



NATIONWIDE ECLIPSE BALLOONING PROJECT: VIRGINIA TECH TEAM

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Abstract

Virginia Tech's NEBP Team embarked on a remarkable journey to live-stream the April 2024 Total Solar Eclipse from the edge of space. Led by the mentors and students, meticulous preparations were made to manage the fill team, payload logistics, flight string, and flight directing. The abstract presents an overview of the team's preparations, challenges faced, and lessons learned during the project. Through numerous launches, the team honed their skills and perfected launch procedures. As the fateful day approached, anticipation peaked as the team readied for the eclipse expedition. Despite challenges posed by windy conditions, the team successfully launched both balloons with numerous payloads, adhering to the timeline meticulously. While having a successful launch, the team encountered a technical issue, the team encountered a technical issue with streaming video due to a power connector failure and proposes strategies for mitigation in future projects. Ultimately, the presentation aims to provide insights into the team's experience and contribute to the broader discussion on eclipse observation and space-based projects, highlighting the overall team performance and invaluable lessons learned.

Introduction

The Nationwide Eclipse Ballooning Project (NEBP) is a collaborative effort led by NASA to increase student participation in eclipse observation through scientific ballooning. The process involves using a weather balloon filled with helium to carry payloads into the stratosphere, providing a cost-effective platform for scientific research and education. Virginia Tech assembled a team of students and faculty who actively participated in the engineering track, focusing on planning, and innovative solutions, to capture the April 2024 Total Solar Eclipse from the edge of space.

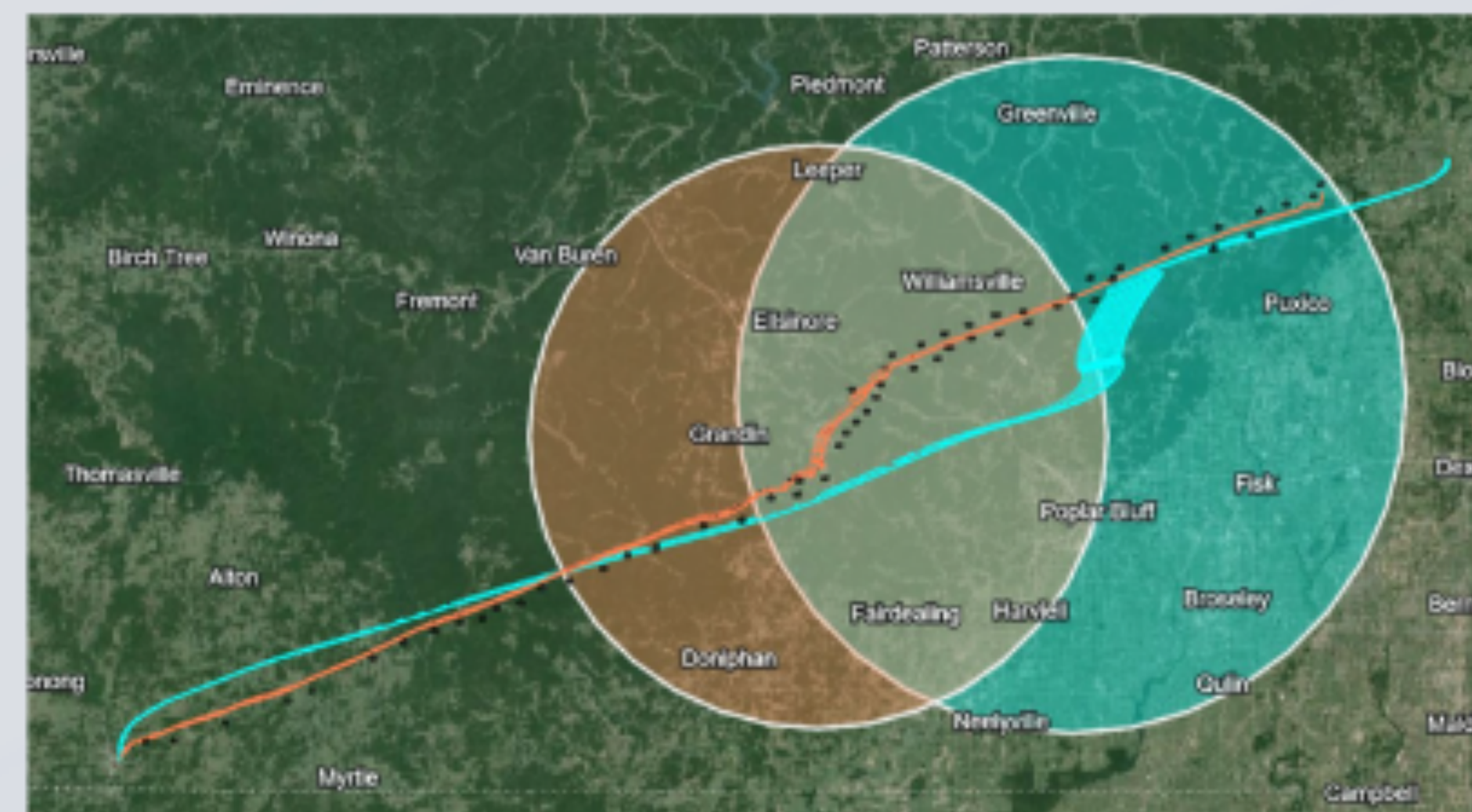
Ballooning Teams

Virginia Tech's engineering team is comprised of several smaller teams working on different stages of the project, including planning, building, testing, flight, and data collection. The **Systems Engineering Team** consists of a group of students who are in charge of overall planning for all the project stages. They coordinate with all payload teams, predictions, flight coordination, flight string assembly, and flight directing, ensuring that all aspects of the mission align with the project's objectives and timeline. The **Fill Team** manages the balloon-filling process, ensuring that helium-filled balloons are properly inflated and prepared for flight. They monitor gas levels, weather conditions, and safety protocols for a successful launch. The **Payloads Team** comprises students tasked with designing, building, and testing various payloads aimed to collect data and conduct experiments during the flight. Their work enhances the scientific value of missions and provides insights into atmospheric science, astronomy, and environmental monitoring. **Ground Station** is responsible for setting up and operating the ground-based communication and tracking systems. They establish communication with specific payloads during flight, monitor their trajectory, and facilitate data transmission and reception, especially for live streaming.



20 VT undergraduate students and the two mentors were joined by 3 WCU students and a mentor for the Eclipse launch from Thayer, Missouri for the April 8 Total Eclipse.

Flight Prediction



F1. Predicted flight path and corresponding Ubiquiti radio range in *teal*. The launch is expected to be very windy with gusts between 15-25mph. Hence, the days leading up to the launch were filled with windy fills and horizontal launch practice with smaller balloon.

Launch

The team assembled in Thayer Senior High School at 9:30 AM CDT to begin their set-up for an exciting double eclipse launch. The team reviewed the familiar timeline before separating into groups. The fill team began setting up right away as the winds picked up. Meanwhile, 4 flight directors and students prepared the flight string, parachute, and payloads. The Ground Station was set up in Poplar Bluff's Three Rivers College. The entire launch was live-streamed on the group's YouTube page as the team worked to keep the balloons safe in windy conditions.

The two different balloons and flight strings were named NEBP and VT, corresponding to the majority of the payloads being sent by NEBP or designed by VT students. Each flight string consisted of 9 payloads. The NEBP flight string weighed 11.97 lbs, and the Kaymont 2000 balloon was filled with 18.5 lbs of helium. The VT flight string weighed 11.6 lbs, and the balloon was filled with approximately 18 lbs of helium.

At 12:05 PM CDT, all the payloads in the VT flight string were moved from the shade to start attaching them with zip ties and duct tape. Two groups of students managed both balloons, and when the time came one of the flight directors attached the flight string and balloons. The VT had a hand-over-hand launch at 12:34 PM CDT, one minute before the planned launch. The NEBP flight string and balloon were set up almost right away and horizontally launched on the dot at 12:50 PM CDT.



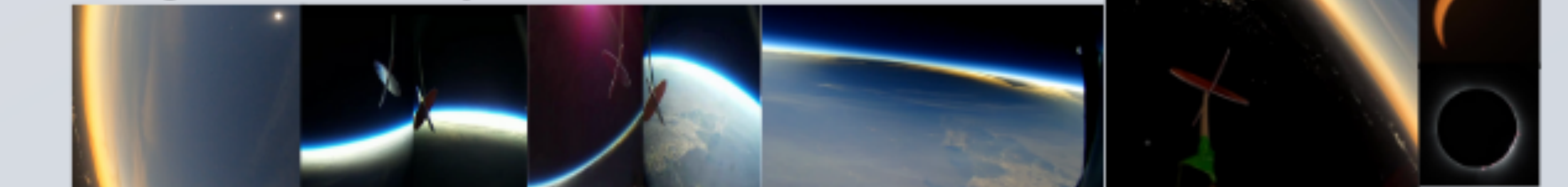
Recovery

Due to the unusual wind pattern, the balloons landed in Mingo National Wildlife Refuge. The actual flight path is marked in orange, while the predicted path is in teal in **F1**. The team split into two groups to recover the NEBP and VT balloons. The NEBP flight string was partly on land and mostly in the marsh. Thanks to the styrofoam payload boxes, everything was safely recovered. However, the VT balloon could not be retrieved on the day of the launch and had to be canoed to the next morning. Some of the payloads were submerged in the marsh and rain, while others were on land.



Results

The NEBP Balloon was at approximately 89kft during the eclipse and burst at 99,366.9ft. The VT balloon was descending during the eclipse and burst at a record low of 73731ft. Almost all the payloads gathered a significant amount of scientific data and recorded the entire flight and eclipse from multiple cameras. However, due to technical issues, we were unable to live-stream the eclipse during the flight. The payload boxes, made of cardboard submerged in the marsh and rain overnight, were destroyed.



Conclusion

The Virginia Tech team's participation in the NEBP proved to be a rewarding experience. Despite the challenge of video streaming, we achieved several key goals such as successfully launching two balloons, recording the total eclipse at a certain altitude, and collecting valuable eclipse data contributing to the project's success. Despite the weather conditions during launch, changes in the flight path, and challenging recovery, the team flexibly adapted to the issues at hand, fostering problem-solving skills, and a deeper understanding of high-altitude ballooning. The invaluable lessons learned will continuously be used for future High Altitude Ballooning.

Acknowledgements

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