NEW MEXICO SPACE STUDIES

NMSS-1 Flight Report

August 10, 2013

(and a look ahead)

V1.2, January 4, 2014

NMSS-1

- New Mexico Space Studies was formed to support the launching of a Near Space Balloon for the 2013 Duke City Hamfest.

The launch was successful!

- Launch date: August 10, 2013
- Launch location: Abq Balloon Fiesta Park
- Landing location: Near Cochiti Lake
- Max altitude: 83,000+ feet

NMSS-1

Much of the credit for the successful launch goes to the Arizona Near Space Research group (www.ansr.org)

- Provided mentorship
- Flight path predictions
- FAA coordination
- Loan of critical payloads (tracking / APRS beacons)
- Loan of cross band repeater, video recording, and more.

NMSS-1

Special thanks also goes to VectorNav corporation: www.vectornav.com

VECTORNAV
Embedded Navigation Solutions

- Provide data logger for the student payload
- Provided an Inertial Measurement Unit (IMU) for the prototype “Standard” payload.

NMSS-1 – Planning

- Scott Stevenson, KC5VVB, took on the responsibility to coordinate and plan the launch
- Several individuals stepped up and made significant contributions to the effort
- The first formal planning meeting was July 11-- 1 month before the launch!

Manifest

New Mexico Space Studies High Altitude Balloon NMSS-01

Balloon-1600 Gram MANIFEST

Payload	Lbs	Oz
Beacon – APRS (ANSR) Also – Recovery Beacon – 2 Meter and audible?	2	36 4
Repeater- Dual Band (ANSR)	4	64
Camera – ANSR (Vince) CW – Fast Scat		55 20 35
Vectornav Data Recorder (Student)		61
Radiation\Sensor – Pendley		16
~~Mustang Mascot – Alma~~		~~6~~
Train, Chute and PVC	2	32
Total		

16.87 lb

8 259

264 oz

264 oz

16.5 lbs

16.5 pound total payload weight

NMSS–1 – The Launch

- The groups first choice for a launch site was Hotel Albuquerque – the DCHF venue. However, after much debate, the launch site was moved to the Balloon Fiesta Park (BFP) for safety reasons. BFP was use was approved by the city.
- Launch and payload preparation went according to schedule and the balloon was released at 9:13 AM MDT.

Balloon Fiesta Park – north parking lot


AD5CS
Dick Powell
Amateur Radio

SUMA


CAUT


SONY
DCR-SR200


NAVY
"MENTOR EO"


WMHS
WMHS
WMHS
NAVY
"MERITOR EO"


Mike being
scolded by Scott
and others ☺

Sheet1

Culligan – WalMart 3 Gal Jug Weight Table

8.75 Diameter Inch

8.432 Weight Lbs/Ga

25% off for taper

Inches Depth	Gallons	Weight Lbs	Total Weight
1	0.260311887	1.646212372	1.6
2	0.260311887	2.19494983	3.8
3	0.260311887	2.19494983	6.0
4	0.260311887	2.19494983	8.2
5	0.260311887	2.19494983	10.4
6	0.260311887	2.19494983	12.6
7	0.260311887	2.19494983	14.8
8	0.260311887	2.19494983	17.0
9	0.260311887	1.975454847	19.0
10	0.260311887	1.975454847	21.0
11	0.260311887	1.975454847	22.9
12	0.260311887	1.646212372	24.6
13			
14			
15			
16			

10% off Cut out
10% off Cut out
End straight side
25% off Transition to cone


NAVY
TRITON


FIESTA

NMSS-1 Launch: The Movie

Click picture to start 29 second video
Video by Tom, KG6MVB
(if this version does not have the video imbedded go to https://www.youtube.com/watch?v=1yTbG68FOxU)

NMSS-1 View from the balloon

Click picture to start 1 minute 48 second video

Video from Vince and Kim Jenkins' payload (ANSR). Quality reduced for this presentation

(if this version does not have the video imbedded go to https://www.youtube.com/watch?v=waQ6xuevM1Q)

NMSS-1 – The Flight

- The balloon, for the most part, followed the predicted path heading north east then drifting back to the west and landing north of the launch site.
- All payload packages functioned as expected except the primary APRS beacon. As a result, tracking the balloon in real time was difficult.
- A “440” APRS beacon was picked up in Arizona after the balloon reached 30,000+ feet so a partial track was captured.
- The landing site was approximately 7 miles south of the predicted site (our balloon burst at a lower altitude)

NMSS-1 – Flight Report

Subject: [NewMexicoSpaceStudies] Initial Flight Report

Thank you everyone for a successful first flight. NMSS-01 was launched and successfully recovered. All I can say is “What a relief”! It was a wild ride for this first timer – here are some highlights.

Setup and launch went smoothly, except for 5 – 7 MPH winds that buffeted the inflating balloon. Mark Hendrick's ROTC students stayed the balloon and were a big help throughout the entire operation. Thanks to all.

Tracking problems began immediately after launch. The primary APRS transmitter was sending my call (KC5VVB) with no information. FAA was soon on the phone. Fortunately, Vince Jenkins from ANSR (thanks for coming Vince and Kim!) was receiving APRS from a third, low power transmitter. I manually read Lat\Long and Altitude off to FAA until the balloon rose to an altitude from which the secondary APRS signal was received in Arizona. There was no support in New Mexico for APRS digipeating (and iGateing) on the 440 band. All we really needed was one digipeater dedicated to this! This is a lesson learned, we won't fly this way again.

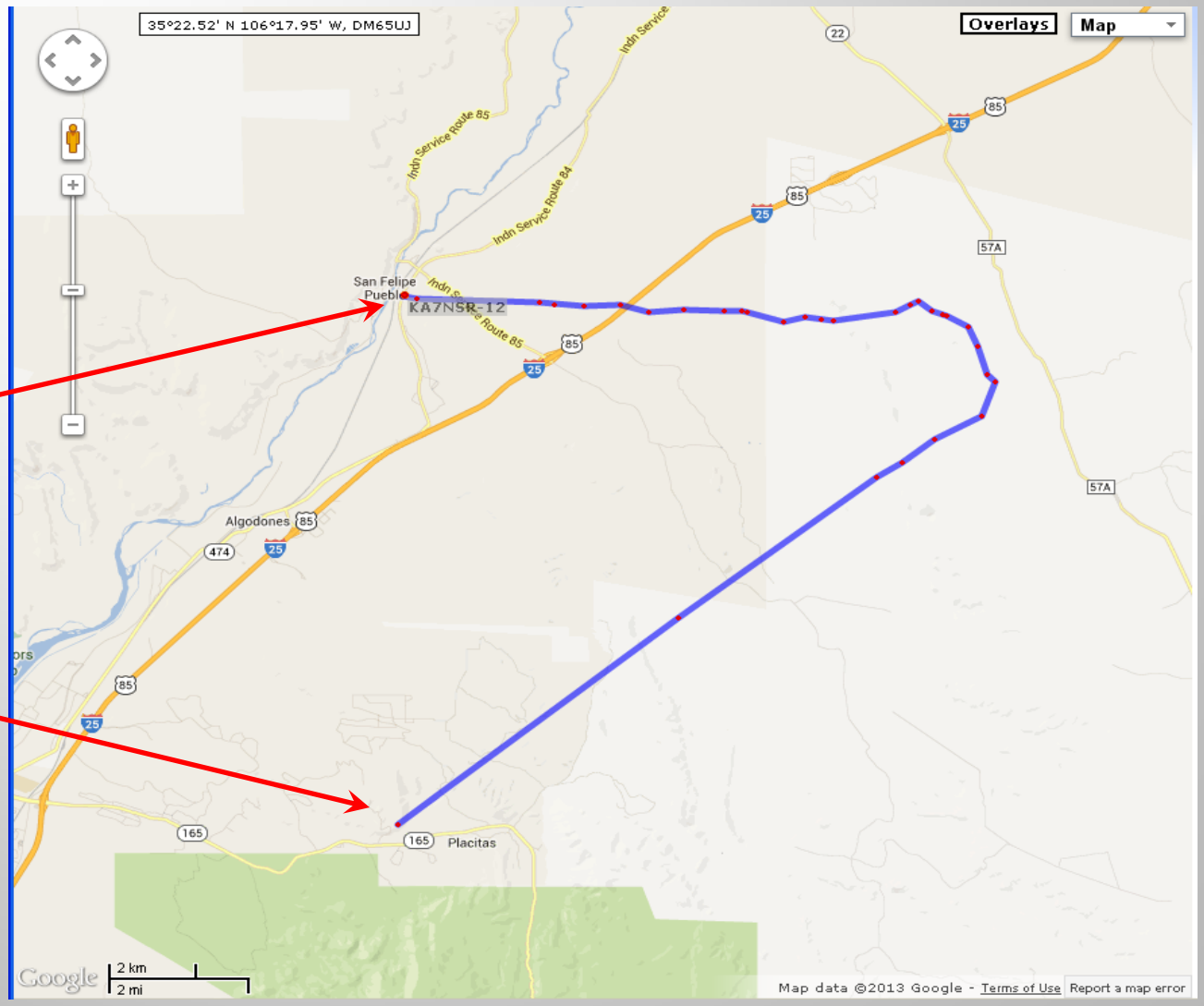
Somewhere between I25 and Cochiti Lake the balloon burst. The Packets recorded at the Duke City Hamfest Website show a max altitude of 83,388 feet. Over15 Miles above sea level. Wow!

Continued ….

NMSS-1 - Flight Path

End

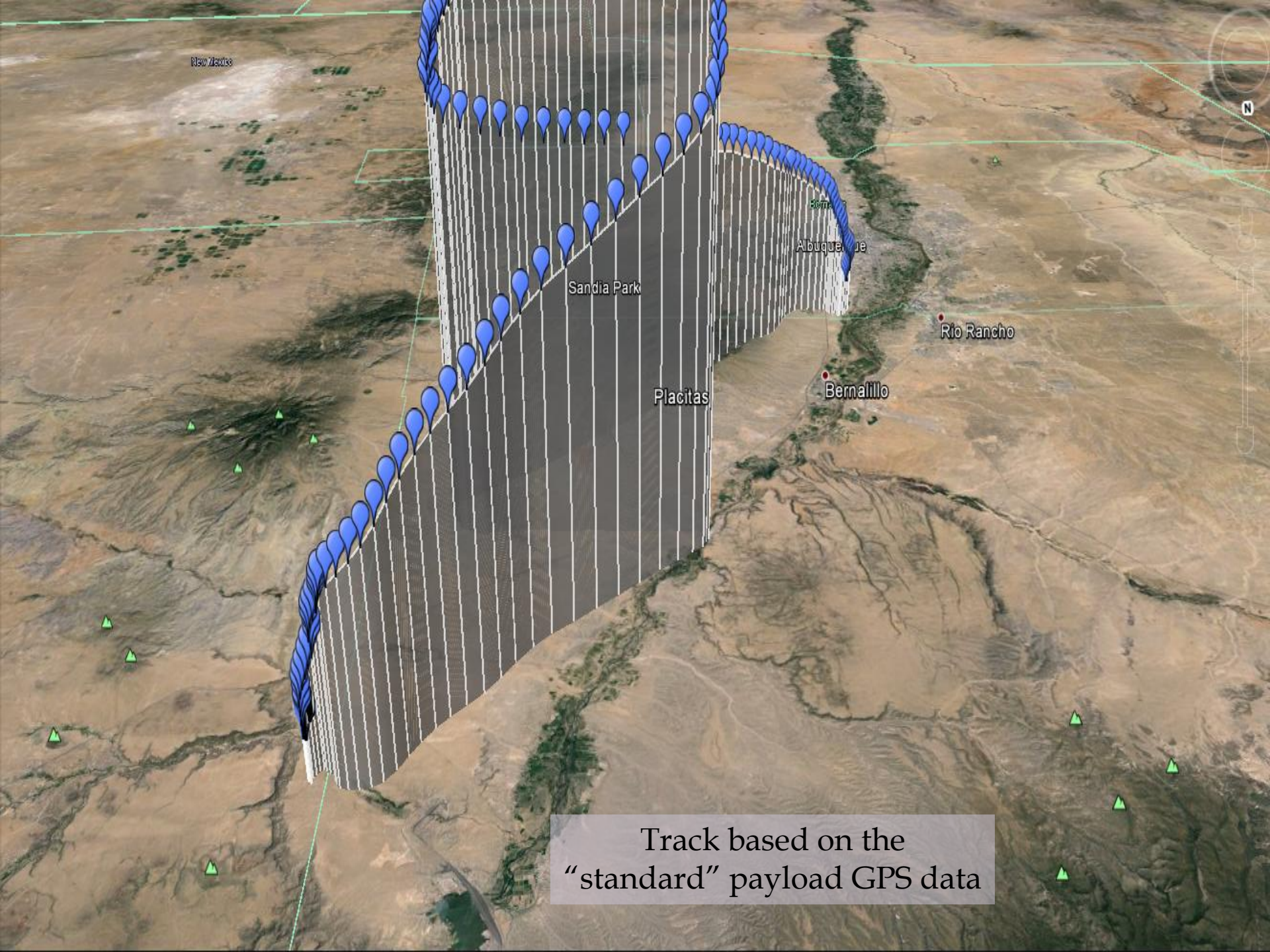
Start



Partial 70cm APRS track. Data Igated by Az station

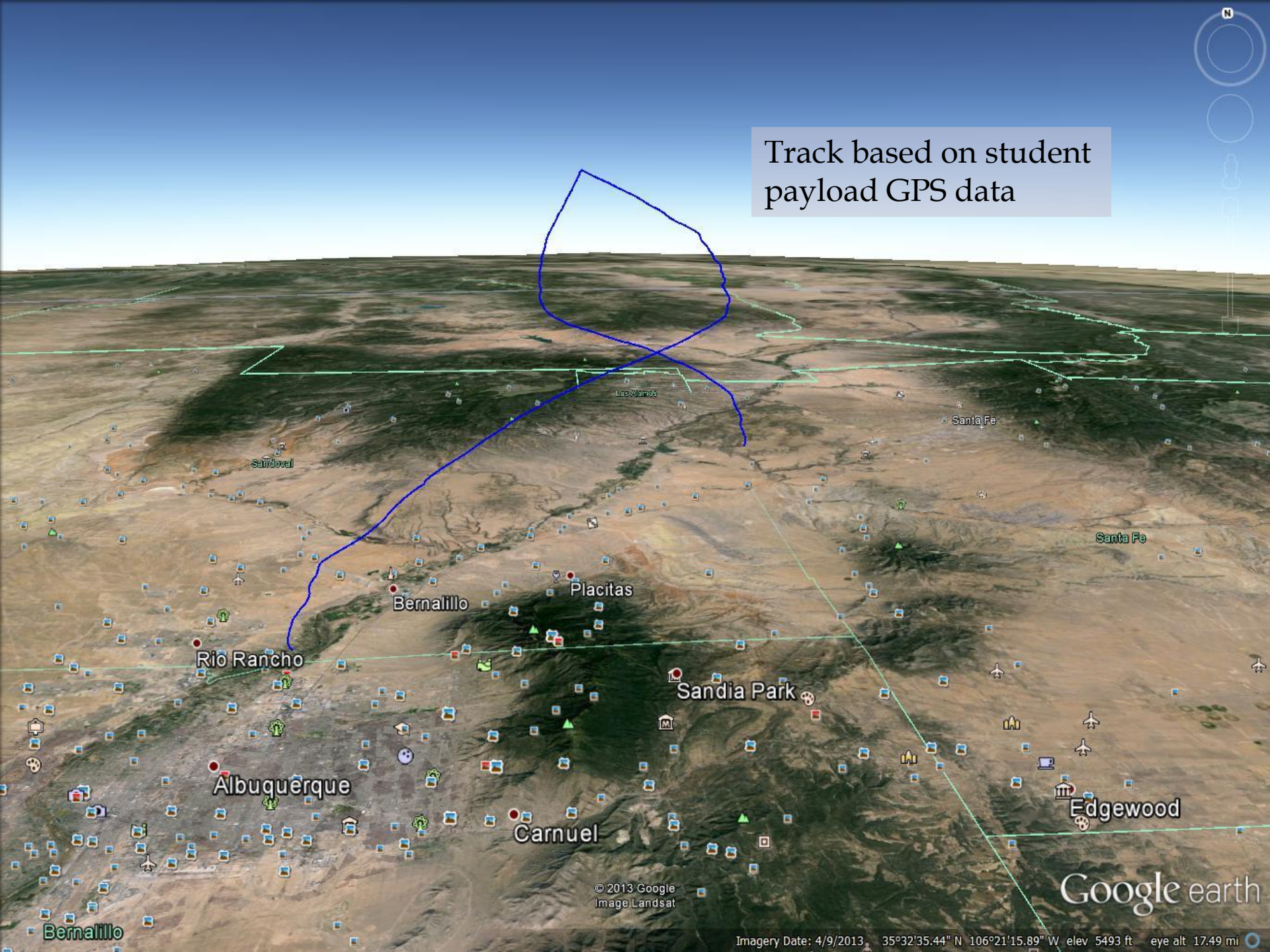
Track based on the "standard" payload GPS data

Track based on the "standard" payload GPS data



Track based on the
“standard” payload GPS data

Track based on student payload GPS data



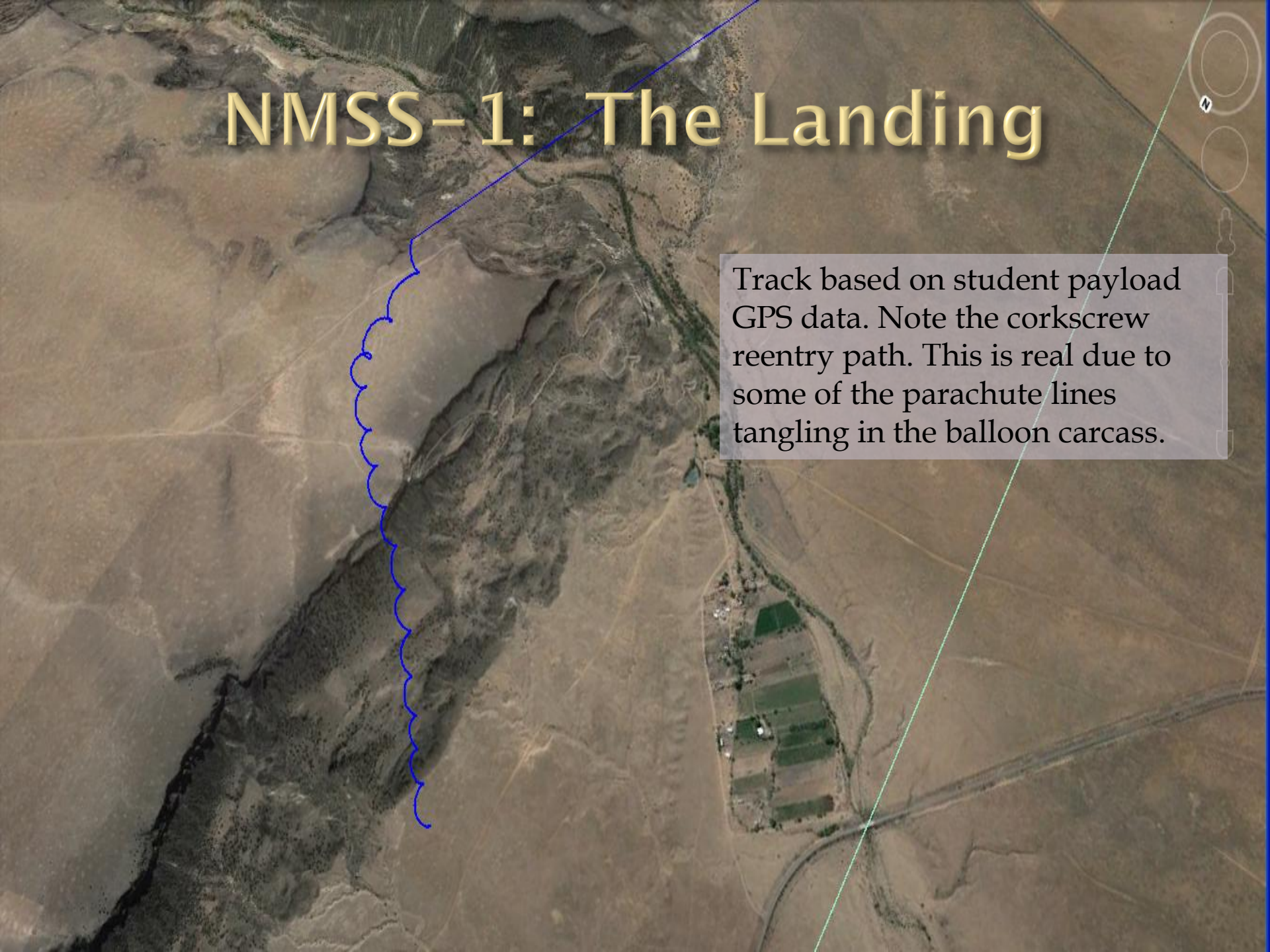
NMSS-1: At Altitude

Click picture to start 2 minute 2 second video

Video from Vince and Kim Jenkins' payload (ANSR). Quality reduced for this presentation

(if this version does not have the video imbedded go to https://www.youtube.com/watch?v=ysPiTmxEG6s)

NMSS-1: The Landing



Track based on student payload GPS data. Note the corkscrew reentry path. This is real due to some of the parachute lines tangling in the balloon carcass.


Predicted
B
Approx 7 mi
Actual
A
Map
Traffic
Cochiti Recreation Area
Tetilla Peak Recreation Area
Cochiti Lake
Domo At Santa Fe
La Cienega

NMSS-1 – Recovery

Continuation of Scott's flight report …

Larry Golden and I were approaching the Cochiti turnoff on I25 when we heard the balloon had burst. We watched the CW signal increase slightly on the S-Meter, then disappear. It was on the ground! My heart dropped, because I was not sure where – we had some T-Hunting to do.

FAA called again – they had lost their iGated tracking. They were pleased to learn the balloon was down. I wasn't so sure, until Bob Shipton called from Arizona with the predicted landing coordinates on Cochiti Pueblo.

We took the Cochiti Exit,headed west, and were soon receiving both packet and CW signals from the downed payload train. Indian Land! **We were stuck .2 miles from our payloads, waiting for the Cochiti Police to come look us over.** Our caravan of 5 vehicles included two solo T-hunters who were flying payloads, a family from Arizona, a search and rescue 4WD and a truckload of ROTC students.

The Cochiti police listened to our explanation and treated us with kindness and hospitality. We could not have found two more professional and enjoyable gentlemen. With our official escort, we quickly recovered the payloads and headed home.

NMSS-1: The Landing

Click picture to start 1 minute 1 second video

Video from Vince and Kim Jenkins' payload (ANSR). Quality reduced for this presentation

(if this version does not have the video imbedded go to https://www.youtube.com/watch?v=m7SPPOyk654)

NMSS-1 – Payloads

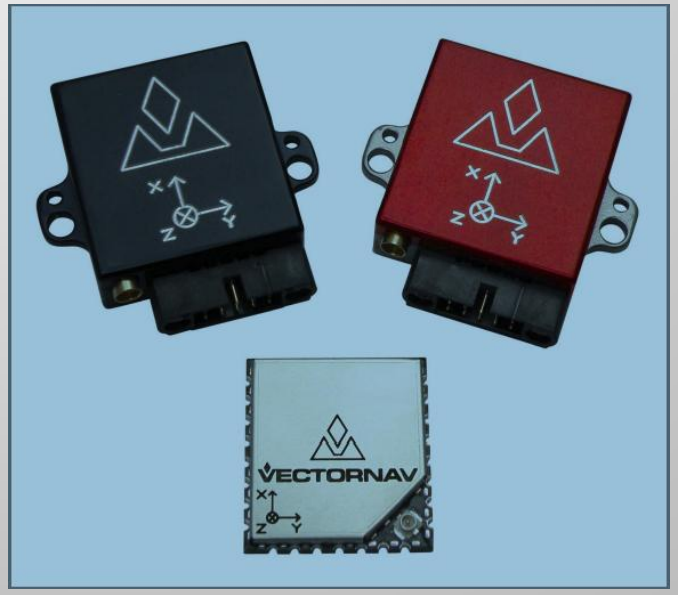
- APRS beacon (2 meter) (ANSR)
- APRS beacon (70 CM) (ANSR)
- Cross band Repeater (ANSR)
- CW beacon (ANSR)
- Video Camera (ANSR)
- Real Time Video feed (ANSR)
- Student Payload
- Standard Payload

NMSS-1 Student Team

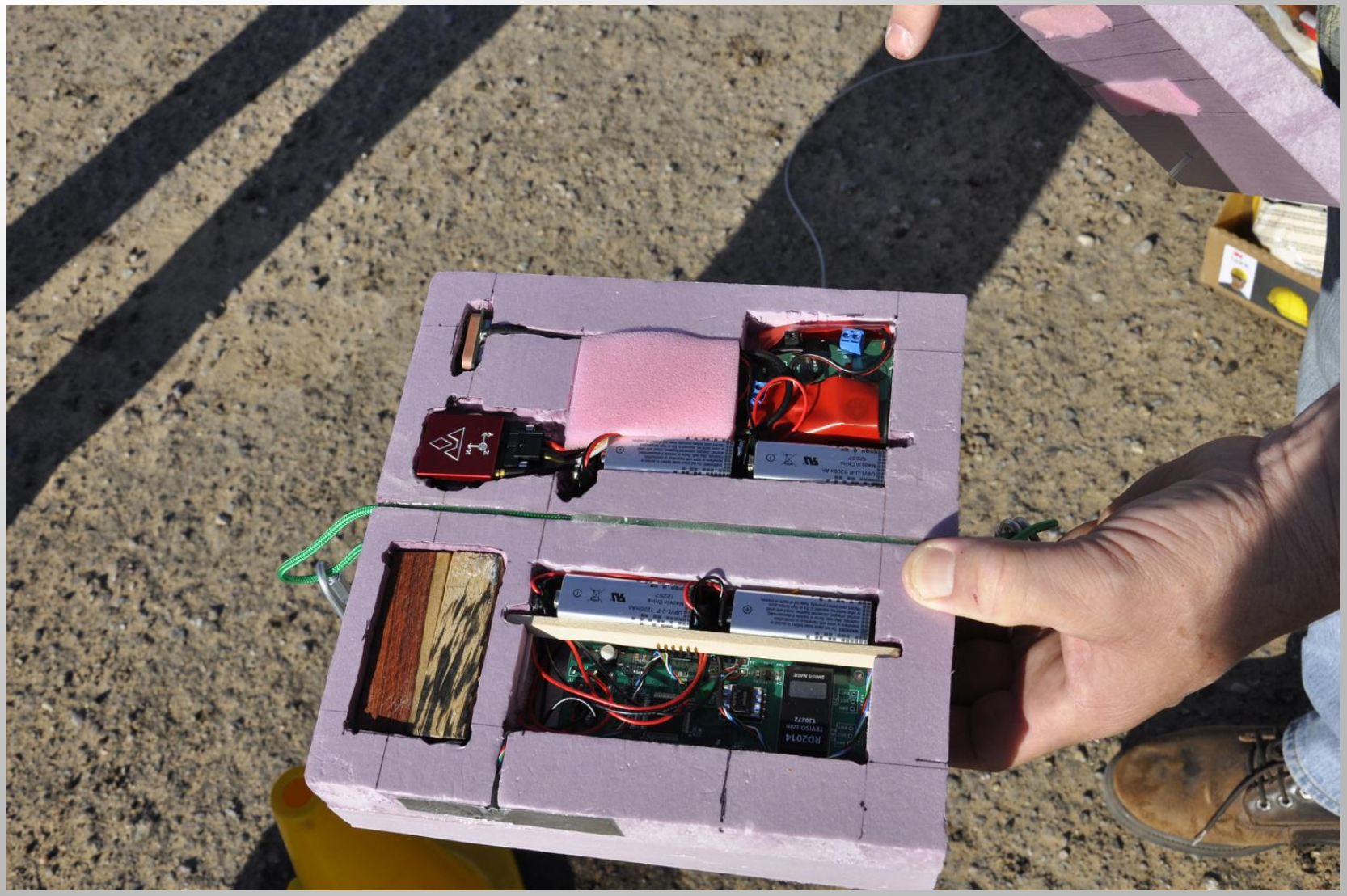
NMSS-1 – Student Payload

NMSS-1 – Student Payload

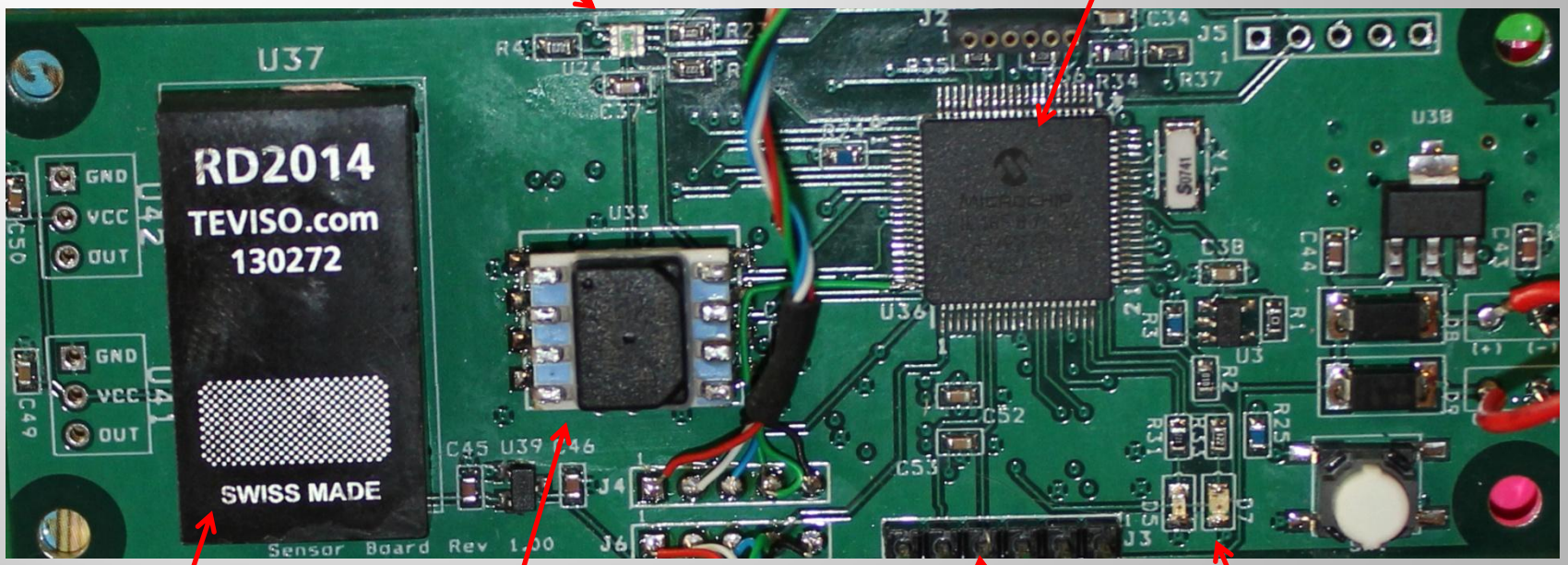
- VectorNav Data Logger
  - 2ea VN-200 modules
  - Each is a complete Inertial navigation module
  - Recorded about 1GB of data



NMSS-1 Standard Payload



NMSS-1 Standard Payload



Light

Off-board temperature

Processor

Cosmic Ray

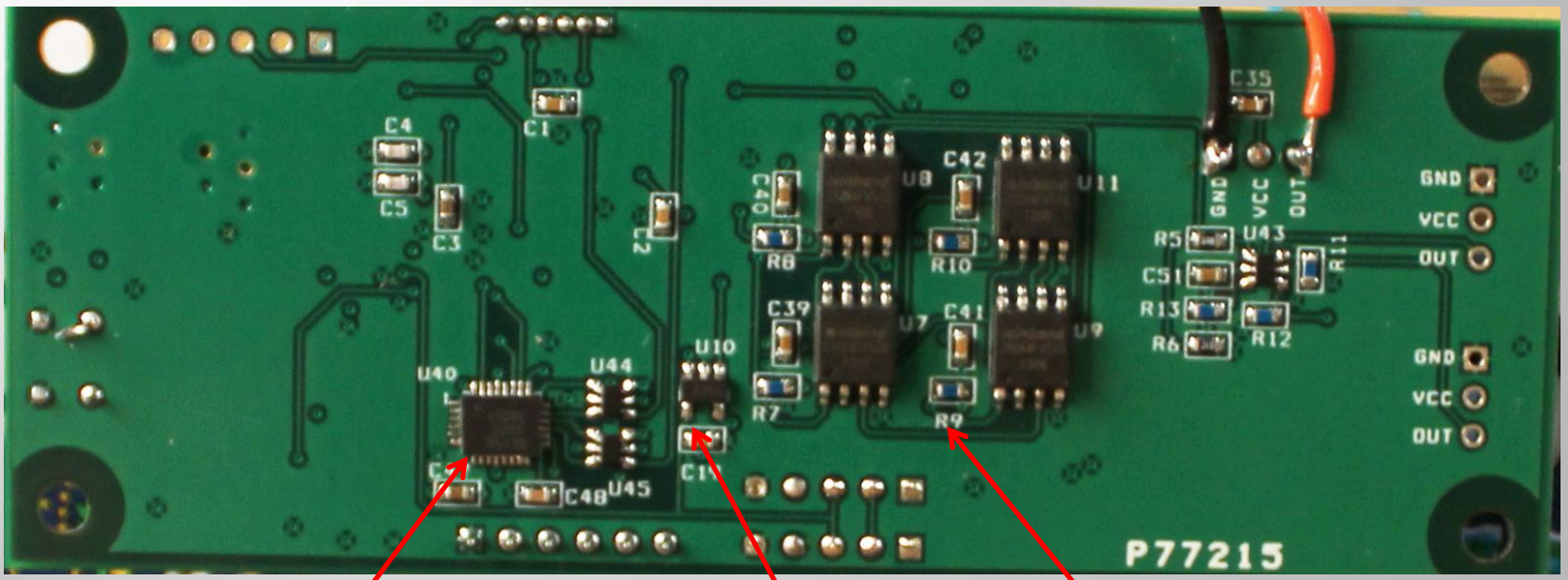
Pressure & Temp

Off-board temperature

Data I/O

LEDs

NMSS-1 Standard Payload



IMU – 3 axis gyro, 3 axis accelerometer, temp

Temperature

32MB Flash Memory

NMSS-1

Standard Payload – Sensor Board 1

- PIC microcontroller
- Light sensor
- 3 temperature sensors (inside, battery, outside)
- Pressure
- Cosmic Ray Detector
- Inertial Module (3 axis accelerometer / gyro)
- 32MB flash storage

NMSS-1

Standard Payload – Sensor Board 2

- PIC microcontroller
- VectorNav VN-200 inertial module (GPS, 3 axis accelerometer, 3 axis gyro, 3 axis magnetometer, temperature, GPS)

NMSS-1 – Initial Data Analysis

Microsoft Excel

A1 | 0

nemo_raw_after_flight.csv

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	0	0	0	0	0	0	0	5	0	3	7075	2895	2839	2799	23	731	853	-160	-80	-3949	72	196	-5
2	0	1	0	0	0	0	0	5	0	3	7113	2895	2839	2783	23	731	853	-64	-464	-4045	110	297	6
3	0	2	0	0	0	0	0	5	0	3	8716	2895	2839	2783	22	731	853	-128	-128	-3981	107	229	0
4	0	3	0	0	0	0	0	5	0	3	10031	2895	2839	2791	22	731	853	-112	-128	-3965	117	215	-4
5	0	4	0	0	0	0	0	5	0	3	10345	2895	2831	2791	22	731	853	-160	-128	-3949	112	237	-18
6	0	5	0	0	0	0	0	5	0	3	6828	2895	2831	2783	22	731	853	-192	-144	-3981	115	226	-7
7	0	6	0	0	0	0	0	5	0	3	4869	2895	2831	2783	22	731	853	-144	-144	-3933	73	191	14
8	0	7	0	0	0	0	0	6	0	3	4587	2895	2831	2791	22	731	853	-192	-128	-3949	-10	206	-33
9	0	8	0	0	0	0	0	6	0	3	3975	2903	2839	2791	22	731	853	-128	-128	-3965	155	33	138

Microsoft Excel

AL11 | =AI11/65536 * 16

nemo full data set with all formatting.xlsx

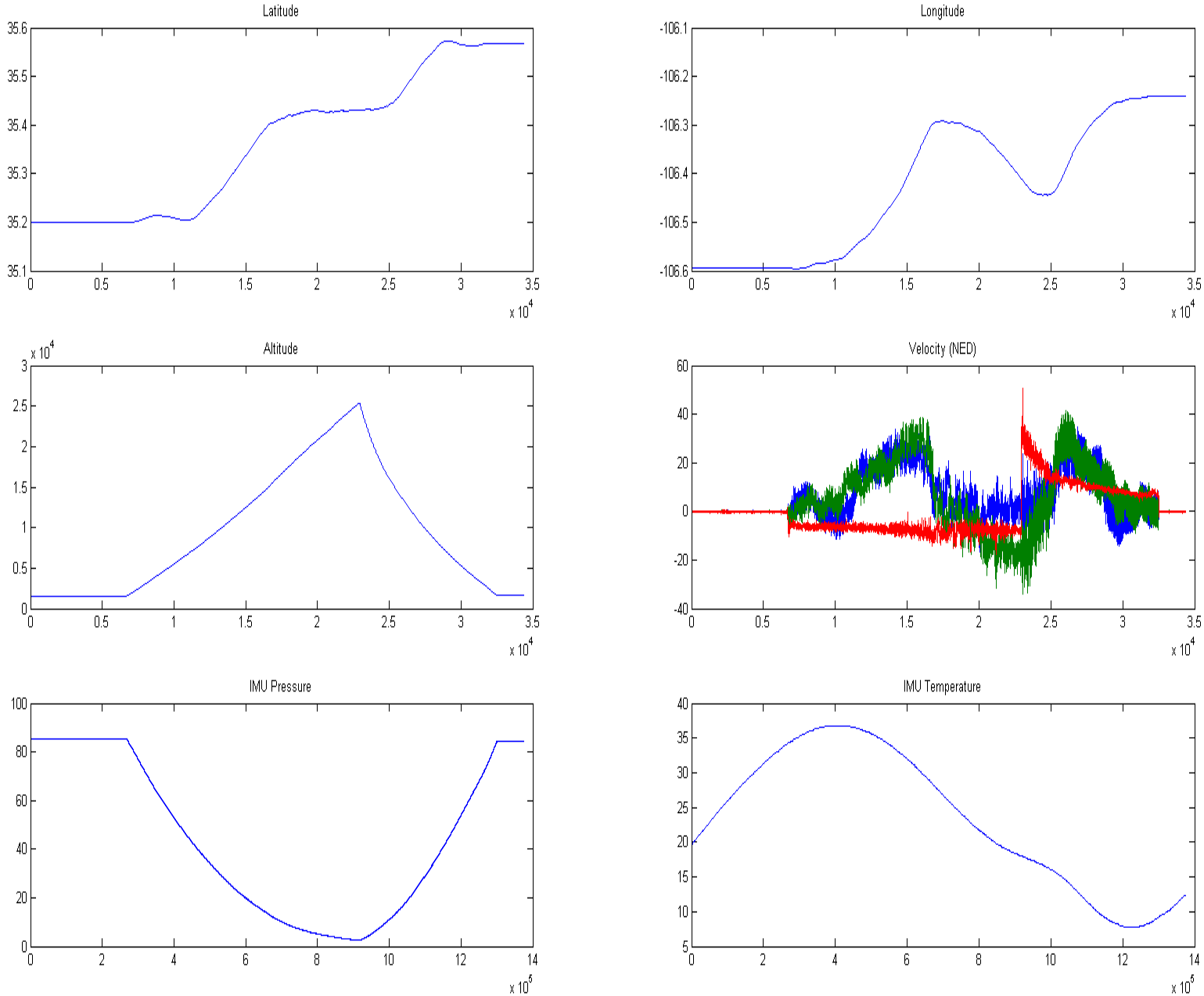
Set A1 (then use data/filter on the menu bar) to cull out, for example, every 10 value or every 20th value, etc

	A	D	L	O	R	T	U	W	X	Z	AA	AC	AD	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR
3	Filter	Sample Number (derived)	Derived time since power on	Derived approx counts per minute	Light, formatted , Lux	Board temp, formatted deg C	Board temp, formatted deg F	Battery temp, formatted deg C	Battery temp, formatted deg F	Outside temp, formatted deg C	Outside temp, formatted deg F	Temp, NEMO, formatted deg C	NEMO temp, Formatted deg F	Pressure sensor temp, formatted deg C	Pressure sensor temp, formatted deg F	Pressure formatted by firmware to mBar	Accel-X, raw, 16G full scale	Accel-Y, raw, 16G full scale	Accel-Z, raw, 16G full scale	Accel-X, formatted (Gs)	Accel-Y, formatted (Gs)	Accel-Z, formatted (Gs)	Gyro-X, raw, deg/sec	Gyro-Y, raw, deg/sec	Gyro-Z, raw, deg/sec	Battery Voltage, firmware formatted
4	Filter	Samp_num	Mission Time	C_ray	Light	T_board_C	T_board_F	T_batt_C	T_batt_F	T_out_C	T_out_F	T_NEMO_C	T_NEMO_F	T_pres_C	T_pres_F	Pressure	Ax_raw	Ay_raw	Az_raw	Ax	Ay	Az	Gx	Gy	Gz	Batt V
5	0	0	5.00	0	1727	22.6	72.7	22.2	71.9	21.9	71.4	23.0	73.4	21.4	70.6	853	-160	-80	-3949	-0.04	-0.02	-0.96	72	196	-5	9.59
6	1	1	5.13	0	1737	22.6	72.7	22.2	71.9	21.7	71.1	23.0	73.4	21.4	70.6	853	-64	-464	-4045	-0.02	-0.11	-0.99	110	297	6	9.58
7	2	2	5.25	0	2128	22.6	72.7	22.2	71.9	21.7	71.1	24.0	75.2	21.4	70.6	853	-128	-128	-3981	-0.03	-0.03	-0.97	107	229	0	9.58
8	3	3	5.38	0	2449	22.6	72.7	22.2	71.9	21.8	71.2	24.0	75.2	21.4	70.6	853	-112	-128	-3965	-0.03	-0.03	-0.97	117	215	-4	9.58
9	4	4	5.50	0	2526	22.6	72.7	22.1	71.8	21.8	71.2	24.0	75.2	21.4	70.6	853	-160	-128	-3949	-0.04	-0.03	-0.96	112	237	-18	9.58
10	5	5	5.63	0	1667	22.6	72.7	22.1	71.8	21.7	71.1	24.0	75.2	21.4	70.6	853	-192	-144	-3981	-0.05	-0.04	-0.97	115	226	-7	9.58
11	6	6	5.75	0	1189	22.6	72.7	22.1	71.8	21.7	71.1	24.0	75.2	21.4	70.6	853	-144	-144	-3933	-0.04	-0.04	-0.96	73	191	14	9.58
12	7	7	6.00	0	1120	22.6	72.7	22.1	71.8	21.8	71.2	24.0	75.2	21.4	70.6	853	-192	-128	-3949	-0.05	-0.03	-0.96	-10	206	-33	9.58
13	8	8	6.13	0	970	22.7	72.8	22.2	71.9	21.8	71.2	24.0	75.2	21.4	70.6	853	-128	-128	-3965	-0.03	-0.03	-0.97	155	33	138	9.58
14	9	9	6.25	0	918	22.7	72.8	22.2	71.9	21.8	71.2	24.0	75.2	21.4	70.6	853	-240	-208	-3773	-0.06	-0.05	-0.92	593	953	-45	9.59

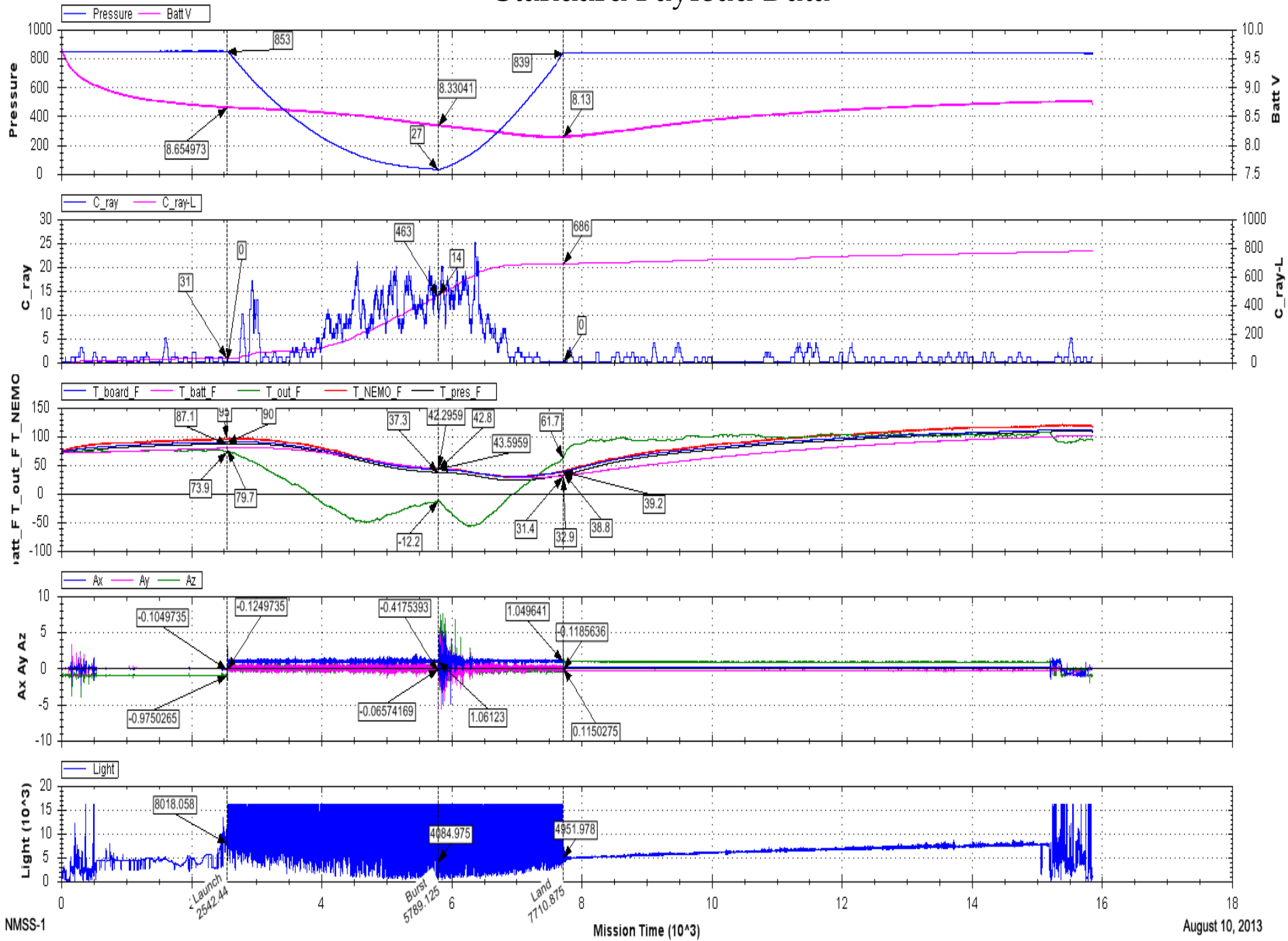
nemo_raw_after_flight_with_labl

Ready

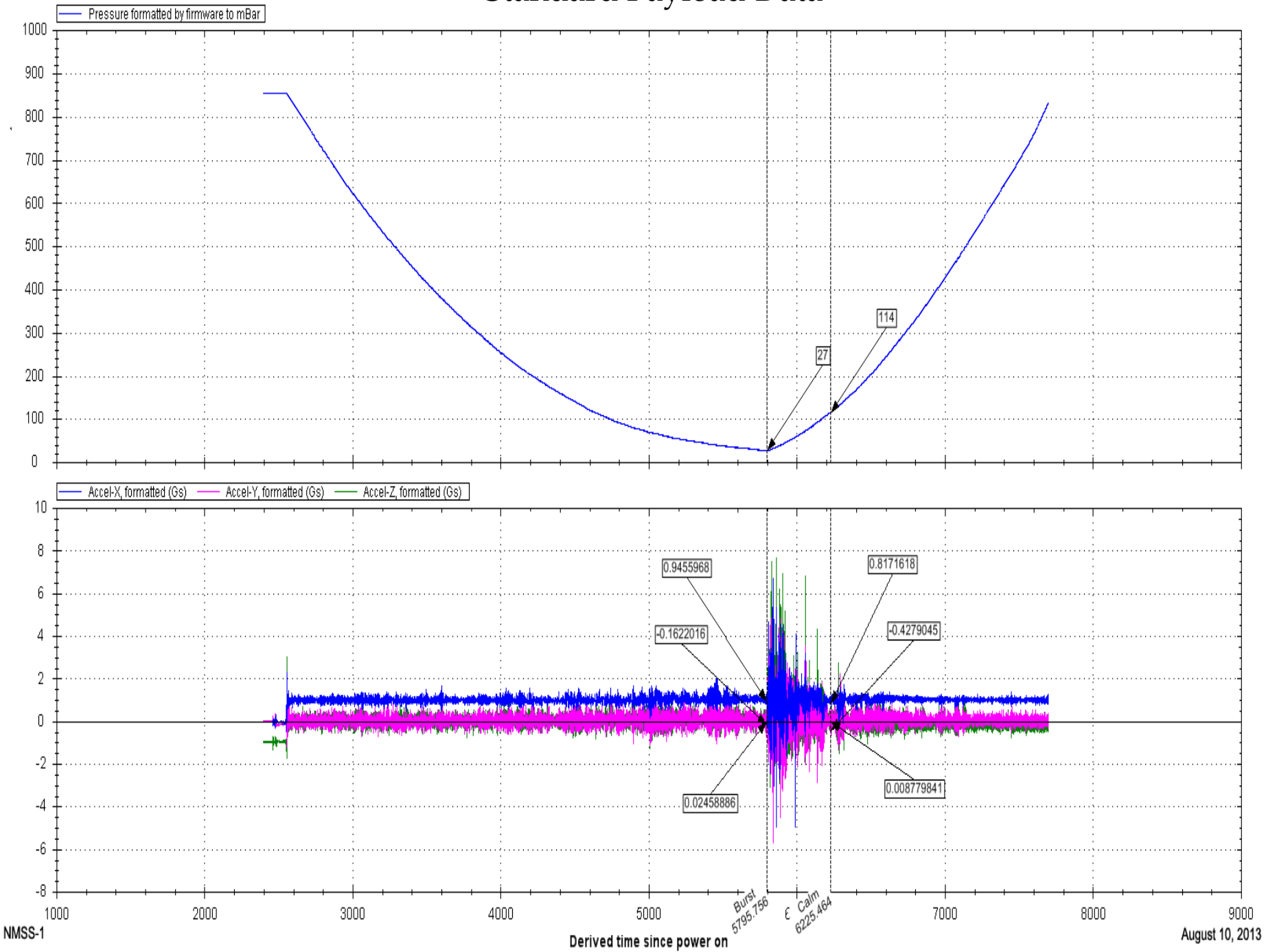
Initial Student Data



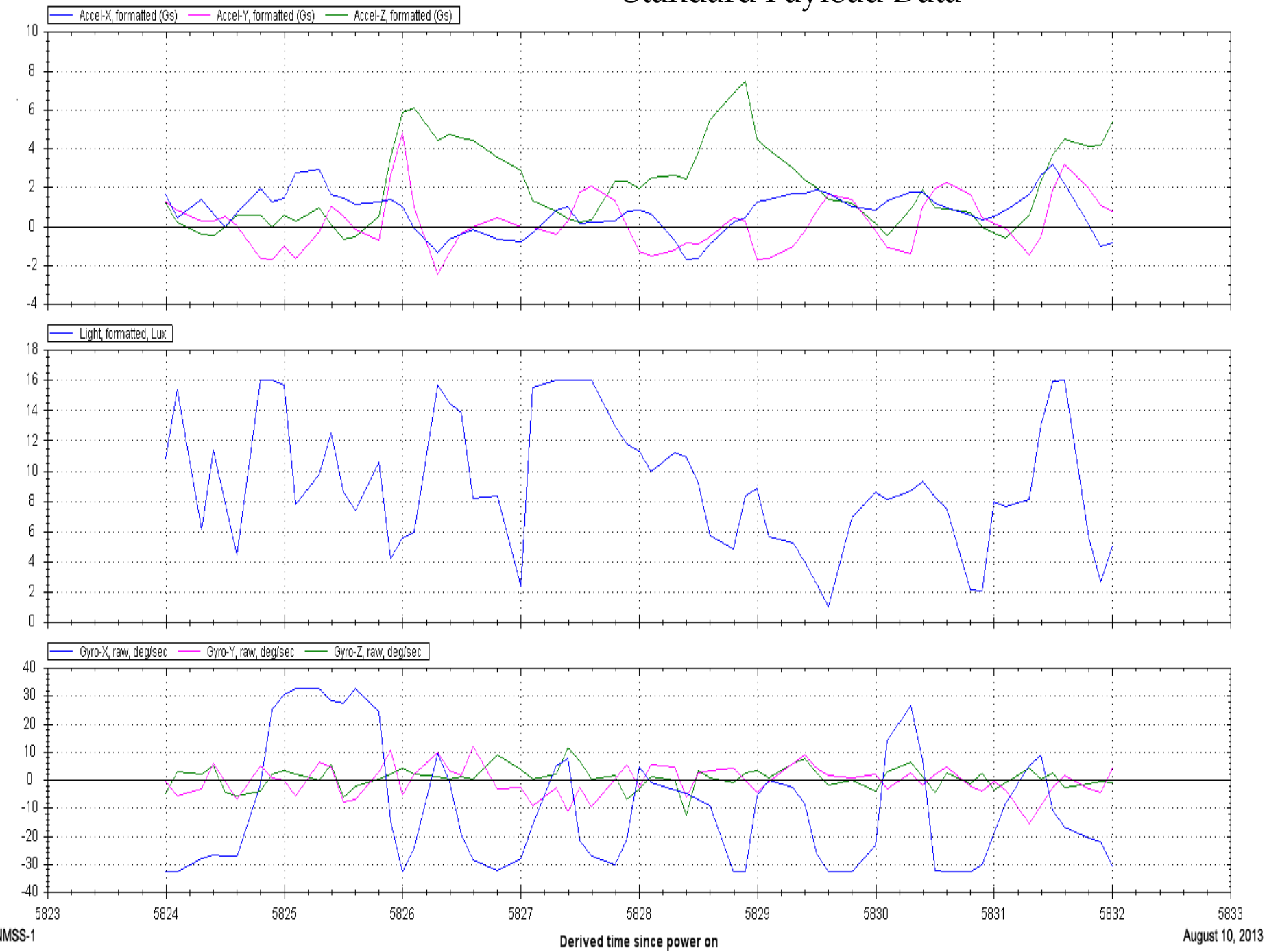
Standard Payload Data



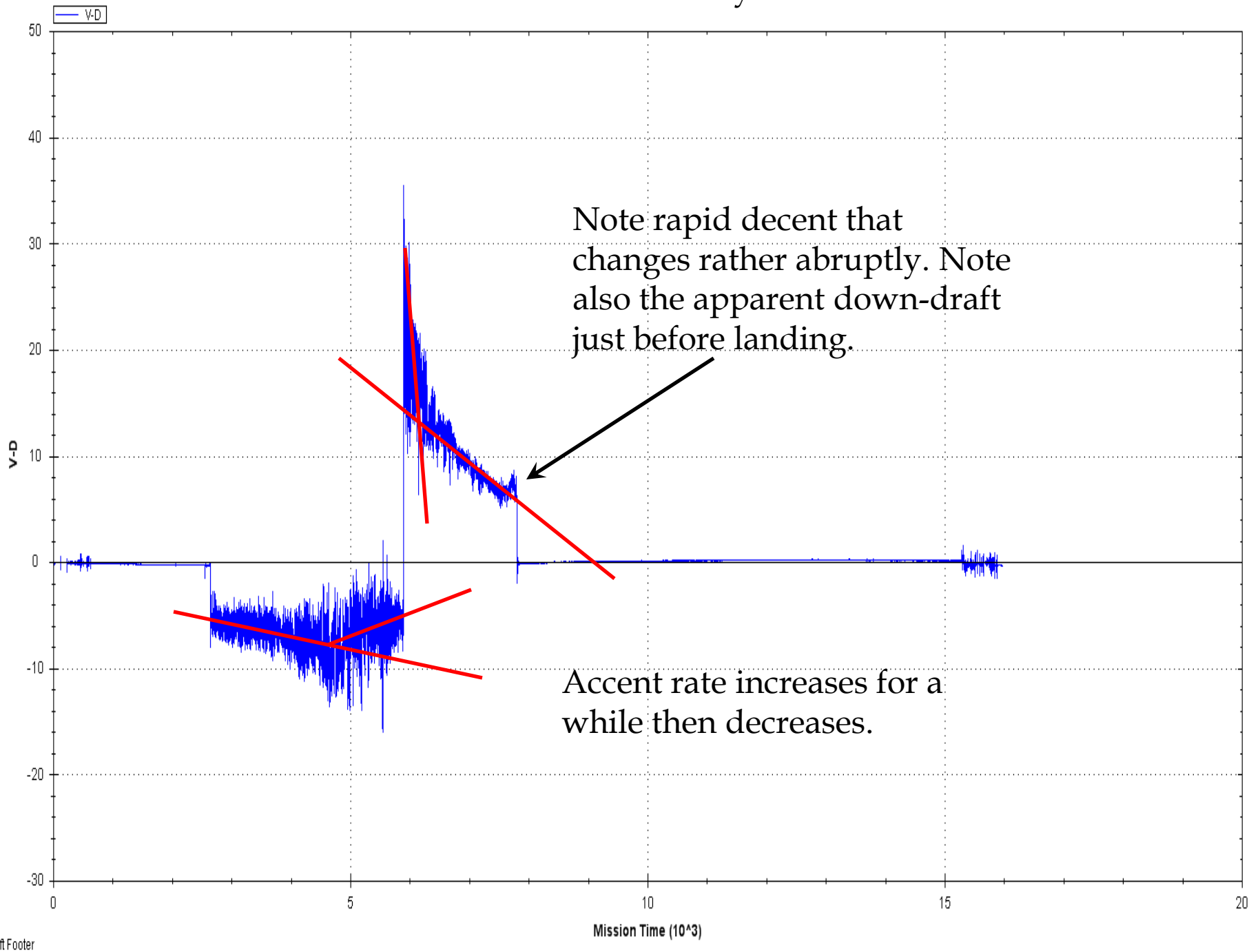
Standard Payload Data



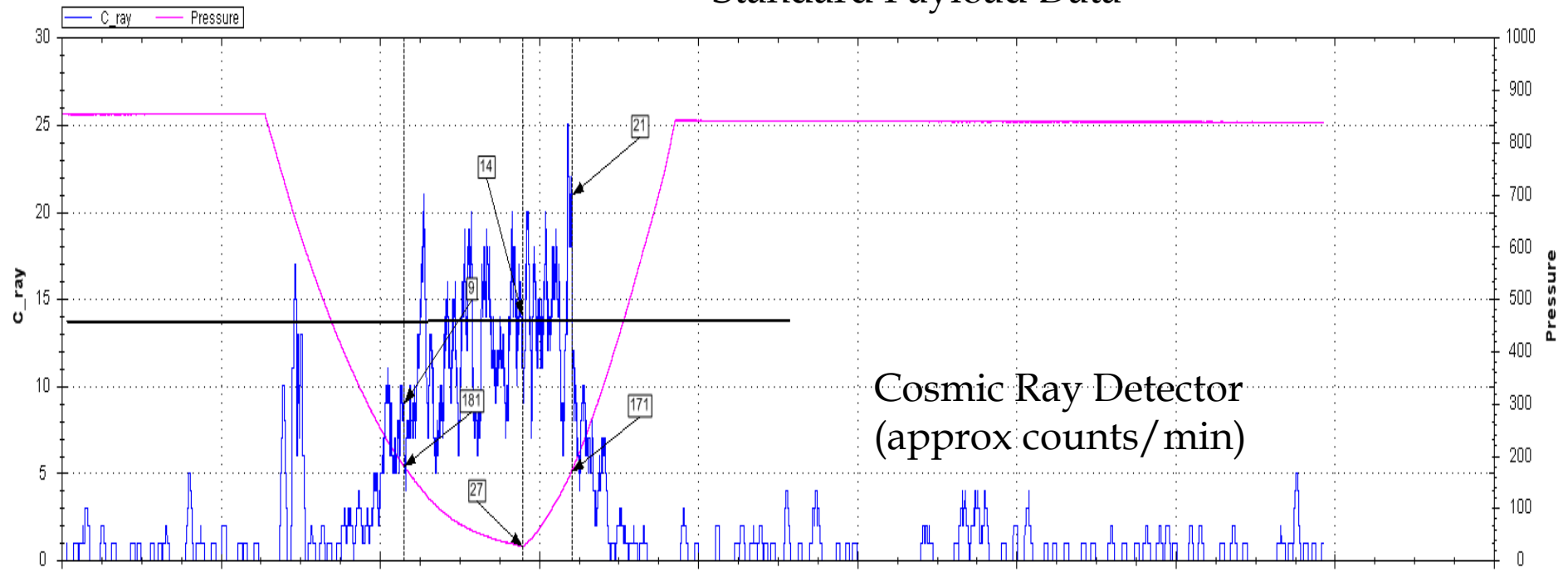
Standard Payload Data

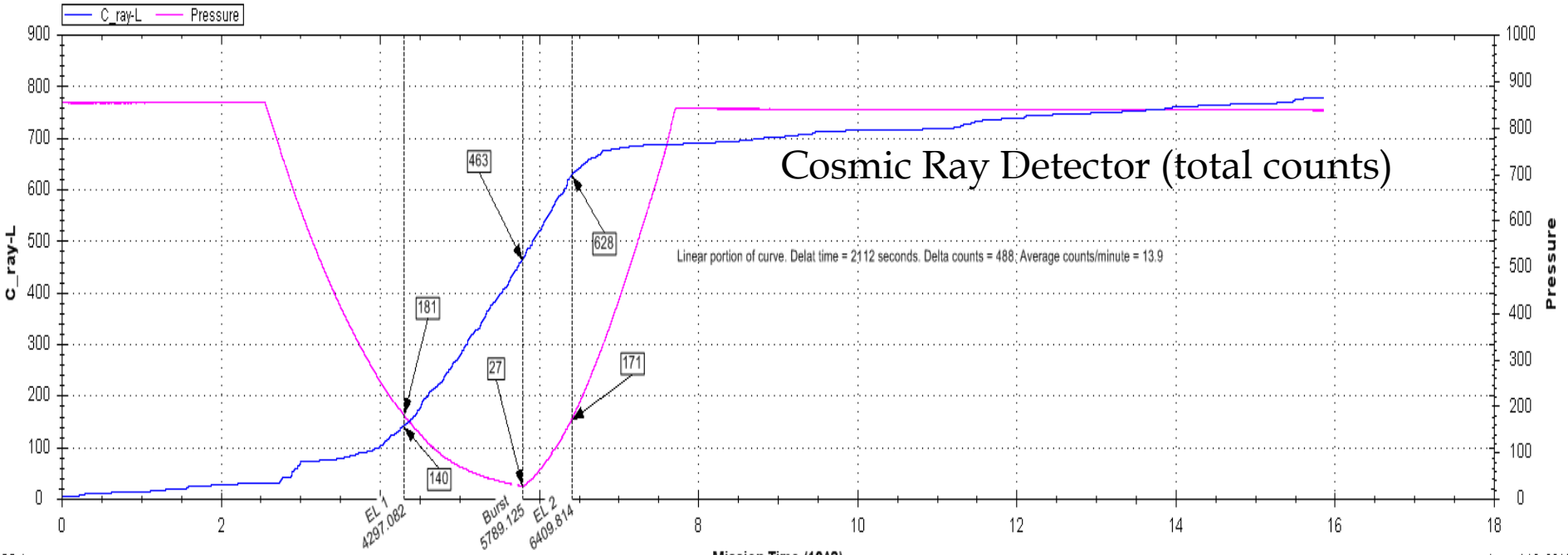


Standard Payload Data



Standard Payload Data





New Mexico Space Studies

Future of the Organization

Develop Infrastructure to

- Support Amateur Radio Experimentation
- Support and encourage interest in Science, Technology, Engineering, and Math (STEM) among youth of all ages

New Mexico Space Studies

Future of the Organization

Solar Balloons?

- Low Cost
- Small payload
- Low altitude

NMSS-2 (Next Flight)

December 2013 ???

Lots to do

- Develop formal organization – 501(c)(3)?
- Develop hardware infrastructure
- Develop relationship with pueblos
- Obtain grants
- <u>Develop a Logo!!!</u> (volunteer in the audience?)

The best we could do so far!

New Mexico Space Studies

Stay in touch via Yahoo Groups

To join send an email message to

NewMexicoSpaceStudies-subscribe@yahoogroups.com

Videos are on YouTube.

Go to **www.youtube.com** and search for

"NMSS Balloon"

New Mexico Space Studies

Questions