Development of Sensor Payload to Record Atmospheric Changes During the 2023 and 2024 Eclipse

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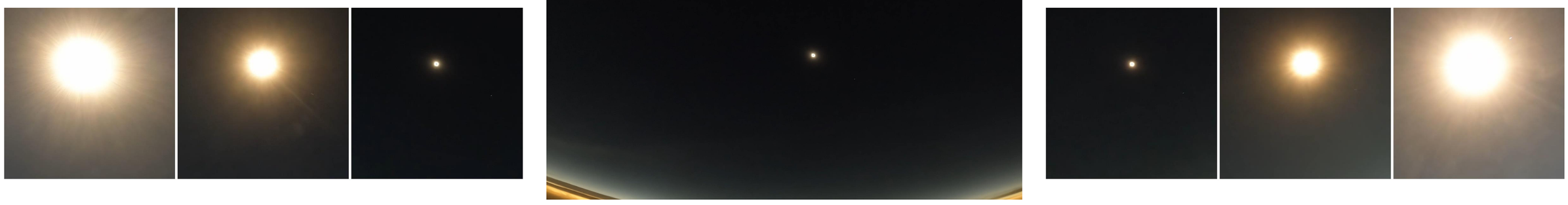


Motivation

NASA Nationwide Eclipse Ballooning Project (NEBP)

- Work with over 50 research teams from across the nation
- Further local community's engagement in STEM activities
- Southeast Atmospheric Science Pod: OSU, Okmulgee HS, and Gordon Cooper Technology Center Teams

Location: Broken Bow, OK

Heliotropes

What are heliotropes (solar balloons)?

- Light-weight, solar powered, relatively low-cost to build, require no lifting gas
- Zero-pressure balloon
- Float within the lower stratosphere (~ 20 km)

Objective

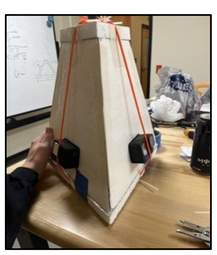
Develop payload that is attached to a solar balloon to record atmospheric changes of the eclipses

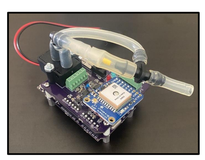
2023 Annular Eclipse

Payload Configuration

Upper Payload

- Adafruit BME280 (x2)
- SparkFun GPS Breakout
- GoPro HERO10 (x3)





GEM Sensor

Lower Payload

- GEM sensor that records infrasound , < 20 Hz

Launch Day (2023-10-14)

Attempted 2 launches (10 m tetrahedral balloon)

- Both failed

Solar Tetroon Test Balloon

Goal for 2024 Team

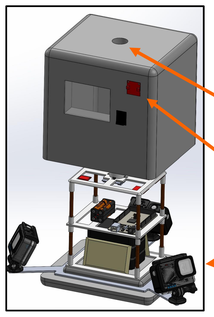
Redesign payload, reduce weight, incorporate pyranometer, and perform solar balloon test launches with payloads

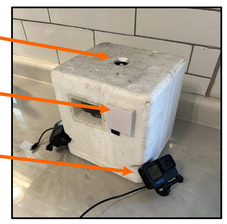
Final Configuration

Final Design

Upper Payload Improvements

- Added LI-COR LI200R Pyranometer (record solar radiation)
- Easily accessible and better organized interior
- Adjustable camera angles
- Smaller weight (allowed us to use a smaller)





Flight Line Weight

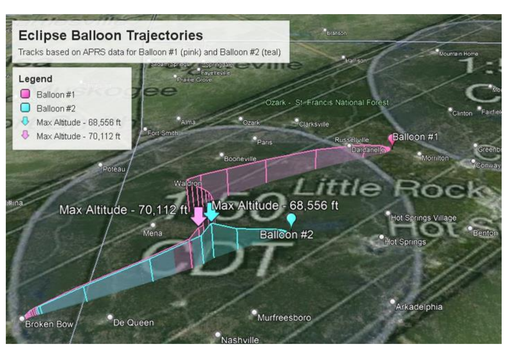
	Weight (kg)
Solar Balloon (7 m)	3.86
HAB Bounder	0.085
Parachute	0.017
SPOT Trace	0.0879
APRS	0.04
Upper Payload	1.704
Lower Payload	0.7
Paracord (~ 30 m)	0.2
Fishing Swivels (x6)	0.036
Total	**6.73**

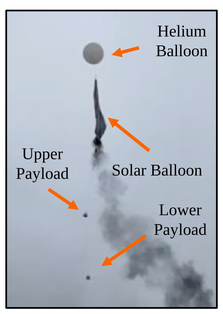
2024 Total Eclipse

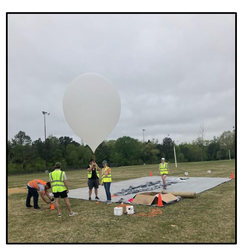
Launch Day (2024-04-08)

Grand Slammed 2 Solar Balloons

- Balloon #1 launched at 1500 UTC and reached float
  - Ripped just before eclipse totality at 1846 UTC
- Balloon #2 launched at 1620 UTC and failed after helium balloon burst







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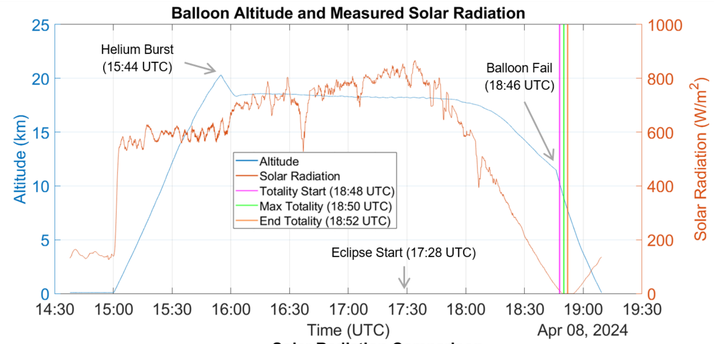
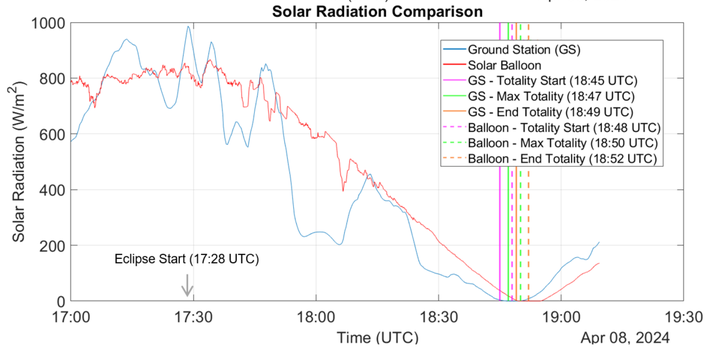
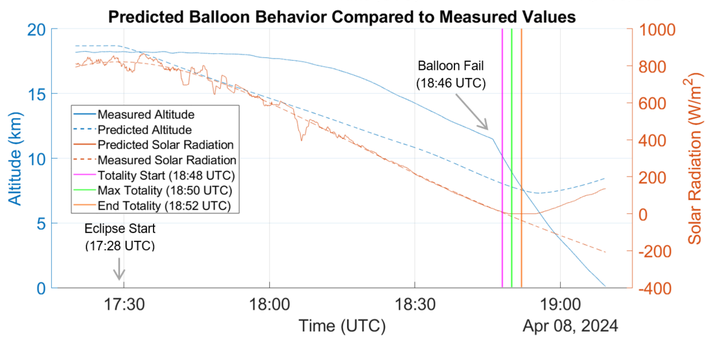
Results







Conclusions

1. The balloon's altitude will begin to decrease after solar radiation begins to decrease
2. There is a disconnect between the radiation model and expected altitude in the current solar balloon trajectory code.

Future Work

Conduct a freezer test to determine if the tape is causing the recent solar balloon failures and possibly launch new balloons based on these results. Continue analyzing the radiation model for the solar balloon trajectory code and modify if needed.