2024 Solar Eclipse HIGH-ALTITUDE BALLOON
Flight Delta

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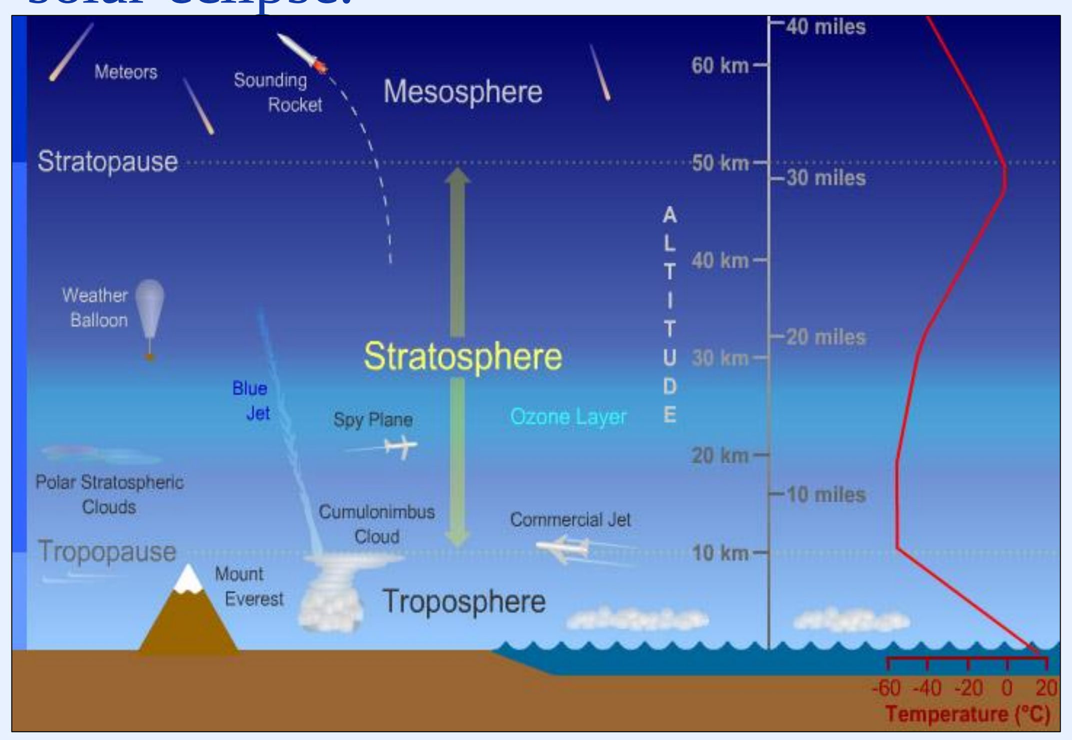
High-Altitude Balloon (HAB)

The balloon is designed to carry a payload up to the stratosphere (100,000 feet), tracked by GPS, and will descend with a parachute. Our project aims to record atmospheric data during the 2024 total solar eclipse.



Balloon travels up to the stratosphere (19 miles), beyond the ozone layer

NASA's 2015 student HAB launch

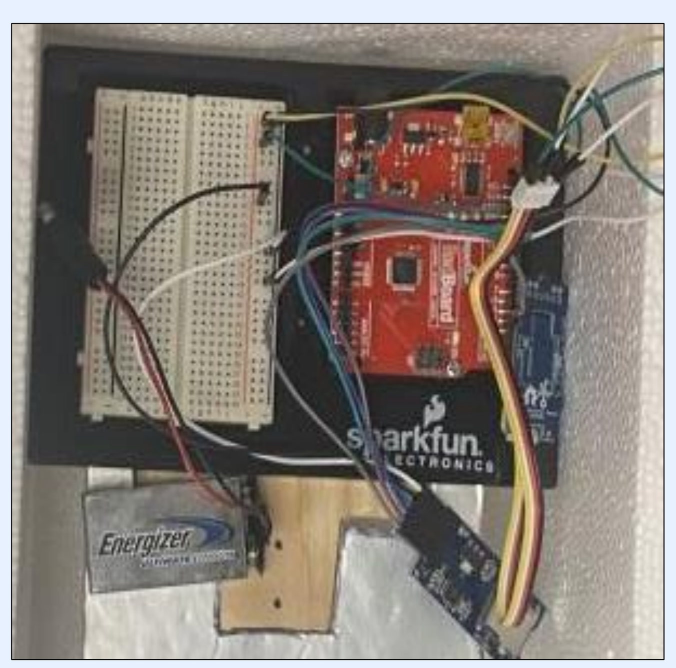
GPS Mapping

Using a SPOT Gen 3 GPS, the balloon trajectory can be tracked, allowing us to estimate its flight path and landing location. QGIS software is used to map the location data and investigate any impacts of the solar eclipse on the path of the balloon.

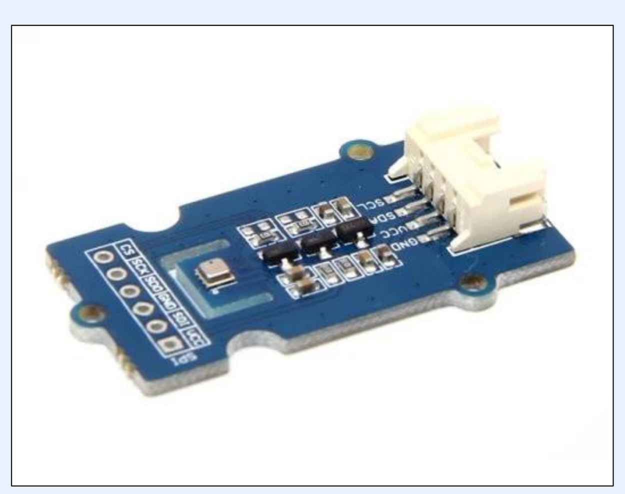
SPOT Gen 3 GPS. Provides live location every 2.5 minutes

Arduino Board

Programmed a SparkFun Arduino Uno Board, utilizing Java, to collect and write data attained from the Grove BME280 sensor into an SD card. Will utilize this sensor's data to calculate atmospheric variables listed on the right half of the poster.



Arduino sensor board in Styrofoam payload



BME 280 sensor tracks altitude, temperature, humidity, and pressure

Structures

To stabilize the payload of our balloon, a system of wind sails and swivels will be utilized. By catching the wind in these sails, the pendulum motion of the balloon is prevented, allowing for better camera footage of the flight.

3D-printed rod connector

3D-printed stabilization ring

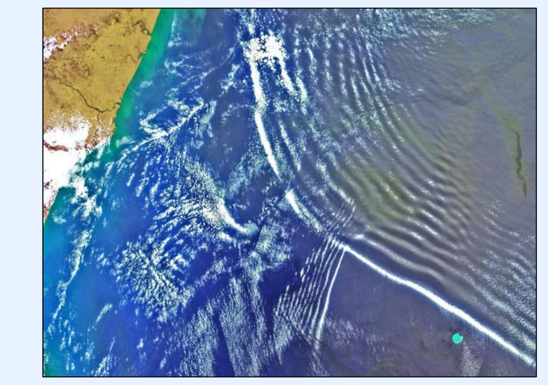
Model of HAB structure

Wind Speed and Direction

A total solar eclipse produces a blockage of sunlight resulting in a temporary disruption of the local winds. Using the coordinate and altitude data from the GPS, the wind speed and direction at each point measured are calculated using a Python script.

Gravity Waves

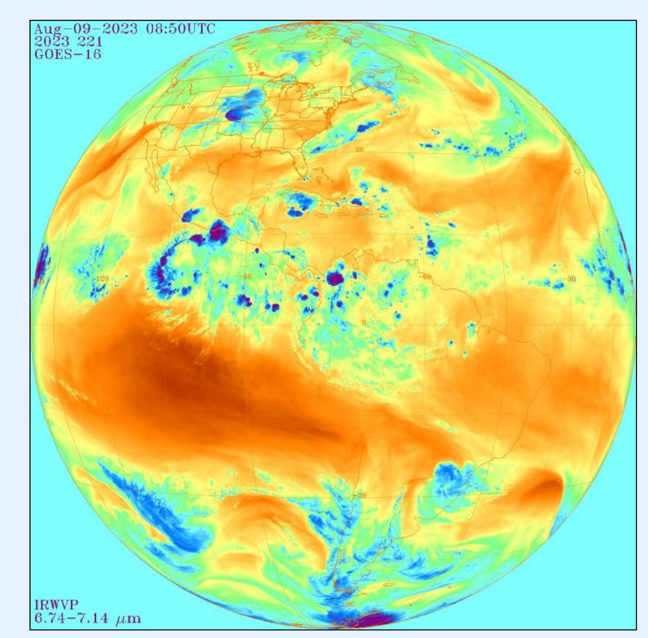
Rapid and uneven cooling of the atmosphere during a total solar eclipse causes pressure differences as seen by the ideal gas law. Waves of pressure emanate through the atmosphere, detectable with a pressure sensor. Each eclipse has waves with differing properties.



Gravity waves in the Mozambique Channel

Atmospheric Water Vapor

Solar eclipses can change the concentration of water vapor, Earth's most abundant greenhouse gas, in the atmosphere. Water vapor is also responsible for about half of Earth's greenhouse effect, which is why understanding how such phenomena impact our atmosphere is crucial for enhancing our knowledge of climatic variations.

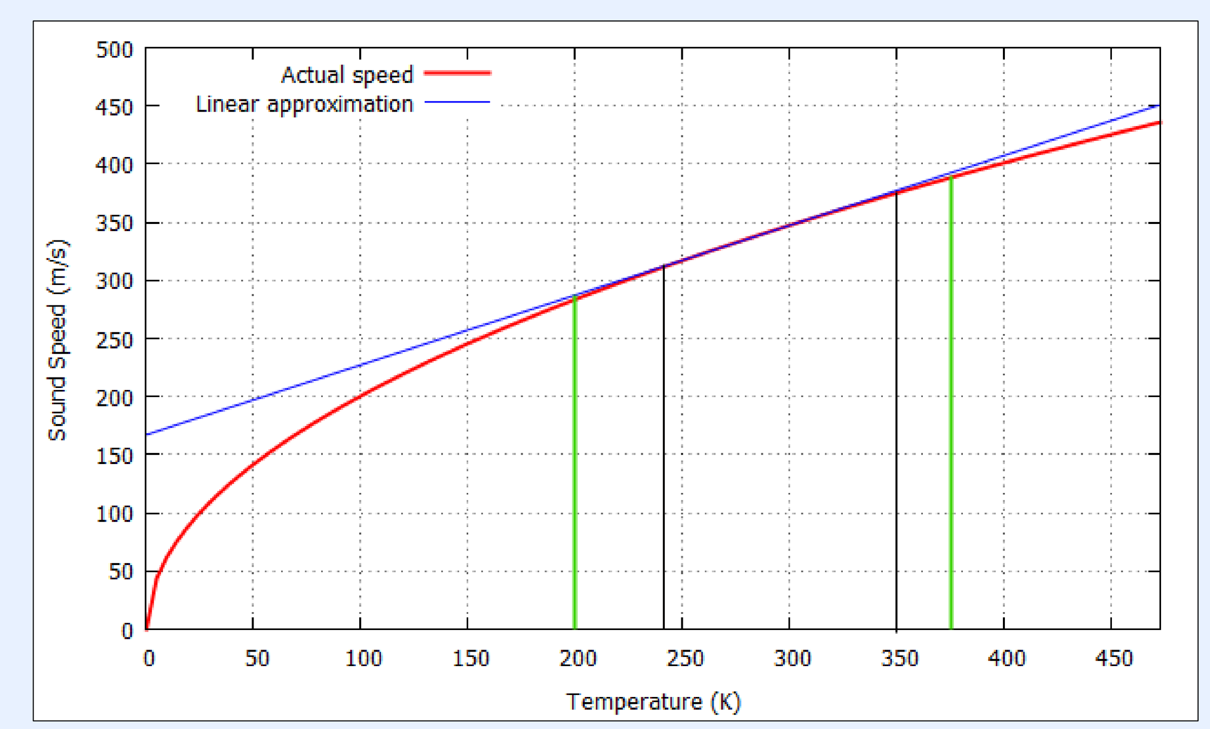


GOES-16 mid-level water vapor observation

Speed of Sound

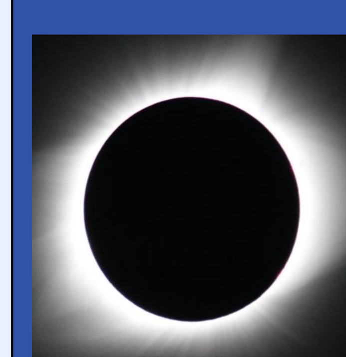
As a solar eclipse decreases heat radiation exposure on Earth, temperatures in the atmosphere drop. Consequently, the speed of sound decreases, dependent on temperature.

Speed of sound = sqrt(γRT)
Constants γ (ratio of specific heats) and R (gas constant)



Speed of Sound vs Temperature Graph

Acknowledgements & Additional Info



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