and transmitter, and a lot of luck

Camera and transmitter free fell from burst altitude to ground (not lucky).

Parachute and balloon falling away from camera. Camera and APRS Transmitter now free falling.

From data collected, the camera and transmitter fell for ≈50,000 feet in 1 minute. This calculated out to be a speed of 575 miles per hour



	total flight time	1:49:17															
minutes of flight	Date	Time	Time zone	Latitude degrees N	Minutes	longitude degrees W	Minutes	degrees heading	Knots	MPH	Altitude	feet / minute	feet / sec	meter/minute	meter/sec	15 MPH	
	9/19/2015	7:42:08	CDT:	46	49.3	100	48.66	199	0	0	1738	0	0				
3	9/19/2015	7:45:08	CDT:	46	49.37	100	48.44	59	35	40.25	2755	1017	16.95			11.55681818	
4	9/19/2015	7:46:10	CDT:	46	49.46	100	47.87	81	30	34.5	3953	1198	19.96667	365.1504	6.08584	13.61363636	
5	9/19/2015	7:47:09	CDT:	46	49.54	100	47.46	82	26	29.9	5127	1174	19.56667	357.8352	5.96392	13.34090909	
6	9/19/2015	7:48:10	CDT:	46	49.59	100	47.01	86	23	26.45	6393	1266	21.1	385.8768	6.43128	14.38636364	
7	9/19/2015	7:49:10	CDT:	46	49.67	100	46.52	89	20	23	7594	1201	20.01667	366.0648	6.10108	13.64772727	
8	9/19/2015	7:50:11	CDT:	46	49.69	100	46.03	66	23	26.45	8801	1207	20.11667	367.8936	6.13156	13.71590909	
9	9/19/2015	7:51:12	CDT:	46	49.61	100	45.54	97	28	32.2	10009	1208	20.13333	368.1984	6.13664	13.72727273	
10	9/19/2015	7:52:14	CDT:	46	49.4	100	45	115	35	40.25	11236	1227	20.45	373.9896	6.23316	13.94318182	
11	9/19/2015	7:53:14	CDT:	46	49.31	100	44.44	113	32	36.8	12394	1158	19.3	352.9584	5.88264	13.15909091	
												1260	21	384.048	6.4008	14.31818182	
												1210	20.16667	368.808	6.1468	13.75	
												1217	20.28333	370.9416	6.18236	13.82954545	
												1263	21.05	384.9624	6.41604	14.35227273	
												1267	21.11667	386.1816	6.43636	14.39772727	
												1276	21.26667	388.9248	6.48208	14.5	
												1279	21.31667	389.8392	6.49732	14.53409091	
												1280	21.33333	390.144	6.5024	14.54545455	
												1302	21.7	396.8496	6.61416	14.79545455	
												1375	22.91667	419.1	6.985	15.625	
												1351	22.51667	411.7848	6.86308	15.35227273	
												1375	22.91667	419.1	6.985	15.625	
24	9/19/2015	8:06:24	CDT:	46	48.4	100	35.72	75	44	50.6	29158	1309	21.81667	398.9832	6.64972	14.875	
25	9/19/2015	8:07:24	CDT:	46	48.4	100	34.82	80	45	51.75	30500	1342	22.36667	409.0416	6.81736	15.25	
26	9/19/2015	8:08:25	CDT:	46	48.36	100	33.95	97	37	42.55	31753	1253	20.88333	381.9144	6.36524	14.23863636	
27	9/19/2015	8:09:25	CDT:	46	48.31	100	33.09	89	49	56.35	32944	1191	19.85	363.0168	6.05028	13.53409091	
28	9/19/2015	8:10:26	CDT:	46	48.28	100	32.25	85	38	43.7	34000	1056	17.6	321.8688	5.36448	12	
29	9/19/2015	8:11:27	CDT:	46	48.28	100	31.37	89	39	44.85	35125	1125	18.75	342.9	5.715	12.78409091	
30	9/19/2015	8:12:28	CDT:	46	48.26	100	30.4	81	46	52.9	36237	1112	18.53333	338.9376	5.64896	12.63636364	
31	9/19/2015	8:13:29	CDT:	46	48.2	100	29.4	101	51	58.65	37261	1024	17.06667	312.1152	5.20192	11.63636364	
32	9/19/2015	8:14:29	CDT:	46	48.12	100	28.5	93	49	56.35	38363	1102	18.36667	335.8896	5.59816	12.52272727	
33	9/19/2015	8:15:30	CDT:	46	48	100	27.39	96	45	51.75	39439	1076	17.93333	327.9648	5.46608	12.22727273	
34	9/19/2015	8:16:31	CDT:	46	47.98	100	26.22	91	49	56.35	40492	1053	17.55	320.9544	5.34924	11.96590909	
35	9/19/2015	8:17:31	CDT:	46	47.98	100	25.08	98	58	66.7	41457	965	16.08333	294.132	4.9022	10.96590909	
36	9/19/2015	8:18:32	CDT:	46	47.93	100	23.97	92	55	63.25	42431	974	16.23333	296.8752	4.94792	11.06818182	
37	9/19/2015	8:19:32	CDT:	46	47.91	100	22.97	90	40	46	43412	981	16.35	299.0088	4.98348	11.14772727	
38	9/19/2015	8:20:33	CDT:	46	47.84	100	21.94	99	46	52.9	44311	899	14.98333	274.0152	4.56692	10.21590909	
39	9/19/2015	8:21:33	CDT:	46	47.74	100	20.89	103	48	55.2	45315	1004	16.73333	306.0192	5.10032	11.40909091	
40	9/19/2015	8:22:35	CDT:	46	47.57	100	19.85	104	58	66.7	46289	974	16.23333	296.8752	4.94792	11.06818182	

This is the data collected from the APRS transmitter.
Latitude, Longitude, Altitude and Speed.

From this information the following data was calculated
Ascent rate and Descent Rate in both meter/sec and Feet/sec as well
As miles/hour.

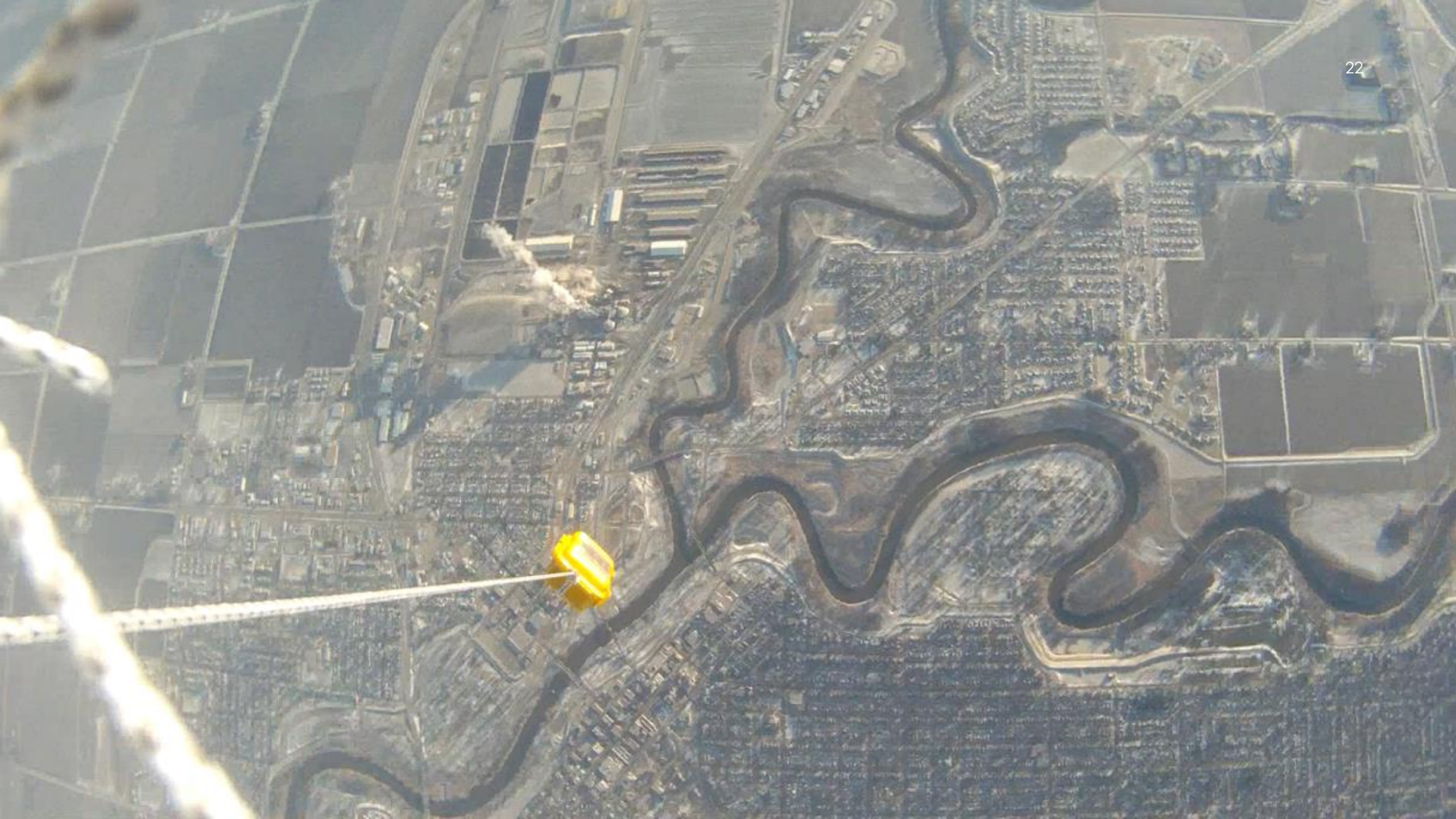
	total flight time	1:49:17															
minutes of flight	Date	Time	Time zone	Latitude degrees N	Minutes	longitude degrees W	Minutes	degrees heading	Knots	MPH	Altitude	feet / minute	feet / sec	meter/minute	meter/sec	MPH
95	9/19/2015	9:17:09	CDT:	46	43.57	100	4.06	170	7		105128	1106	18.43333	337.1088	5.61848	12.56818182
96	9/19/2015	9:18:09	CDT:	46	43.48	100	4.12	327	2		106240	1112	18.53333	338.9376	5.64896	12.63636364
97	9/19/2015	9:19:11	CDT:	46	43.57	100	4.4	306	46		107063	823	13.71667	250.8504	4.18084	9.352272727
98	9/19/2015	9:20:10	CDT:	46	44.03	100	5.39	305	37		106361	-702	-11.7	-213.9696	-3.5662	-7.977272727
99	9/19/2015	9:21:11	CDT:	46	44.33	100	5.91	317	24		106673	312	5.2	95.0976	1.58496	3.545454545
100	9/19/2015	9:22:18	CDT:	46	43.25	100	3.67	107	37		56036	-50637	-843.95	-15434.16	-257.24	-575.4204545
101	9/19/2015	9:23:20	CDT:	46	43.19	100	2.8	92	40		47264	-8772	-146.2	-2673.706	-44.562	-99.68181818
102	9/19/2015	9:24:20	CDT:	46	43.14	100	1.81	87	56		40013	-7251	-120.85	-2210.105	-36.835	-82.39772727
103	9/19/2015	9:25:21	CDT:	46	43.12	100	0.9	86	37		33846	-6167	-102.7833	-1879.702	-31.328	-70.07954545
104	9/19/2015	9:26:21	CDT:	46	43.13	100	0.13	86	32		28298	-5548	-92.46667	-1691.03	-28.184	-63.04545455
105	9/19/2015	9:27:22	CDT:	46	43.15	99	59.44	94	35		23302	-4996	-83.26667	-1522.781	-25.38	-56.77272727
106	9/19/2015	9:28:23	CDT:	46	43.14	99	58.79	97	28		18666	-4636	-77.26667	-1413.053	-23.551	-52.68181818
107	9/19/2015	9:29:23	CDT:	46	43.08	99	58.16	101	32		14392	-4274	-71.23333	-1302.715	-21.712	-48.56818182
108	9/19/2015	9:30:24	CDT:	46	42.99	99	57.57	127	28		10248	-4144	-69.06667	-1263.091	-21.052	-47.09090909
109	9/19/2015	9:31:25	CDT:	46	42.98	99	57.1	70	24		6459	-3789	-63.15	-1154.887	-19.248	-43.05681818

In this image, can see parachute open and slowing balloon down on descent,

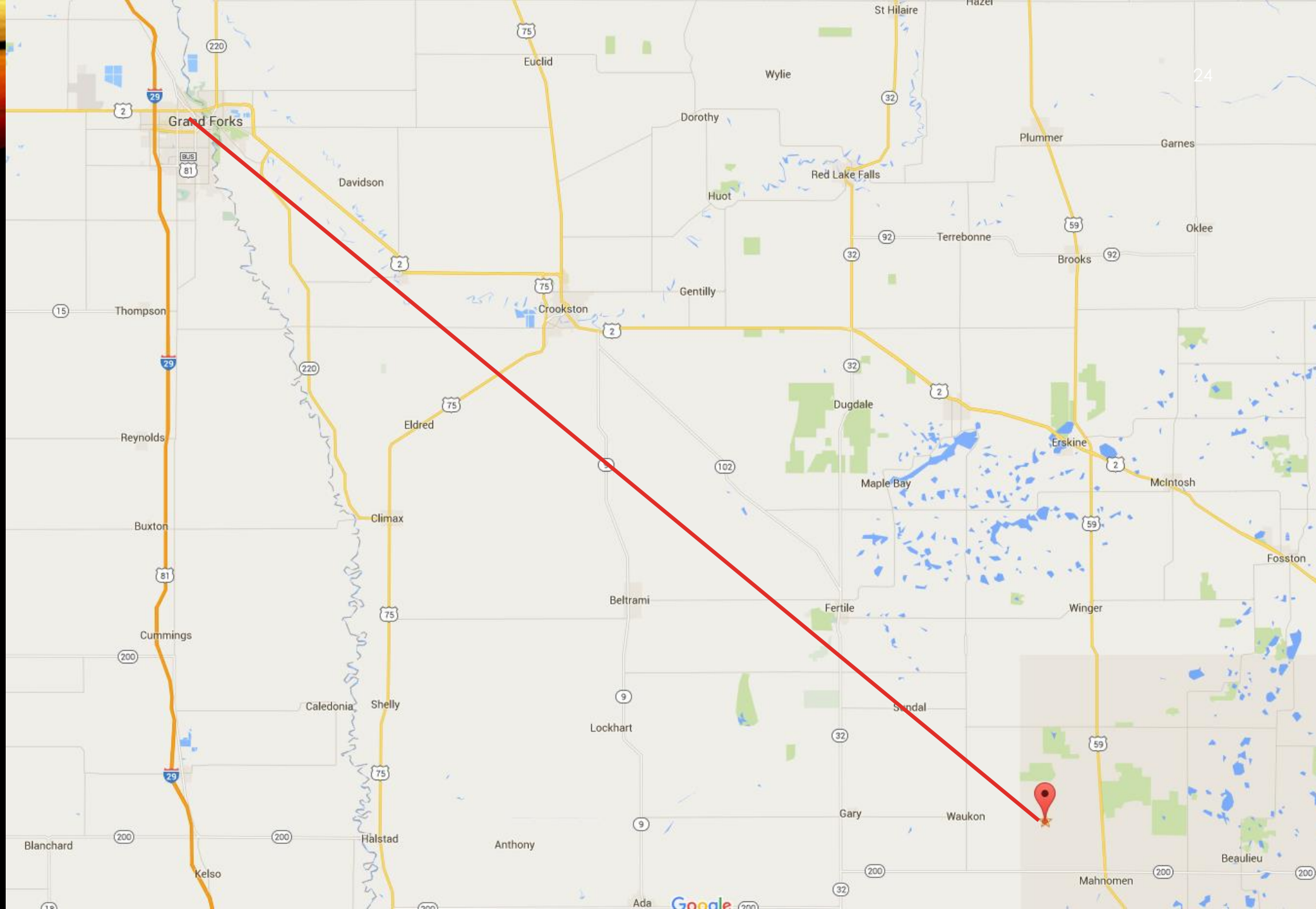
RECOVERY OF BALLOON

Balloon Launch in Grand Forks

Two teams from BSC were selected to design a payload and participate in the launch. This was part of ND Space Grant from UND



- Flight was approx. 50 miles from Grand Forks to about Mahnomen MN in about 1.5 hours.



WHAT TO DO BETTER NEXT LAUNCH

- Secure parachute better.
- Make sure APRS Transmitter is in working order and antenna is not damaged.
- Plan more time for building payload vessel.
- Plan more time for recovery.
- Have a mobile Digipeater for APRS data to collect even low altitude data.

APPRECIATION FOR ASSISTANCE AND EXPERTISE

- Robert Arso Professor of Electronics/Telecommunication, BSC
- Doug Niessen, K6STS
- Peter Fettig, KF0DL
- Mike Holman- Associate Professor of Electronics/Telecommunications, BSC
- Tony Musumba - Associate Professor of Physics, BSC
- Elizabeth Braunagel - Associate Professor of Mathematics, BSC
- Bismarck State College Foundation for Grant for equipment and Supplies
- ND Space Grant