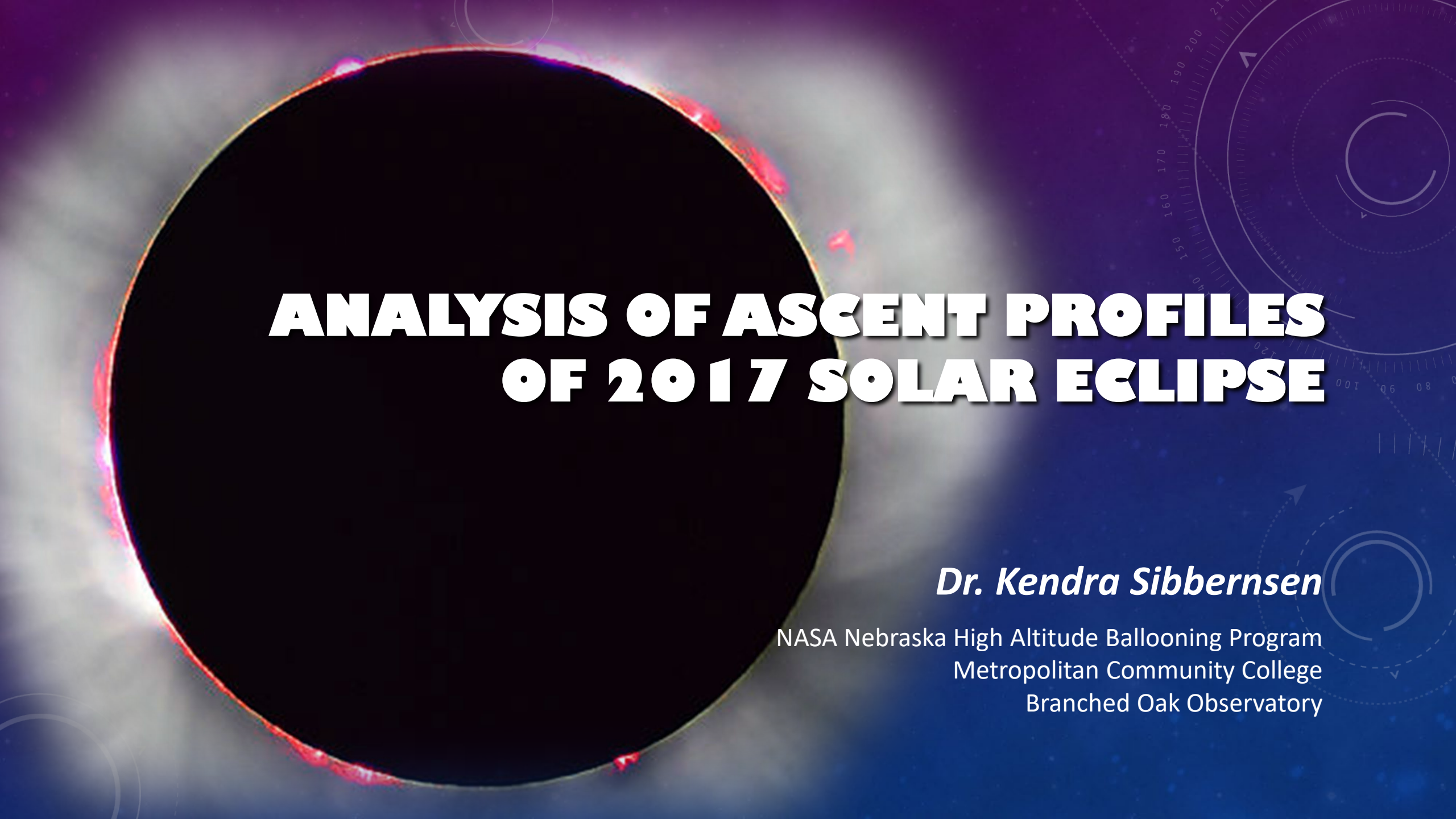


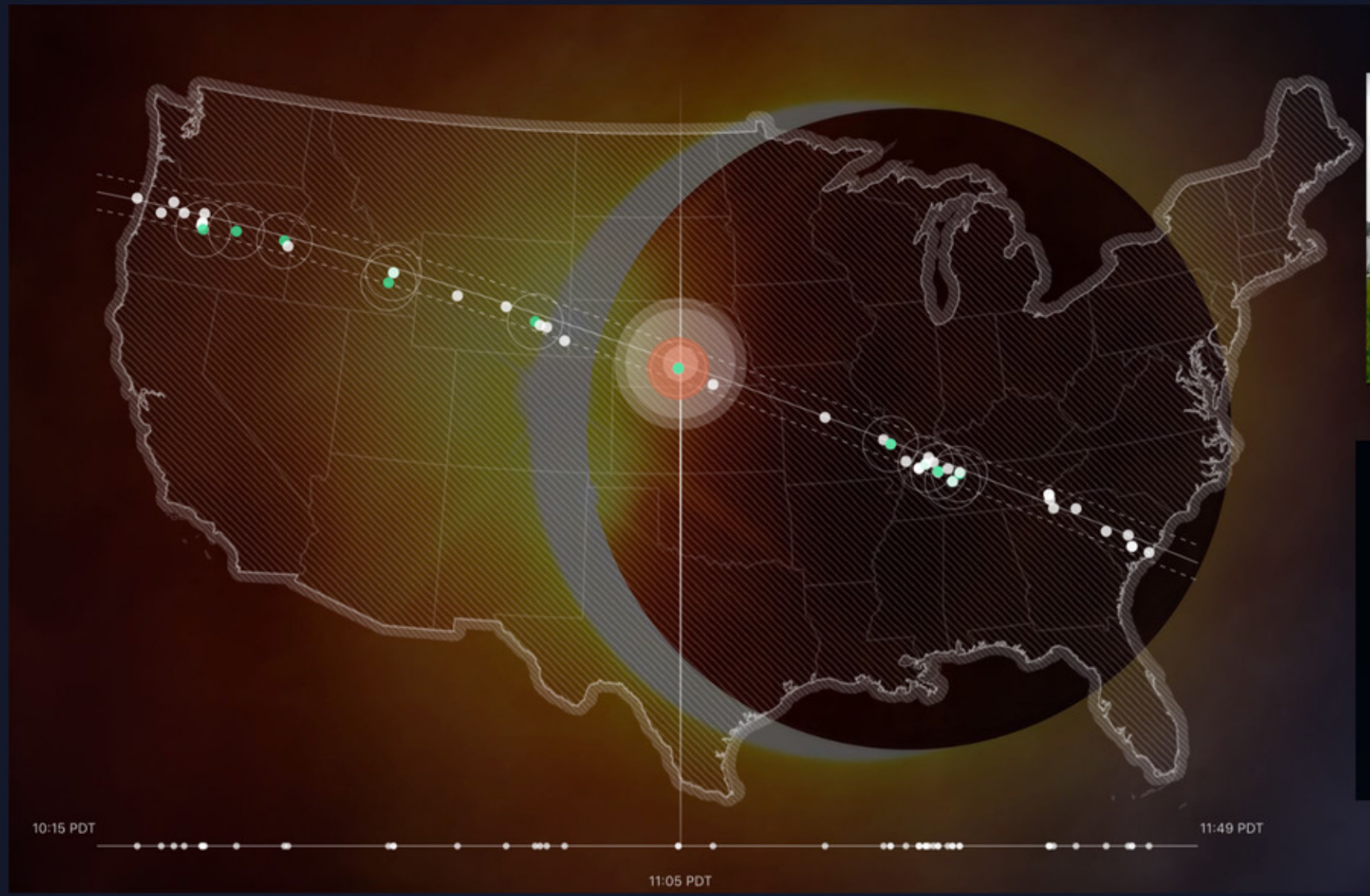
Analysis of Ascent Profiles of 2017 Solar Eclipse

Dr. Kendra Sibbernsen

NASA Nebraska High Altitude Ballooning Program
Metropolitan Community College
Branched Oak Observatory


28
25
32
23
33


NASA



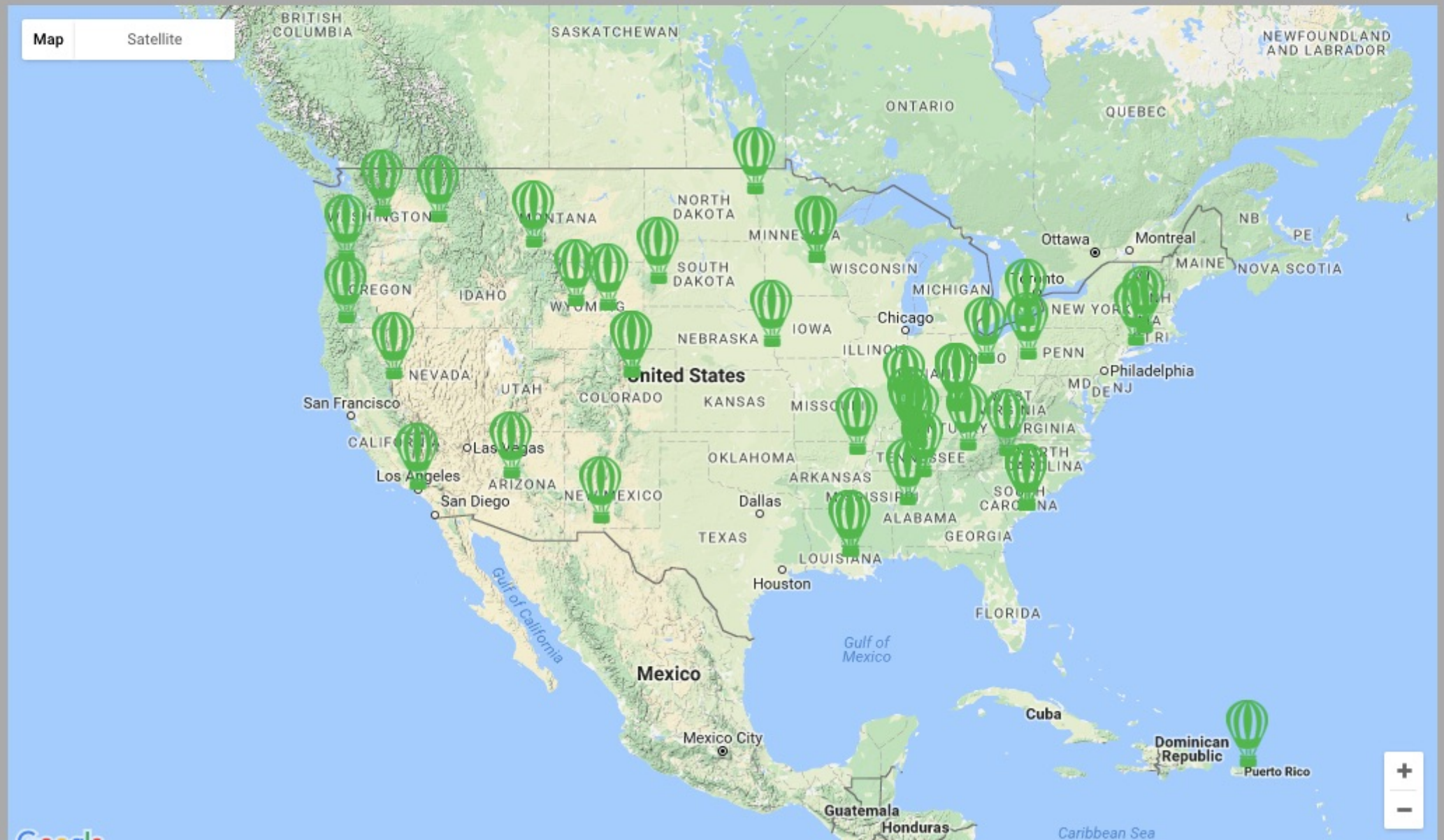
NASA Nebraska High Altitude Ballooning

The NASA Nebraska High Altitude Ballooning team is launching a high altitude balloon (HAB) from Grand Island, NE to a height of 100,000 feet to capture data and video of the August 2017 Solar Eclipse. Watch the onboard camera live here.

BOREALIS: Current Flight Data

Hover cursor over balloon for quick info,

Click on a balloon of interest for a new page of data points and flight track.




LAUNCH
NASA
CREW


OMAHA
34-2757
creek.com


IMU / Local GPS Arduino
MacBook

BOREALIS: Current Flight Data

Hover cursor over balloon for quick info,

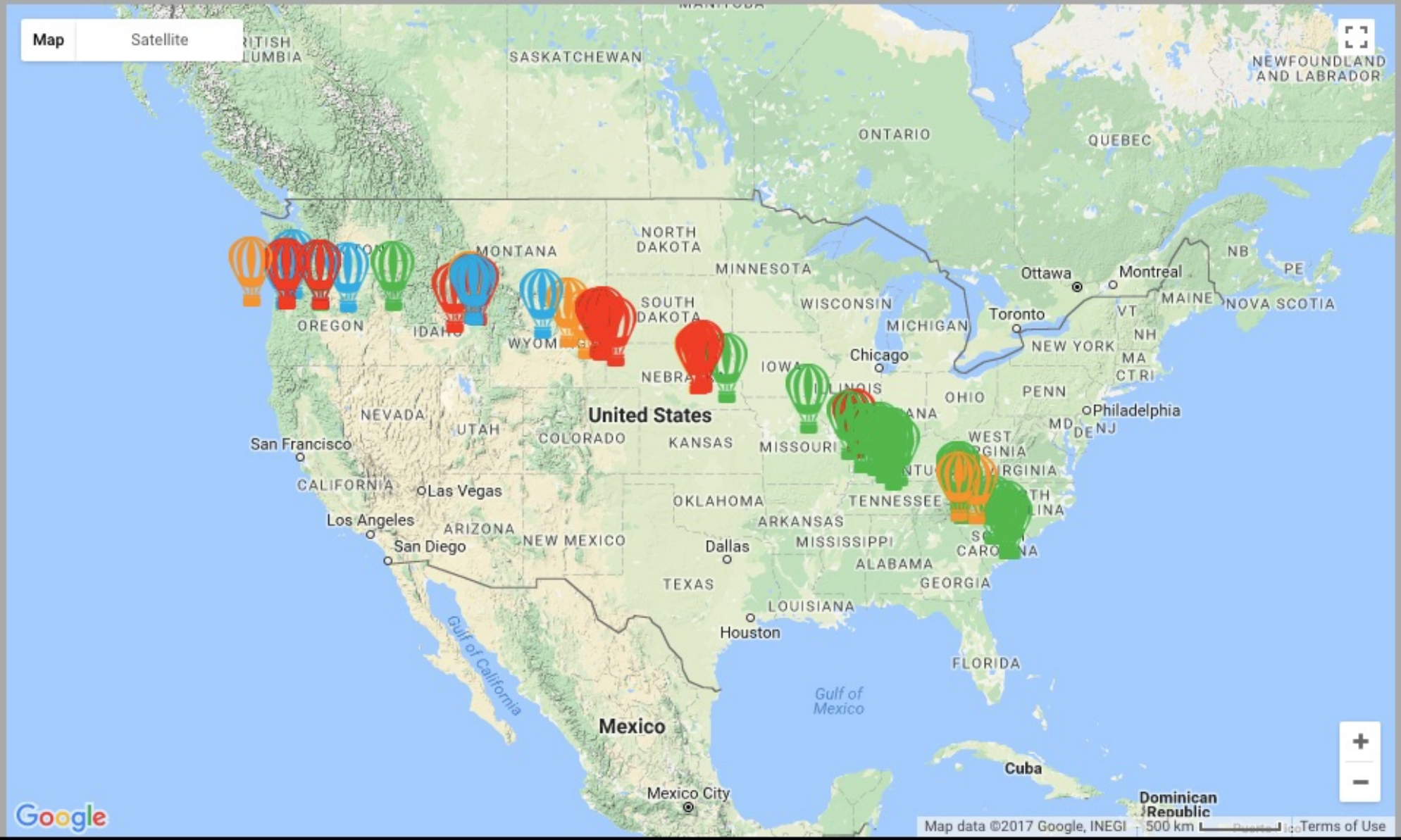
Click on a balloon of interest for a new page of data points and flight track.

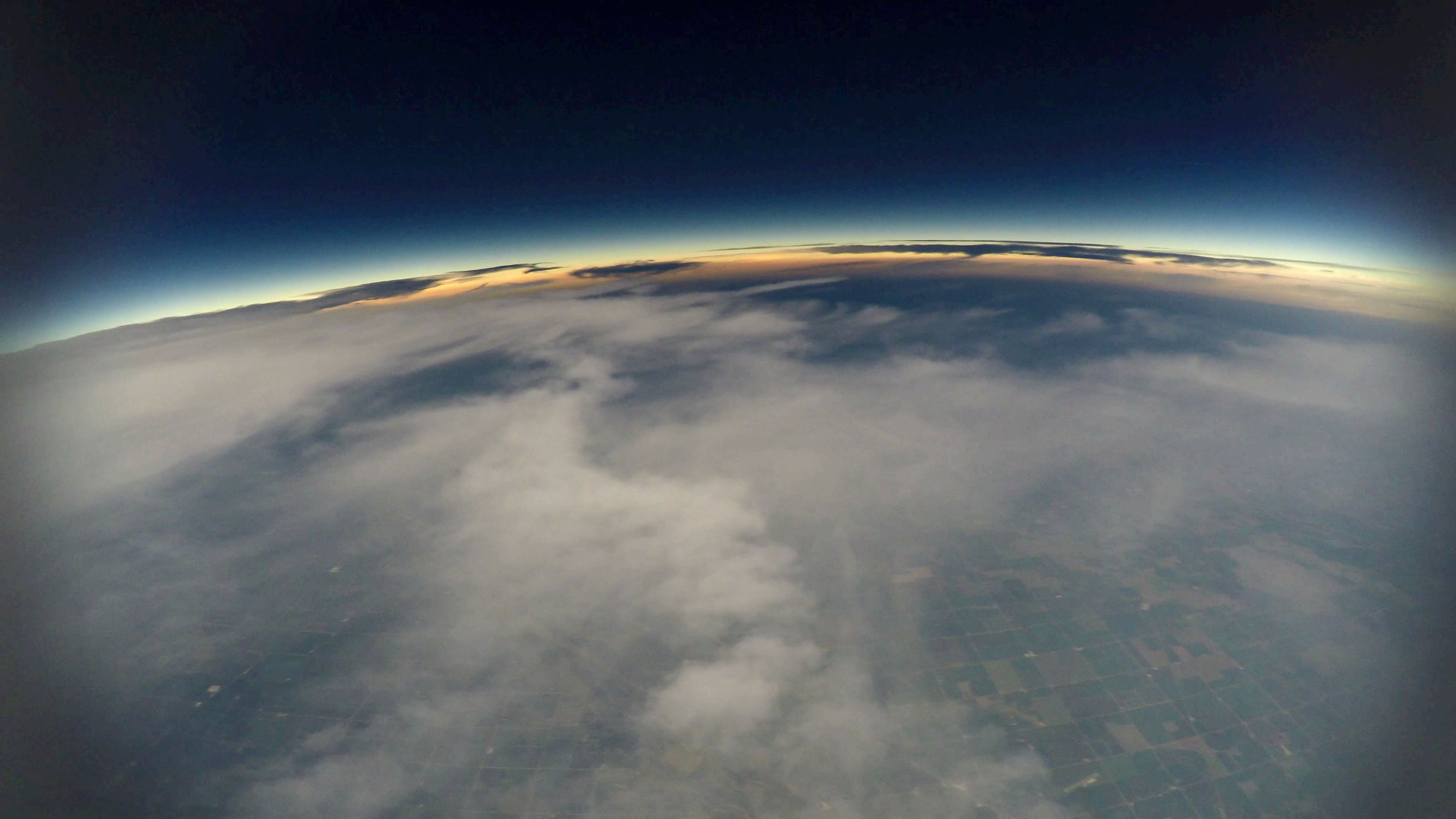
Tracking

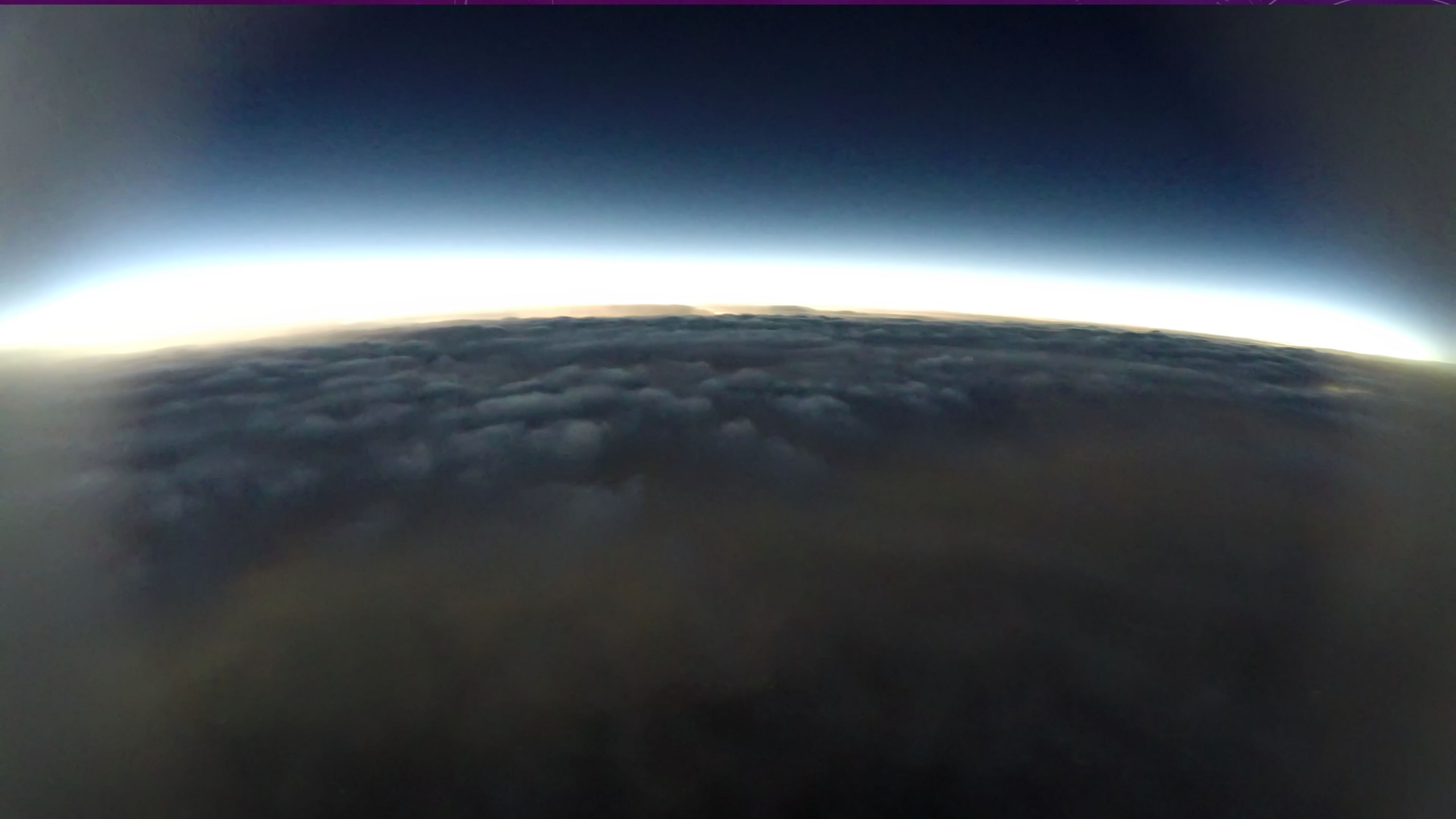
Archive

About

Contact








Michael Gibbensen
STARR PRODUCTIONS
Aug. 21st 2017 Total Solar Eclipse


Michael Gilbertsen
STARR PRODUCTIONS
Aug. 21st 2017 Total Solar Eclipse

RESULTS

- Over 6000 general public guests watched the launch at the Stuhr Museum.
- Three balloons were in the air during totality.
- Three balloons and all corresponding equipment were recovered.
- Transmitted video from balloon to base station and uploaded online.
- Spectacular personal experiences with a clear view of totality.

RESULTS

- Astrobiology sample flown on MCC balloon and returned to NASA Ames.
- Camera heading platform worked throughout flight but dome iced over.
- UV sensor stopped working in pod prior to launch.
- Temperature drop detected at totality at approximately 51,000 ft.
- Took spectacular photos and video from altitude and on the ground.

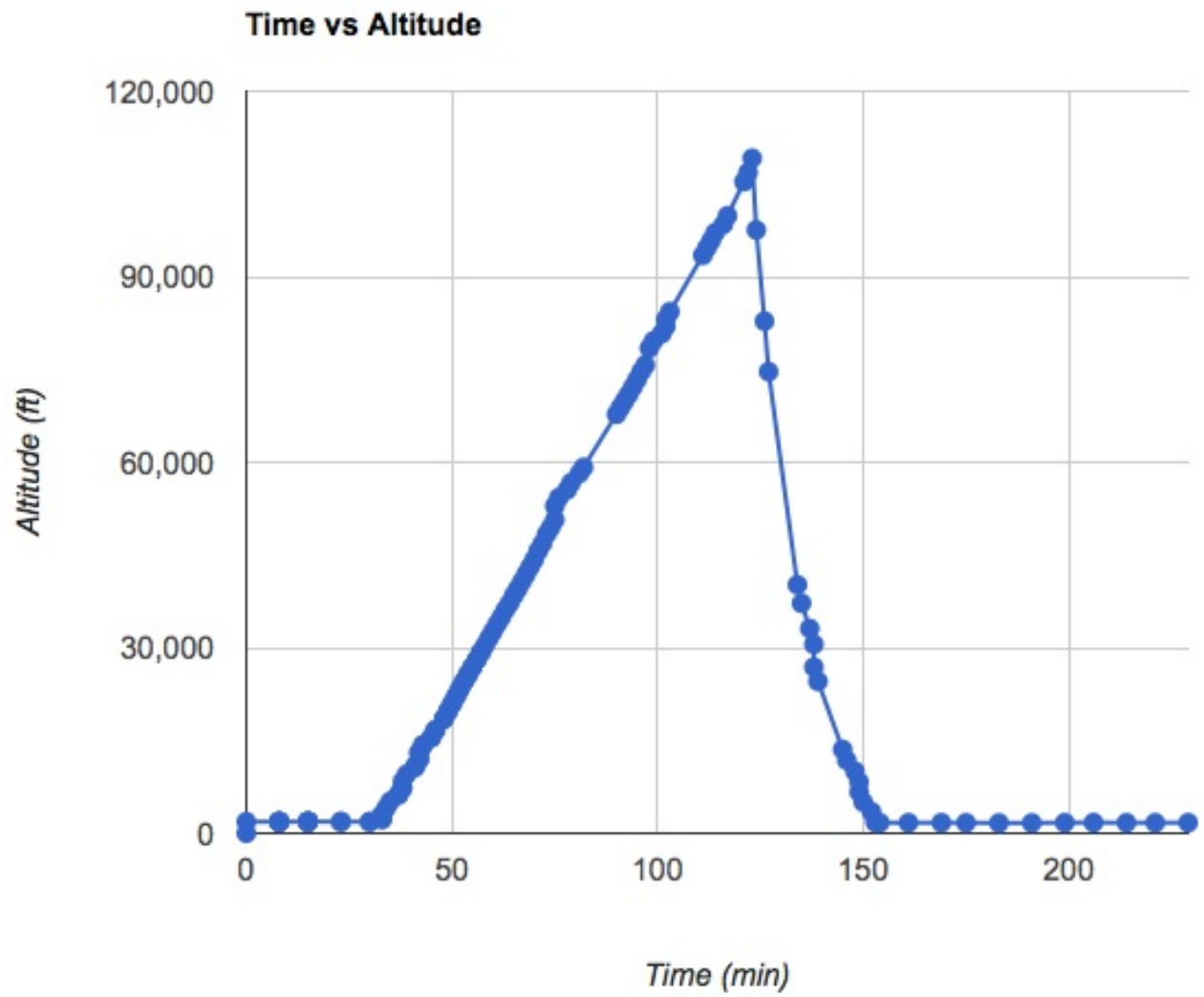
OPS

#StratoStar0164

OPS 1

VOLTAGE: 3.4V

DISTANCE TRAVELED: 37.8 MILES



- TIME
- ALTITUDE

MISSION TIME:
03:49
HRS MIN

- ALTITUDE
- TEMPERATURE
- HUMIDITY
- SPEED
- VERTICAL RATE
- PRESSURE
- HEADING
- SPIN RATE
- BATTERY
- TURBULENCE

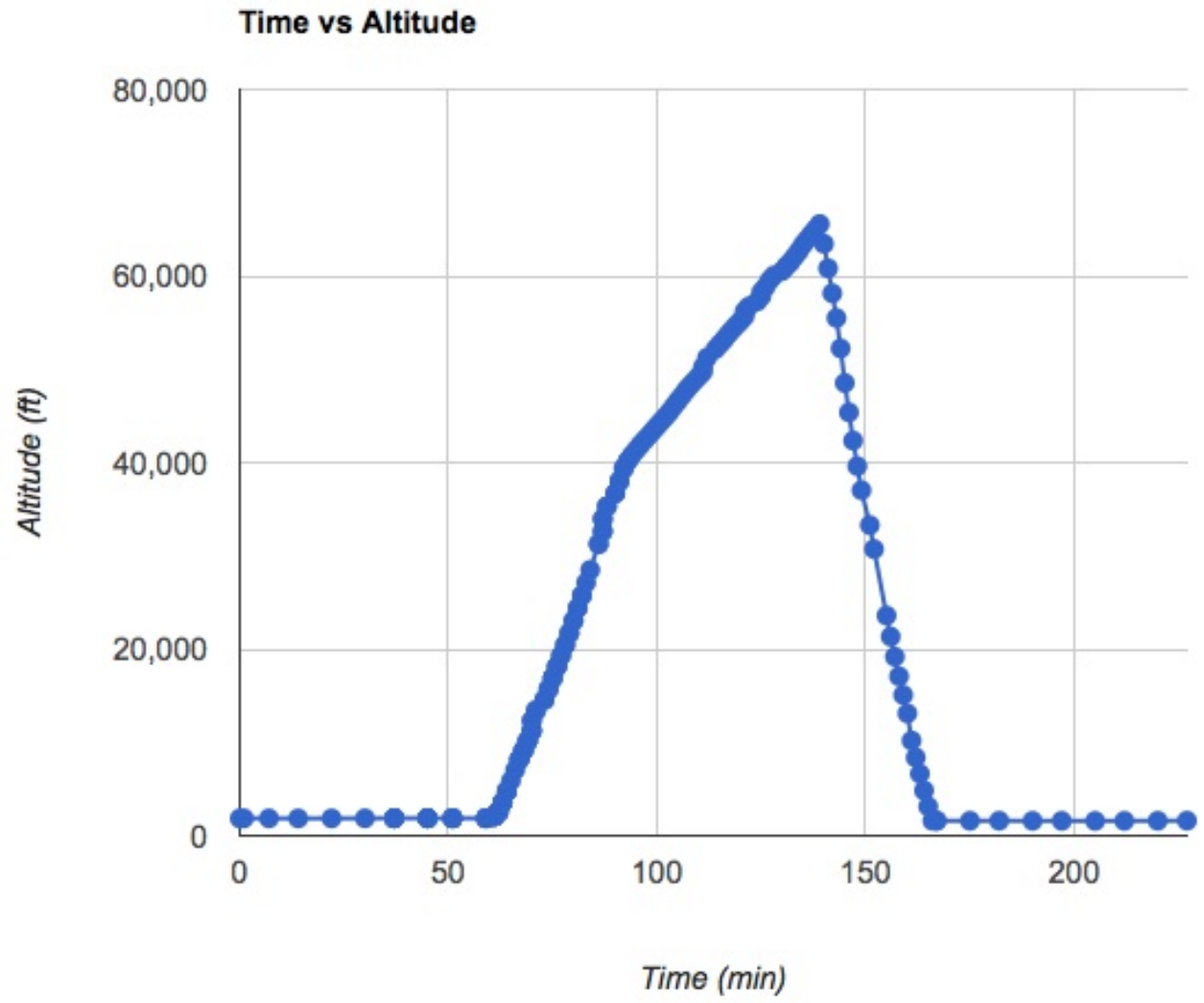
NASA Nebraska HAB

#StratoStar0149

NESPACE1

TURBULENCE: 0 GS/MIN

TEMPERATURE: 89.6° F



- TIME
- ALTITUDE

MISSION TIME:
03:47
HRS MIN

- ALTITUDE
- TEMPERATURE
- HUMIDITY
- SPEED
- VERTICAL RATE
- PRESSURE
- HEADING
- SPIN RATE
- BATTERY
- TURBULENCE

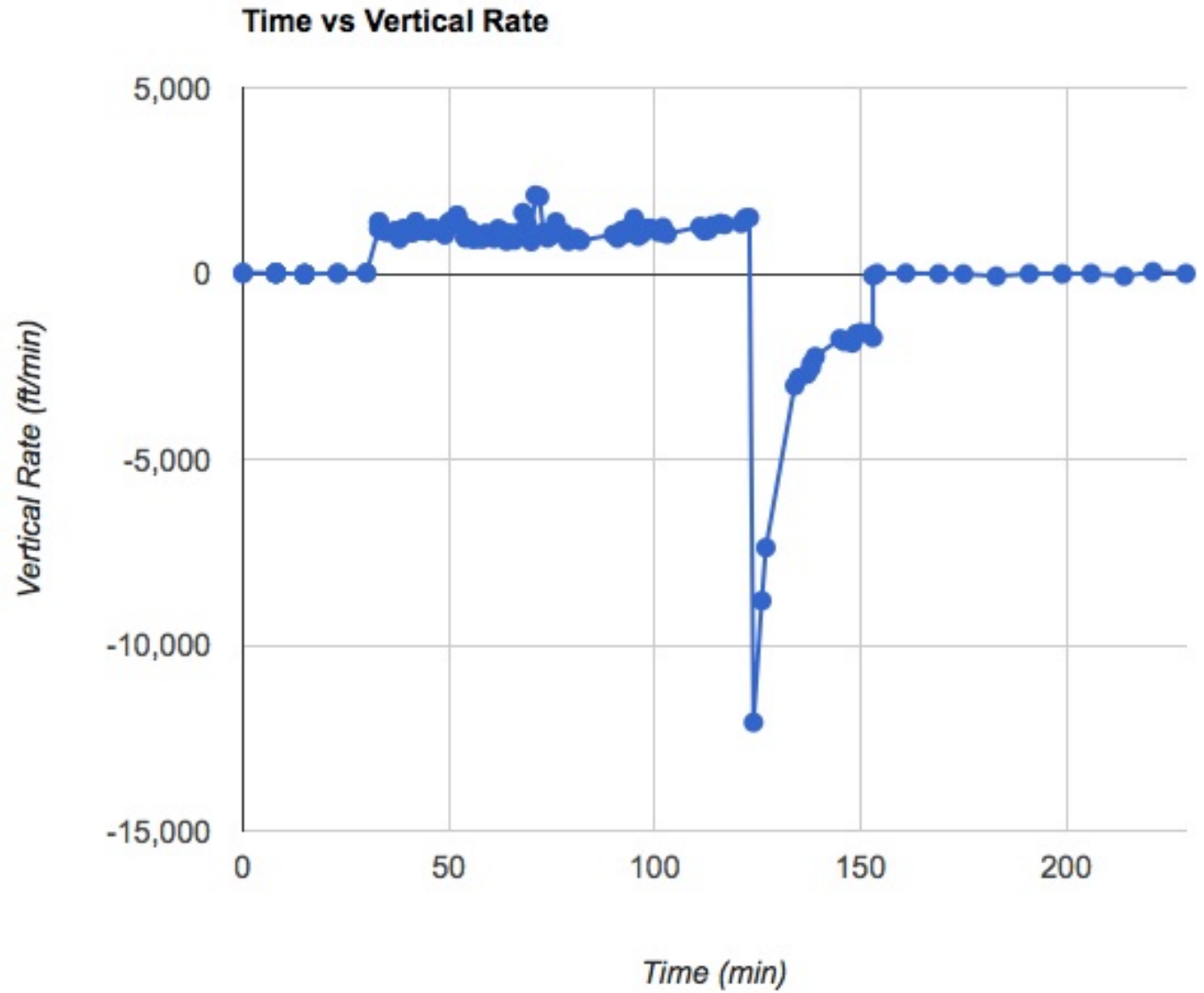
OPS

#StratoStar0164

OPS 1

TIME: 20:40:33 2017-08-21 UTC

SPEED: 0 MPH



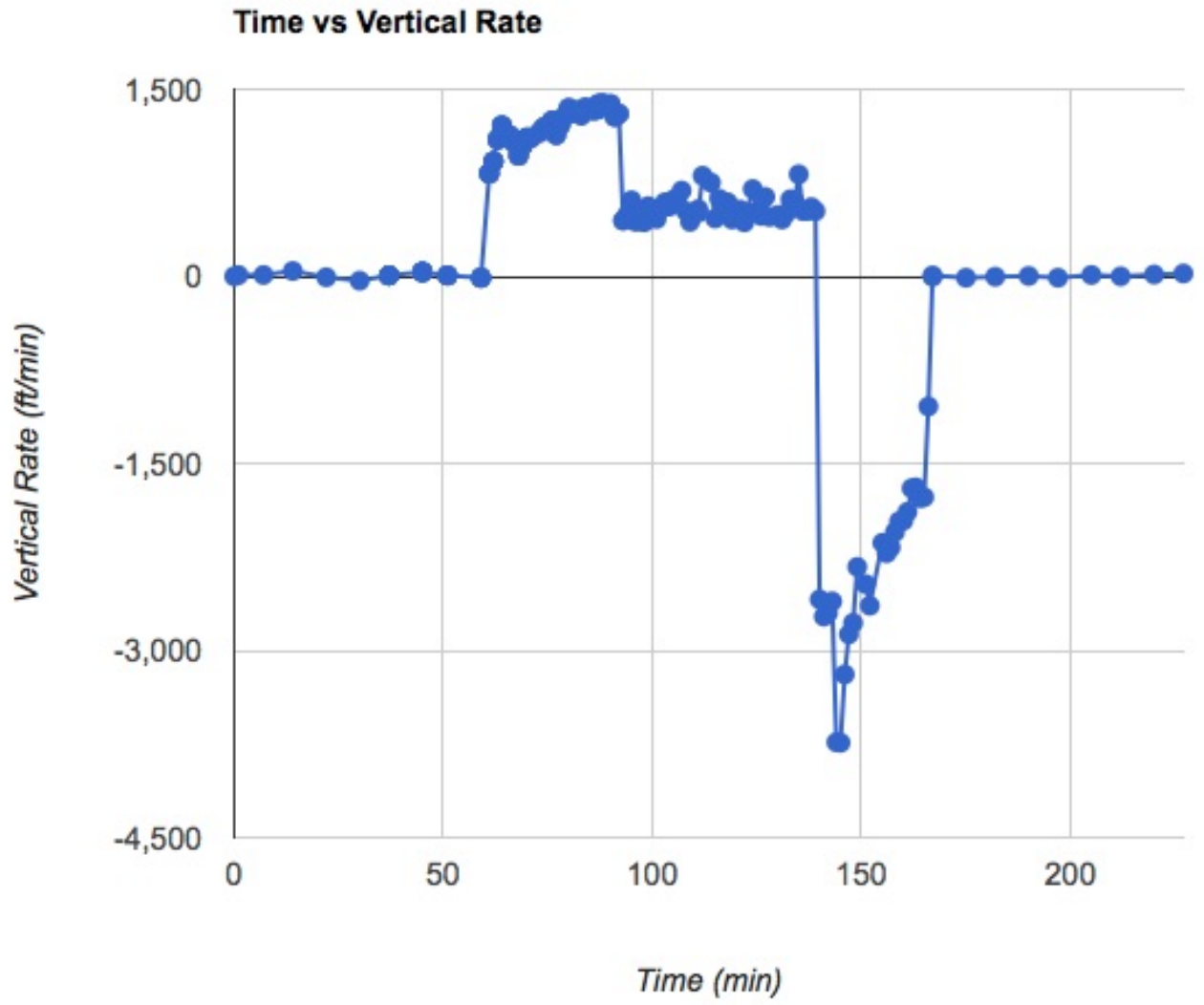
NASA Nebraska HAB

#StratoStar0149

NESPACE1

HEADING: 135.4°

VERTICAL RATE: 23 FT/MIN



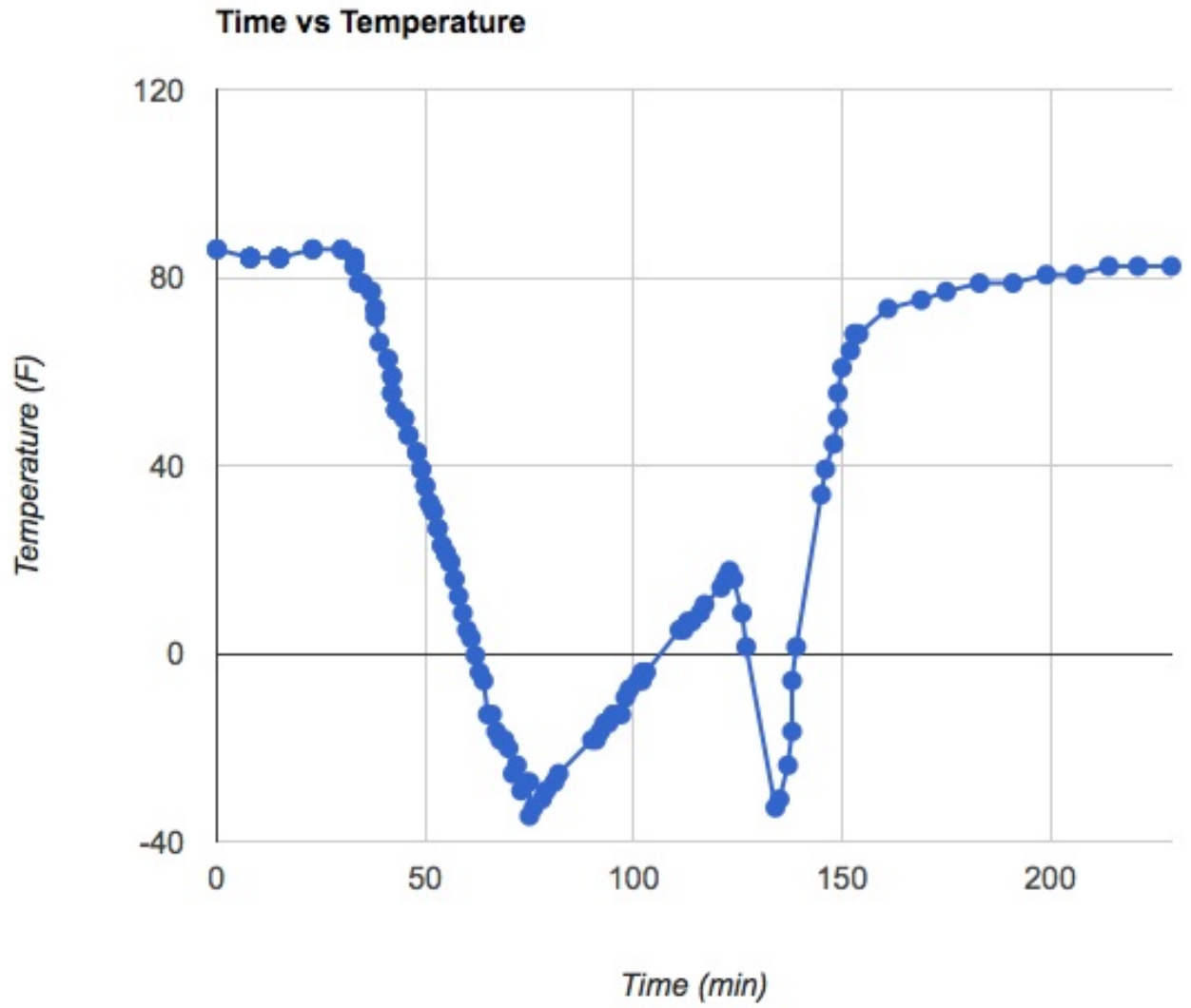
OPS

#StratoStar0164

OPS 1

FOLLOWERS: 651

LATITUDE: 41.11475°



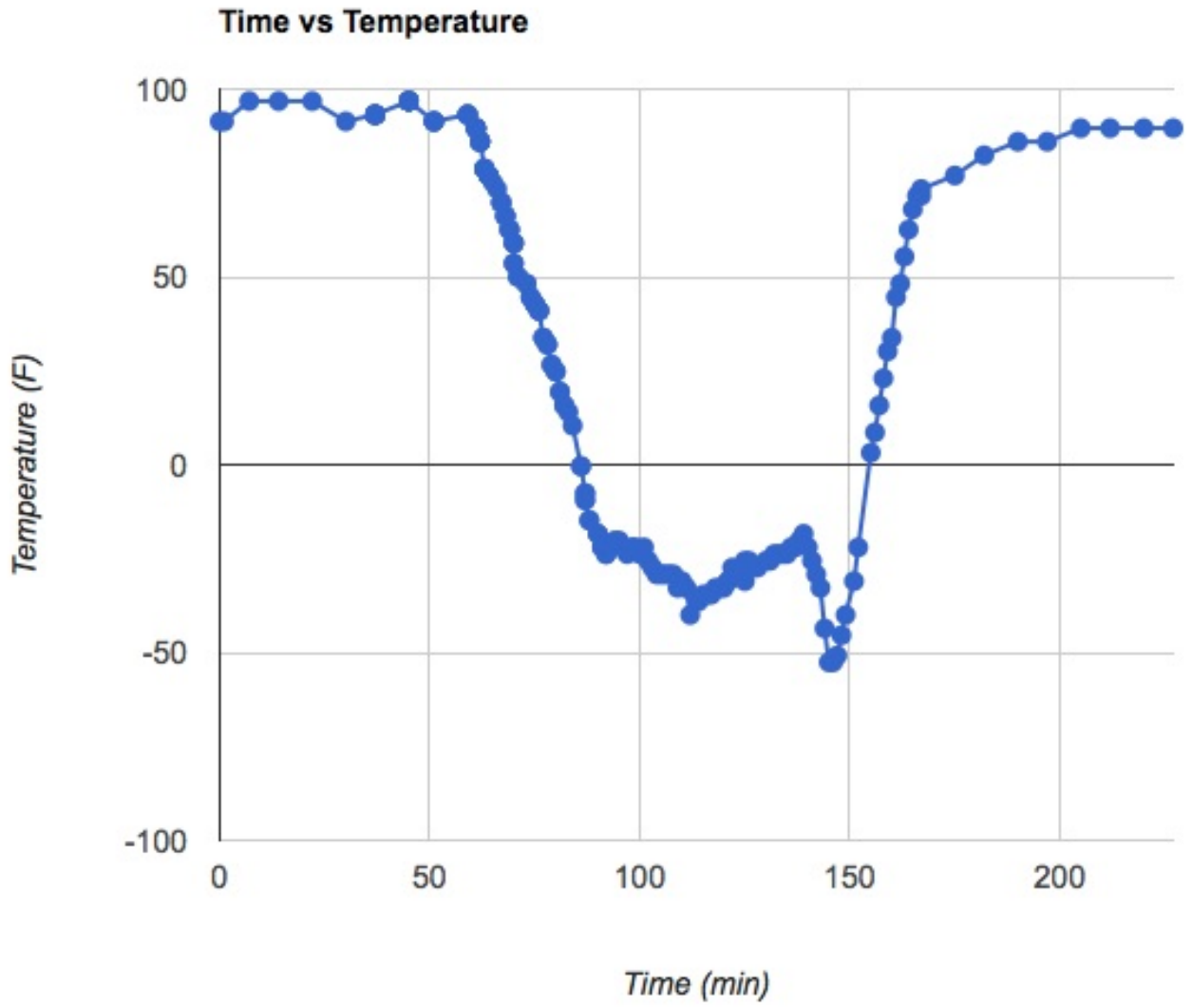
NASA Nebraska HAB

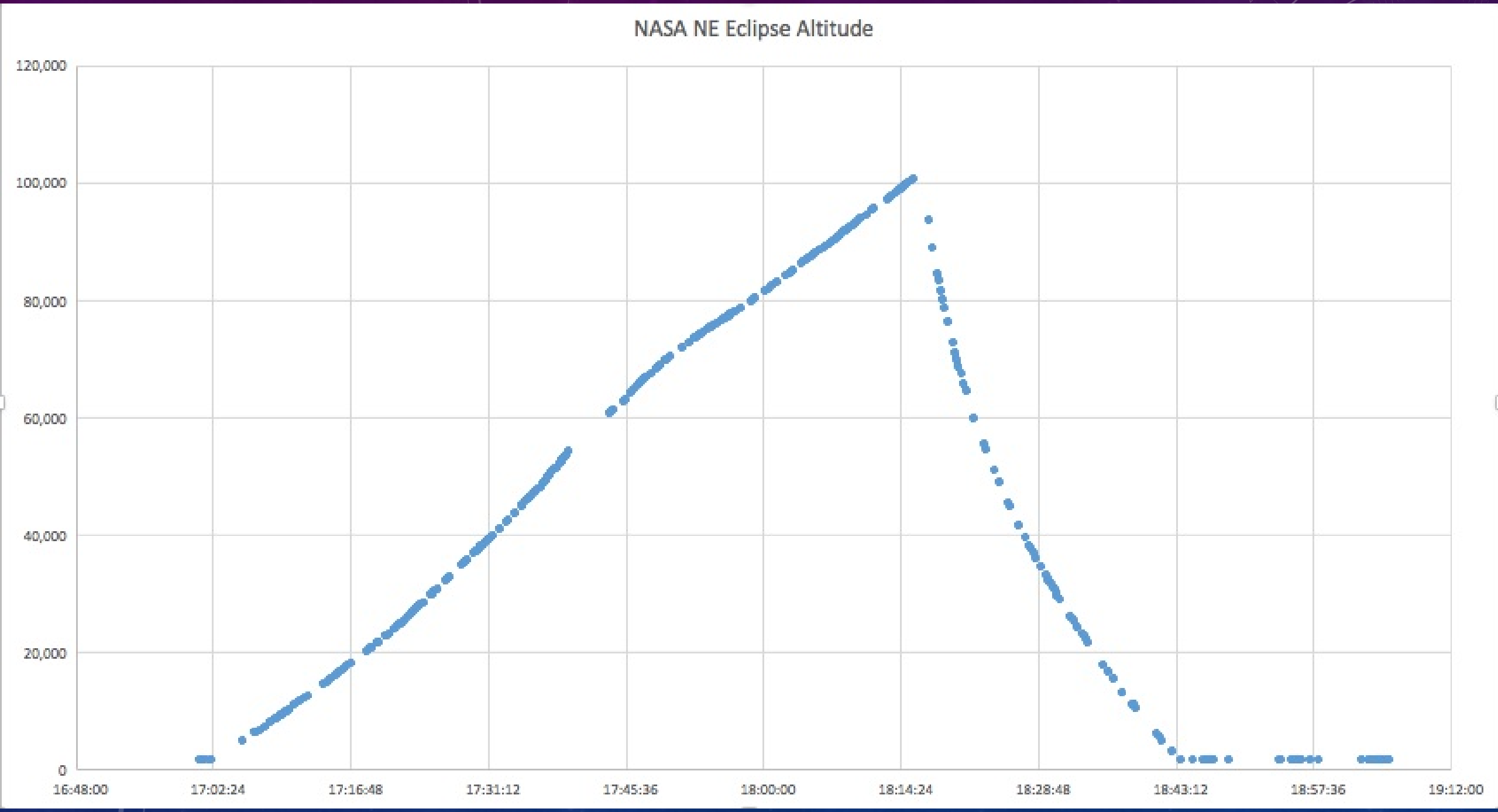
#StratoStar0149

NESPACE1

TEMPERATURE: 89.6° F

PRESSURE: 13.88PSI




NASA NE Eclipse Altitude
120,000
100,000
80,000
60,000
40,000
20,000
0
16:48:00
17:02:24
17:16:48
17:31:12
17:45:36
18:00:00
18:14:24
18:28:48
18:43:12
18:57:36
19:12:00

62 IRIDIUM PAYLOADS RECORDED ON 8/21/17

- 3 – No flight
- 4 – Flights less than 32,000 ft.
- 1 – Data missing above 60,000 ft.

OUT OF THE REMAINING 54 FLIGHTS

- 20 – No knee in ascent graph (37%)
- 24 – Slight knee in ascent graph (44%)
- 10 – Pronounced knee in ascent graph (19%)

- Combined slight knee and pronounced knee (63%)

EXAMINING THE PRONOUNCED KNEE PROFILES

State	Alt. of Knee (ft)	Time difference between Knee and Total Eclipse
Kentucky	60,000	1
Kentucky	44,813	9
Nebraska	42,264	23
Wyoming	44,170	6
Wyoming	44,570	54
Oregon	45,755	7
Tennessee	58,953	13
Nebraska	53,104	12
Idaho	53,761	10
Illinois	45,427	53
Nebraska	59,841	8
	Average Knee	Average time (min.)
	50,242	17.8

EXAMINING THE SLIGHT KNEE PROFILES

State	Alt. of Knee (ft)	Difference between Knee and Total Eclipse
Tennessee	51,355	22
Tennessee	55,620	4
Oregon	61,818	30
Nebraska	66,280	11
South Carolir	59,836	9
Tennessee	60,082	27
Missouri	61,677	12
South Carolir	58,619	11
Tennessee	59,524	-19
Kentucky	58,684	-22
Kentucky	57,306	2
Kentucky	58,192	7
Kentucky	85,474	27
Wyoming	35,541	33
Illinois	51,437	48
Nebraska	55,354	32
	Average	Average time
	58,550	14.6

43 IRIDIUM PAYLOADS RECORDED ON 6/20/17

- 23 – No flight
- 2 – Burst early
- 18 – Successful flights

OUT OF THOSE 18 FLIGHTS

- 15 – No knee in ascent graph (83%)
- 3 – Slight knee in ascent graph (17%)
- 0 – Pronounced knee in ascent graph (0%)

- Combined slight knee and pronounced knee (17%)

COMPARING DRESS REHEARSAL VS. ECLIPSE DAY

- On 7/20/17, 17% of ascents had slight knee ascent graphs.
- On Eclipse Day 8/21/17, 63% of ascents had slight or pronounced knee ascent graphs.

FROM A LITERATURE REVIEW

- Modeling the ascent of sounding balloons: derivation of the vertical air motion by Gallice et al. Atmos. Meas. Tech. 4, 2011
  - Uses modeling with buoyancy, drag on a spheroid, adiabatic expansion, heat diffusion inside the balloon, the balloon effective radius and recorded values from experimental flights.
  - They model a small decrease in ascent around the troposphere from about 6 m/s to 5 m/s. Our balloon dropped from 6 m/s to 2.5 m/s.
  - This only includes data from night flights and mentions that solar radiation has a strong impact on balloon temperatures and applications to daytime soundings calls for a further study.

FROM A LITERATURE REVIEW

- Simulation of the 21 August 2017 Solar Eclipse Using the Whole Atmosphere Community Climate Model-eXtended, McInerney et al. , Geophysical Research Letters, May 2018
  - Used computer modeling of entire atmosphere with masking light during eclipse and produced global temperature changes throughout vertical structure.

FROM A LITERATURE REVIEW

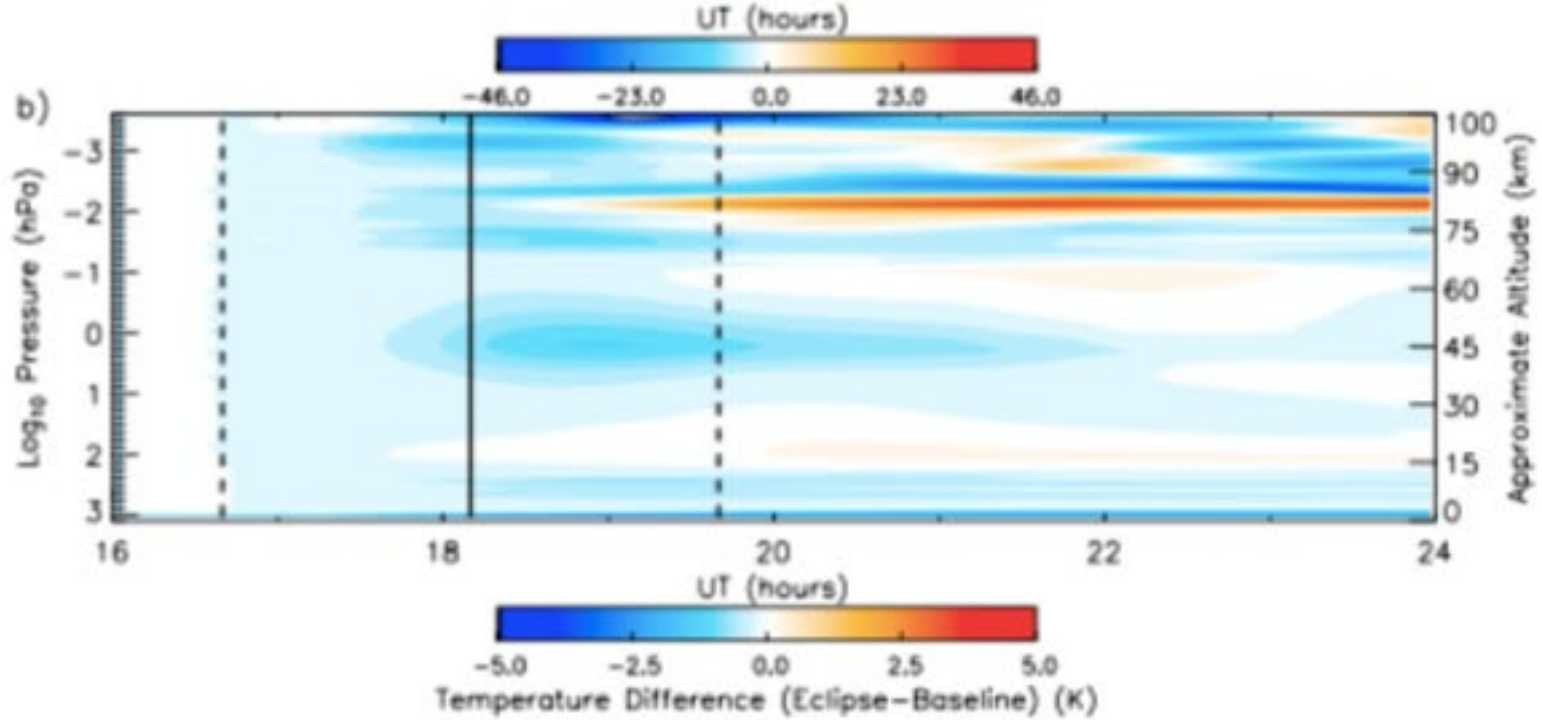


Figure 2. Temperature differences between the eclipse and baseline simulations as a function of UT and altitude at a latitude of 38.8° north and a longitude of 95.0° west. (a) Entire model vertical range up to 600 km. (b) Surface to 100 km only. The dashed vertical lines denote the start and end of the eclipse, and the solid vertical lines indicate totality.

Geophysical Research Letters, May 2018

FROM A LITERATURE REVIEW

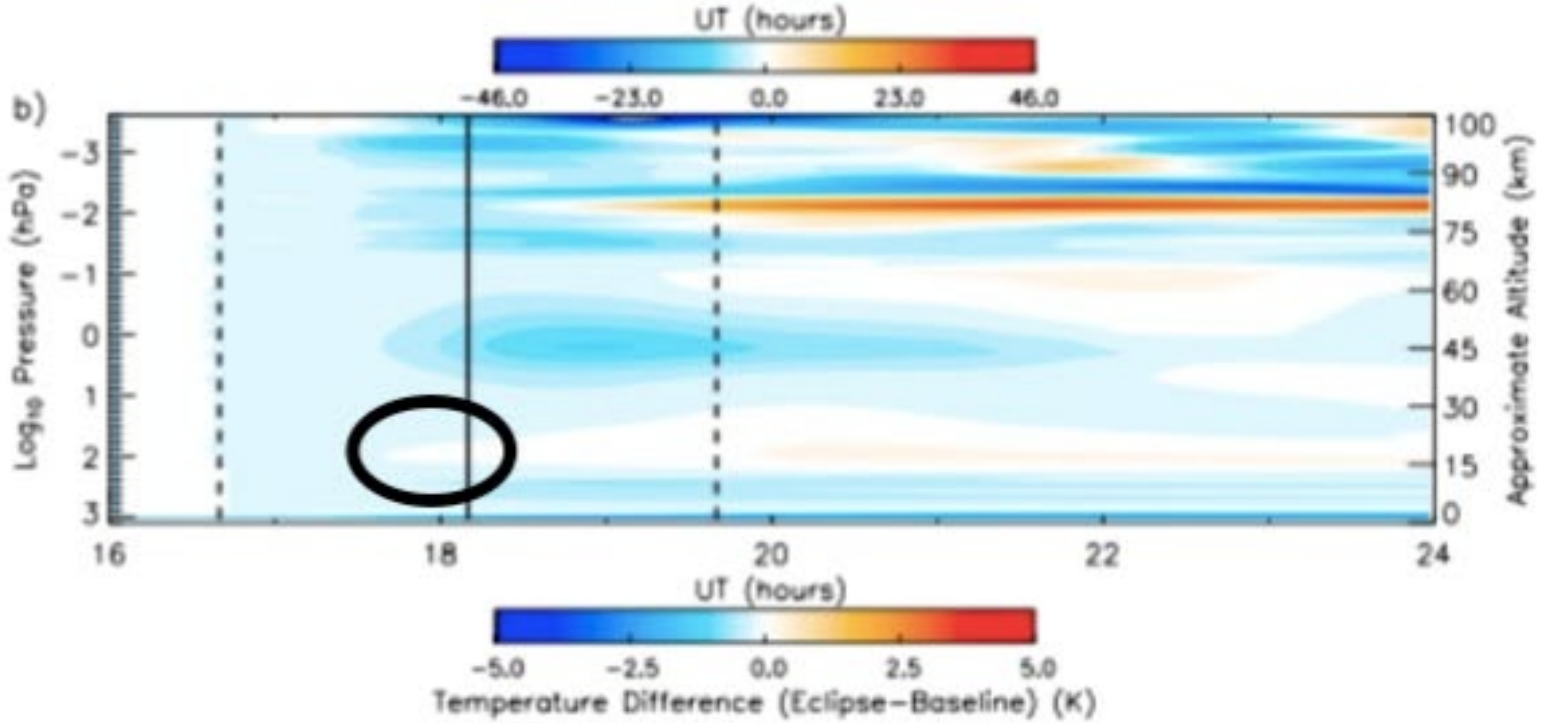


Figure 2. Temperature differences between the eclipse and baseline simulations as a function of UT and altitude at a latitude of 38.8° north and a longitude of 95.0° west. (a) Entire model vertical range up to 600 km. (b) Surface to 100 km only. The dashed vertical lines denote the start and end of the eclipse, and the solid vertical lines indicate totality.

Geophysical Research Letters, May 2018

So, now what?

The next Total Solar Eclipse is on April 8th, 2024

POTENTIAL FURTHER STUDIES

- We predict that the majority of balloon flights in totality during the 2024 eclipse will experience a slowing in the troposphere.
- If a nationwide ballooning study takes place again, we would request the sharing of ascent curves and temperature data if available.

POTENTIAL FURTHER STUDIES

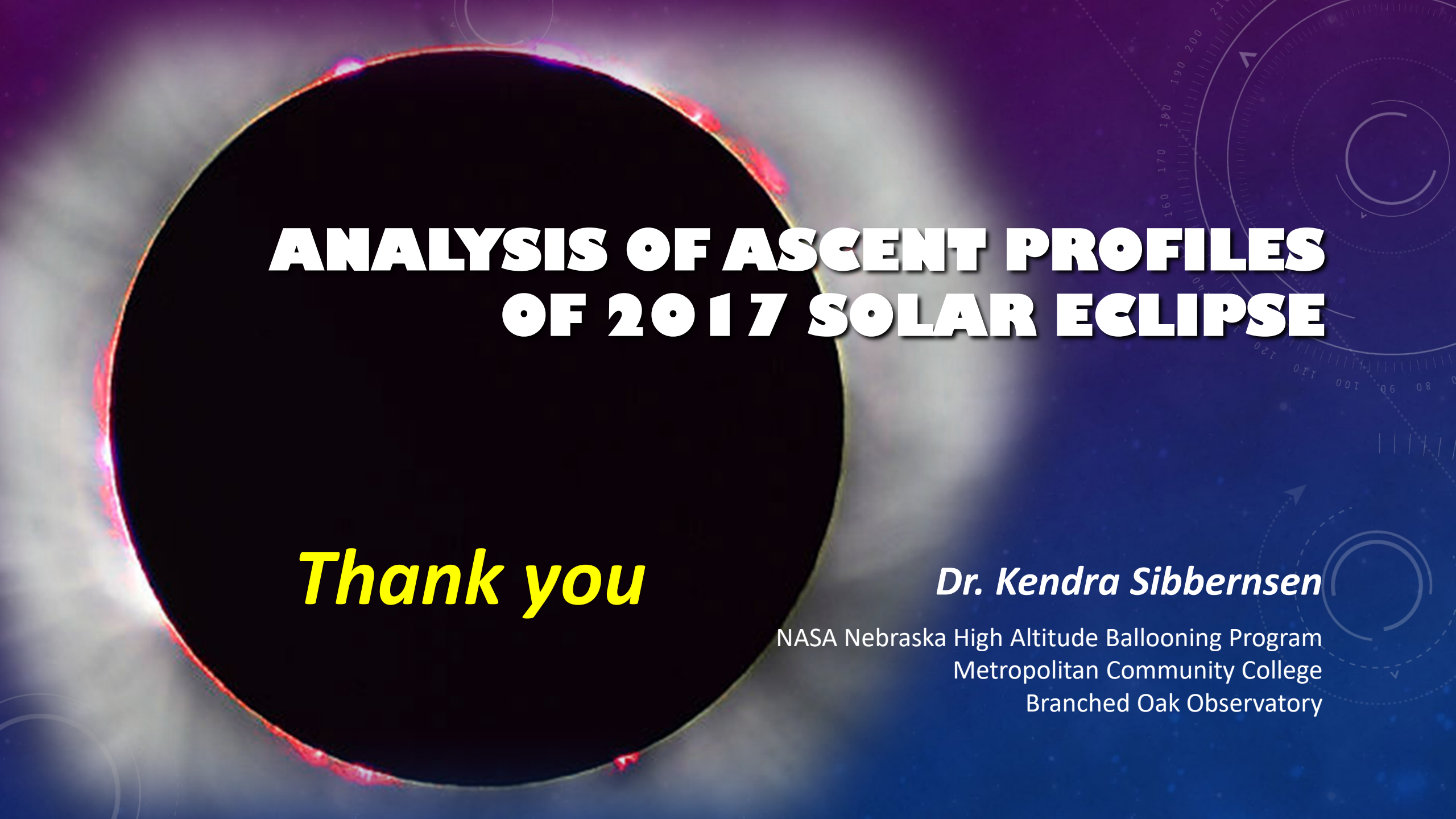
- Perform flights during sunrise or sunset to simulate the changes in brightness of the eclipse.
- Work with atmospheric researchers on better ascent models through the tropopause.

THANKS!

- NASA Science Mission Directorate
- NASA Nebraska Space Grant
- Angela Des Jardins and Montana State University Ballooning Group
- Stuhr Museum Staff
- Participating MCC Students
- OPS Ballooning Group and OPS Students

- For more information, go to: www.nearspacescience.com

or email: ksibb@cox.net



ANALYSIS OF ASCENT PROFILES OF 2017 SOLAR ECLIPSE

Thank you

Dr. Kendra Sibbernsen

NASA Nebraska High Altitude Ballooning Program
Metropolitan Community College
Branched Oak Observatory