INTRODUCTION

On August 21st in 2017, the day of a transcendent total solar eclipse, the University of Maryland Balloon Program (UMDBP) carried out a special flight in Greenville, South Carolina. This flight carried sun-facing cameras and instrumentation with the intent of observing and documenting the eclipse from a high altitude. The flight launched from Williamistown, SC at 13:57 EDT, took 80 min to reach burst altitude, burst at 105 000 ft (approx. 32 000 m) altitude at 15:17 EDT, then spent 35 min descending, during which it reached maximum speed of 600 ft/sec. The balloon experienced totality at 14:38 - 14:41 EDT, and the payload string subsequently landed at 15:52 EDT, 24 km away from the launch site.

FLIGHT PROCEDURE

Ground tracks close to the center of the path of totality were preferred in order to capture a longer period of totality and to guarantee that the balloon experienced totality at a reasonable altitude. Trajectory predictions run at T-2 weeks suggested the balloon would follow a generally east-west path, permitting down-selection of launch sites. The eventual launch site was selected on the evening before the launch.

The target altitude for the balloon when the eclipse reached totality at 14:37 EDT was approximately between 60 000 ft (~ 18 000m) and 80 000 ft (~ 24 000 ft) giving a 15 min launch window. The main goal was for totality to be before balloon burst, thus ensuring that payloads were in a stable orientation while collecting data. Lower altitude was preferable to burst starting. Although inflation started 1 hr before launch, the balloon launched at 13:57 EDT, 5 min after the end of the original launch window. This resulted in the balloon being slightly below targeted altitude.

PAYLOAD OVERVIEW

Tracking

Enables tracking of balloon flight path via small aerial and ground stations.

The onboard system also includes a backup cell tracker.

Sespa

Solar Eclipse Solar Power Analyzer

Designed to analyze net coronal power output in visible light and measure eclipse progress by tracking voltages generated by lightweight solar panels.

IRENE

Ionizing Radiation Exposure Neespace Experiment

A small, cylindrical, full metal Geiger-Müller tube detector sensitive to 0.1 ionization events intended to measure the photometer maximum in the upper atmosphere.

LEOPARD

Lightweight Eclipse Observing Payload (AEOP) Determination

Designed to measure ambient light intensity during eclipse using photodiode based sensors. Specific sensors TAOG TSL2561 lux sensor, TCS54175 color sensor, and SI Labs S1143 UV index and light sensor.

Panoramic

Comprised of two Samsung Gear 360° cameras housed in insulating foam that captured panoramic video of launch ascent, totality, and balloon burst.

TIMELINE

T-2 weeks

Preliminary ground tracks and launch site considerations based on predicted flight path direction.

T-4 days

Potential launch locations narrowed down to five Anderson County schools, received permission from two schools to launch on their property.

T-24 hrs

Launch location selected, Palmetto High School, Williamistown, SC.

T-4 hrs

Team arrives at the launch site and begins preliminary setup.

T-1 hr

Inflation begins.

T-41 min

The balloon experiences eclipse totality from 14:38 - 14:41 EDT.

T-0

Launch at 13:57 EDT.

T+2 hrs

Payload string landed in a field 21.5 km away from the launch site, at 15:52 EDT, and was recovered successfully.

RESULTS

ATOMIC

The bacteria were re-cultured in liquid media, and cryogenic stocks were preserved for further study. Qualitative observation of the bacterial morphology and colony sizes over time did not indicate any significant change from the control, although genetic sequencing will be necessary in order to ascertain the presence or absence of mutations in flight vs control samples.

LEOPARD

Both the TSL and TCS saturated before the eclipse ended, and the S1435 failed to function properly so it is not meaningful to quantify the rates at which the available light changed. Nonetheless, the valid sensor data indicated a marked decrease in available light in throughout the visible and infrared bands near totality.

ACKNOWLEDGEMENTS

The authors would like to thank Dr. Mary Bowen for her leadership and guidance with the UMDBP Payload Program. The authors would also like to thank the UMC Office of Engineering for funding travel and materials for this flight. The Maryland Space Grant Consortium for funding the UMBL Balloon Payload Program since its inception. Kevin Olszewski for his insights in calculating ionization events and permission to use his graphics. Michael Walker for writing the section on IRENE, and Ashay Hermon and Michael Schiavone for writing the section on SEPSA.

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