



# High Altitude Ballooning at BSC

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# Project 1 Details

- 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.

## -Websites:

- 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.



Man 1: A young man wearing a black leather jacket over a bright green t-shirt with "MANDAN" and "YARD" visible, and blue jeans.

Person 2: A young woman wearing a red hoodie with "MANDAN" and "LATIN" printed on it, and black shorts.

Man 3: A young man wearing a grey and brown diamond-patterned sweater over a light blue shirt, and black shorts.

Man 4: A man wearing a grey crewneck sweater, blue jeans, and a dark baseball cap.

Man 5: A man wearing a white short-sleeved polo shirt, blue jeans, and a grey baseball cap.

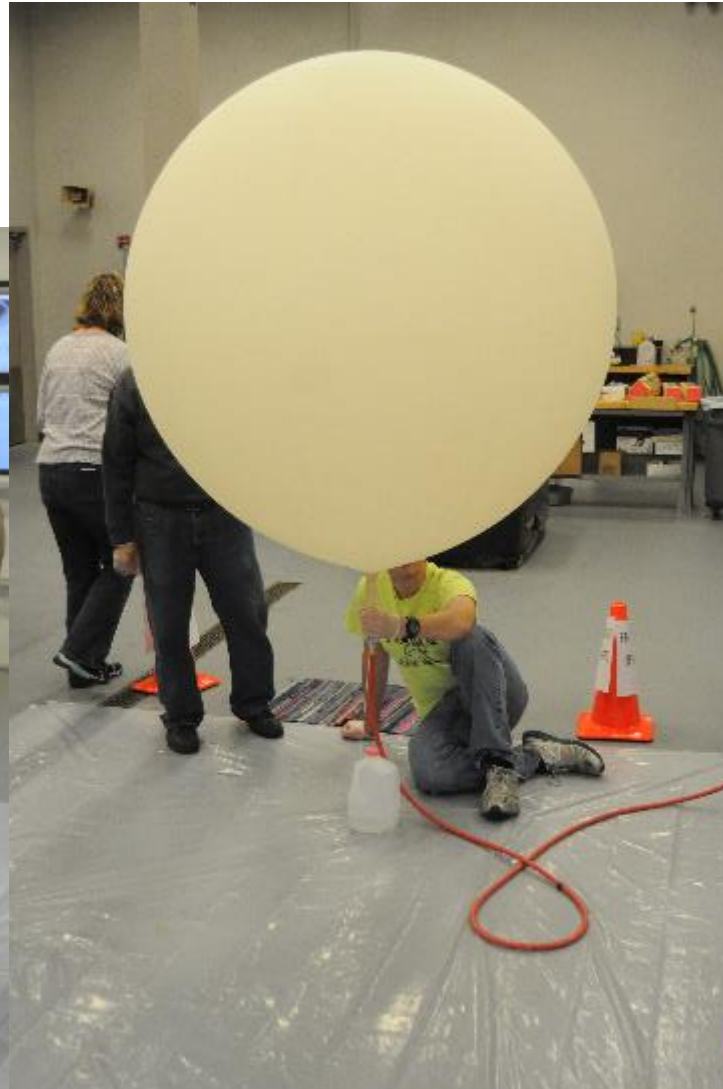
Man 6: A man wearing a brown jacket over a blue button-down shirt, light blue jeans, and glasses.

Man 7: A man wearing a blue and black plaid shirt, blue jeans, a grey baseball cap, and glasses.

Woman 1: A woman wearing a bright blue jacket and dark pants.



# Setup of balloon

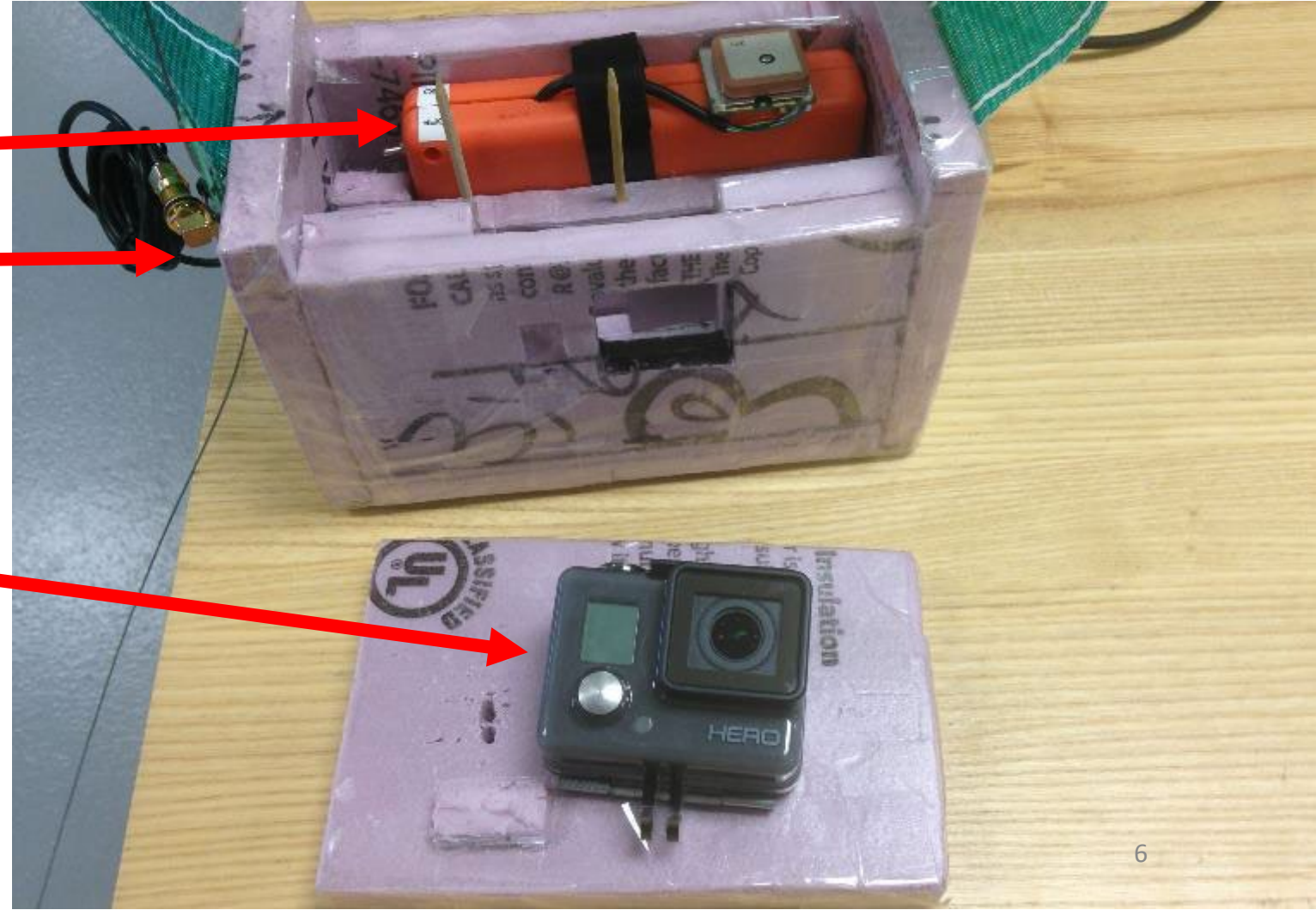


# The Payload

GPS Receiver and APRS  
Transmitter

APRS Antenna

GoPro Camera



# Image from balloon 1



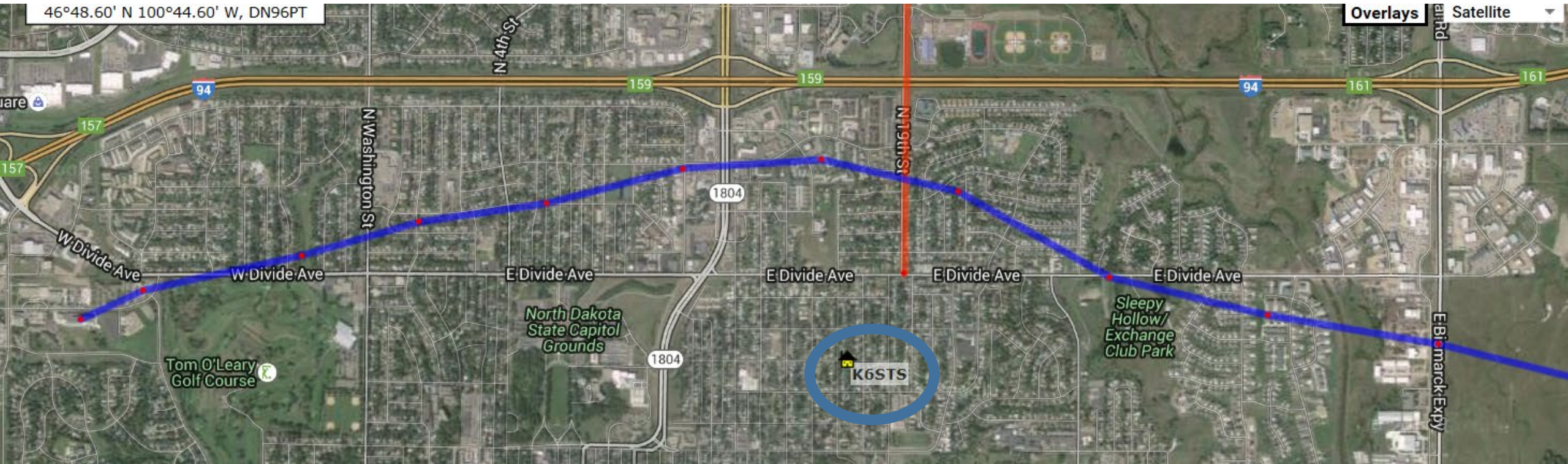


Where balloon was  
launched



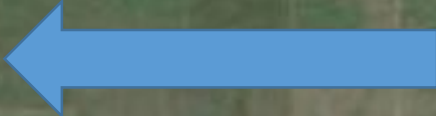


Path balloon Traveled over Bismarck  
all Transmitted data of entire flight was collected from  
K6STS location  
The next launch, A BSC site will be collecting the data of  
the entire flight



46°41.59' N 99°58.55' W, EN06AQ

Overlays



Bismarck ≈  
40miles

Steele ND

This is where  
balloon  
reached burst  
altitude

This is where  
balloon  
Landed

Farm

WB0SXC-11

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).



total flight time		1:49:17		Latitude		longitude		degrees heading		Knots MPH		Altitude		feet / minute		feet / sec		meter/minute		meter/second		MPH	
minutes of flight	Date	Time	Time zone	degrees N	Minutes	degrees W	Minutes	degrees heading	s	MPH	Altitude	feet / minute	feet / sec	te	c	te	c	MPH					
3	9/19/2015	7:42:08	CDT:	46	49.3	100	48.66	199	0	1738	0	0											
4	9/19/2015	7:45:08	CDT:	46	49.37	100	48.44	59	35	2755	1017	16.95										11.55681818	
5	9/19/2015	7:46:10	CDT:	46	49.46	100	47.87	81	30	3953	1198	19.96667	365.1504	6.08584								13.61363636	
6	9/19/2015	7:47:09	CDT:	46	49.54	100	47.46	82	26	5127	1174	19.56667	357.8352	5.96392								13.34090909	
7	9/19/2015	7:48:10	CDT:	46	49.59	100	47.01	86	23	6393	1266	21.1	385.8768	6.43128								14.38636364	
8	9/19/2015	7:49:10	CDT:	46	49.67	100	46.52	89	20	7594	1201	20.01667	366.0648	6.10108								13.64772727	
9	9/19/2015	7:50:11	CDT:	46	49.69	100	46.03	66	23	8801	1207	20.11667	367.8936	6.13156								13.71590909	
10	9/19/2015	7:51:12	CDT:	46	49.61	100	45.54	97	28	10009	1208	20.13333	368.1984	6.13664								13.72727273	
11	9/19/2015	7:52:14	CDT:	46	49.4	100	45	115	35	11236	1227	20.45	373.9896	6.23316								13.94318182	
12	9/19/2015	7:53:14	CDT:	46	49.31	100	44.44	113	32	12394	1158	19.3	352.9584	5.88264								13.15909091	
		7:54:15	CDT:	46	49.24	100	43.84	98	38	13654	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	
											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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	45315	1004	16.73333	306.0192	5.10032								11.40909091	
40	9/19/2015	8:22:35	CDT:	46	47.57	100	19.85	106	58	46289	974	16.23333	296.8752	4.94792								11.06818182	
41	9/19/2015	8:23:36	CDT:	46	47.38	100	18.99	96	28	47370	981	16.35	299.0088	4.98348								11.14772727	

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	Kn ot MPH	Altitude	feet / minute	feet / sec	meter/minute	meter/second	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		

# Recovery of balloon





## NSBC 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







## Balloon Launch in Grand Forks

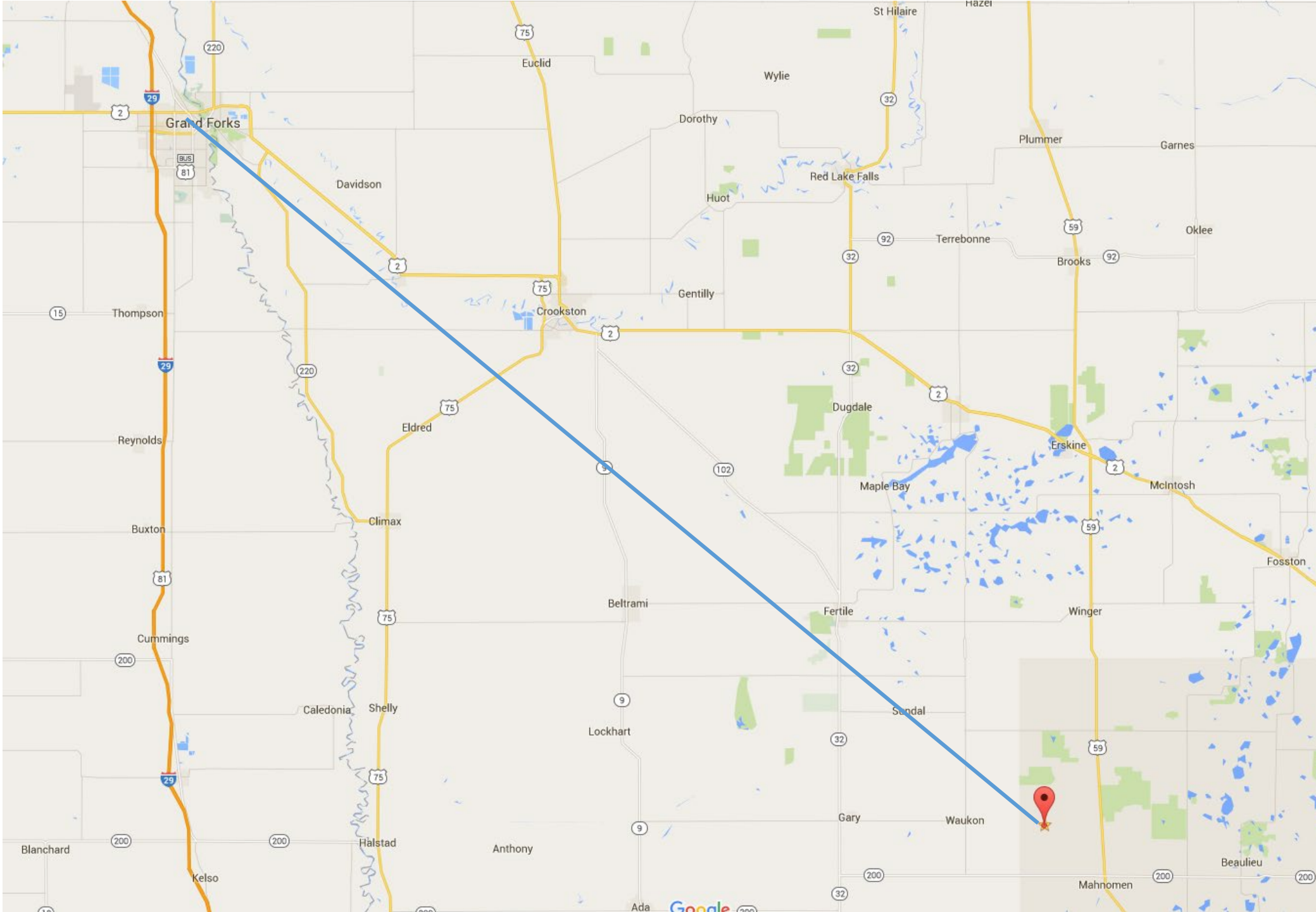
Temperature low  
recorded was -  
61 degrees F.

Relative  
Humidity ranged  
from 1 to 98%  
during flight

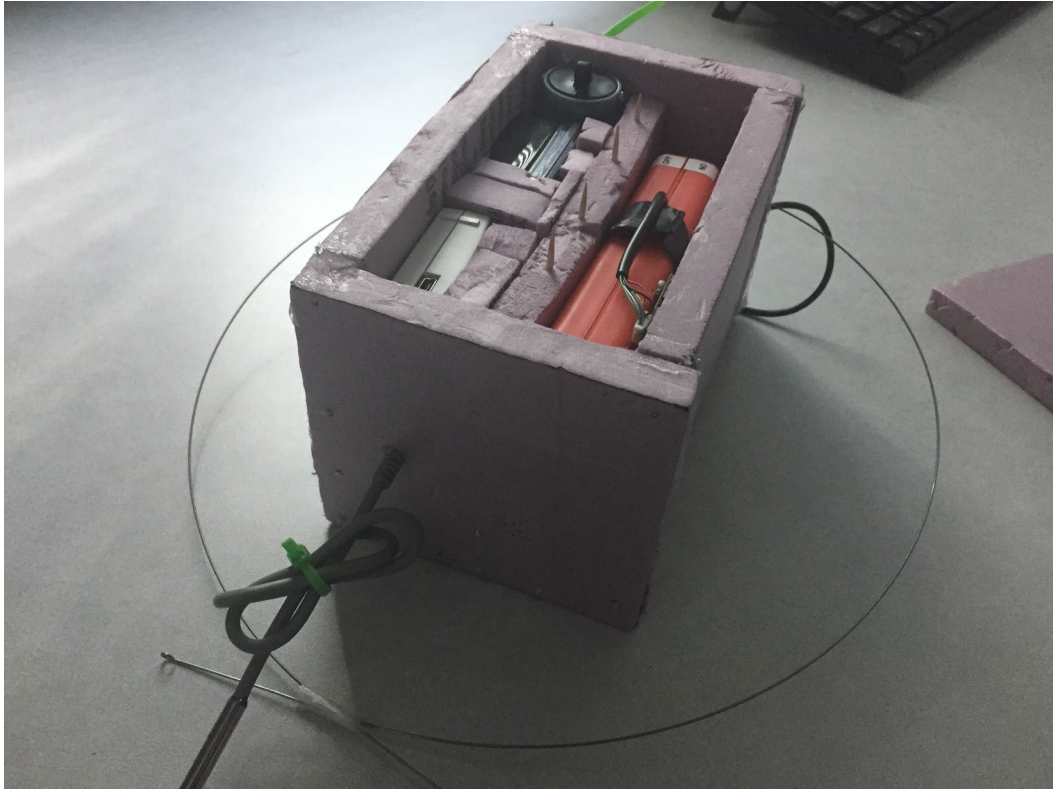


- Flight was approx. 50 miles from Grand Forks to about Mahnomen MN in about 1.5 hours.

- No APRS data











# Lessons from our 2 & 1/2 launches

- Secure parachute better.
- Make sure APRS Transmitter is in working order and antenna is not damaged.
- Turn on the Camera but wait..... not too soon 😊
- 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.
- Analyze the data after payload retrieval ASAP



# Student engagement (faculty engagement?!)

- Can only give anecdotal data...
- Students(faculty) want to do this on top of their academic work.
- Students (faculty) figure out how to work in groups
- Working in a club setting has worked well for us but some structure will help. (We tend to scramble ....quite a bit)
- We are looking at possibilities to involve other Institutions/High Schools
- We would like to have class projects e.g. digital electronics, communications using Arduinos etc
- Mike Holman and Bob Arso have started classes for Ham license

# Acknowledgements (Muchas Gracias)

- BSC students-Aaron Gutierrez, Carlie Borchers, Connor Candrian, Matt Kurti, Brennan Johnson, Alex Johnson, Porter Dixon, Adam Stonestreet, Lauren Wingenbach, Landon Felch, Hunter Andes, Brian Kalvoda, Coltyn Nelson,...
- BSC Faculty in Physical Sciences, GEM & Electronics and Communications
- North Dakota Space Grant Consortium: Caitlin, Marissa & Santhosh
- Bismarck State Foundation
- AHAC/SBA community: James Flaten, Eric Agrimson, Ron Fevig, Chris Folette, Matt Nelson, Kendra Sibbernsen,