Field Test of Altitude-Controlled Stratospheric Ozonesonde Flight with Vented Balloon during the 2024 Total Solar Eclipse

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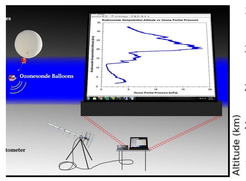
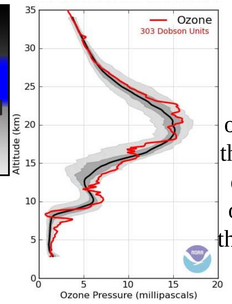
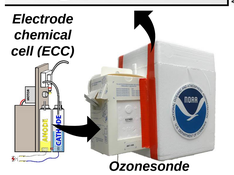
Background



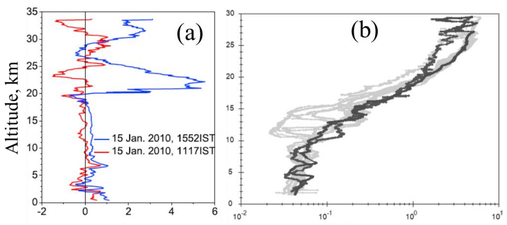


Ozonesondes are used to monitor the ozone levels in the atmosphere, especially the ozone layer in the stratosphere.



Adapted from NOAA ESRL Global Monitoring Laboratory

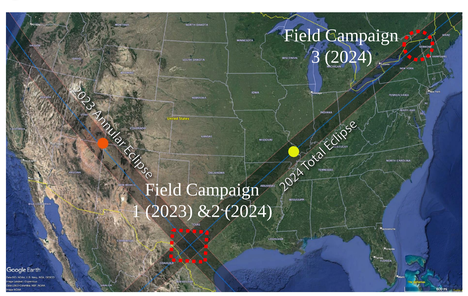
Previous measurements on the ozone layer during solar eclipses showed inconclusive results



2010 Eclipse over India
Ratnam et al. **2011**, *Geophysical Research Letters*, 38, L02803. doi:10.1029/2010GL045903

2017 the "Great American Eclipse"
Sohl et al. **2017**, *Academic High Altitude Conference*, Session 5. https://via.library.depaul.edu/ahac/2017/session5/2/

Our plans to conduct stratospheric ozonesonde flights during the 2023 annular and 2024 total solar eclipses



Acknowledgements

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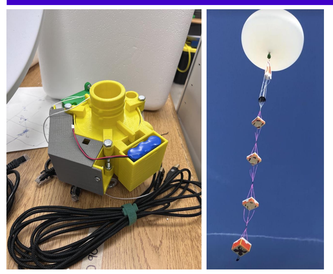
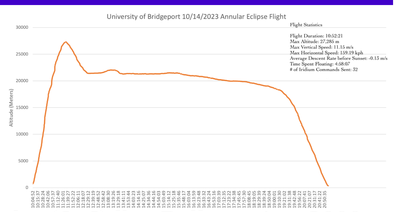
Method



Nationwide Eclipse Ballooning Project (NEBP) vent balloon and its performance during the 2023 annular eclipse (Data source: University of Bridgeport).



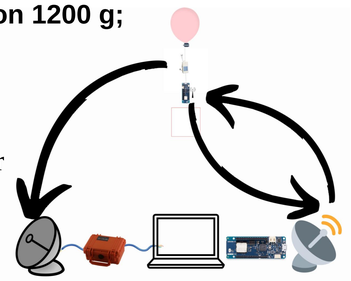
Train Weight: (6+6) lbs; Balloon size: 2000 g
Flight time: ~11 hr; Max Altitude: 27.3 km

Our Objective: Adapt the NEBP vent balloon design to monitor the stratospheric ozone layer at a controlled altitude during the 2024 total eclipse.

Design Goals:

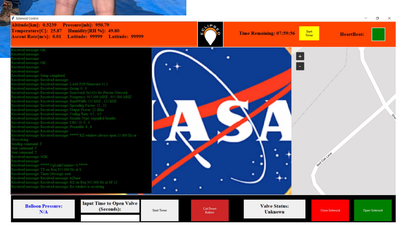
Train weight 6 lbs (payload 2 lbs); Balloon 1200 g; Flight time 5 hr; Altitude 21 km

Vent: Arduino Mega, Solenoid vent (on/off), LoRa Modules+unidirectional antenna
Tracking: GPS Modules (NEO-6M), Light APRS tracker (QRP), radiosonde
Safety: Timed vent, timed and emergency cutdown sequence, parachute, radar reflector&strobe light.

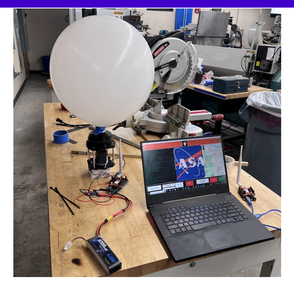


Balloon Train Assembly& Ground Stations

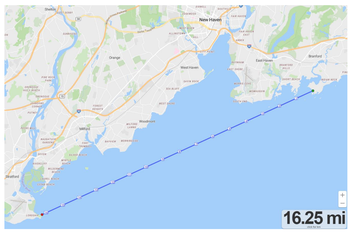
Radiosonde GS based on NOAA ESRL designs



Results&Discussion



Leak, control&comm range tests

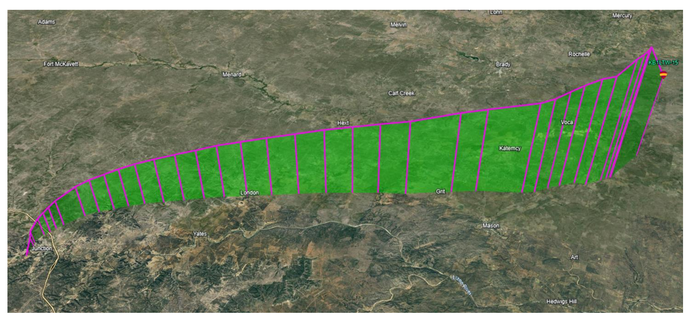


April 8th Flight Data:

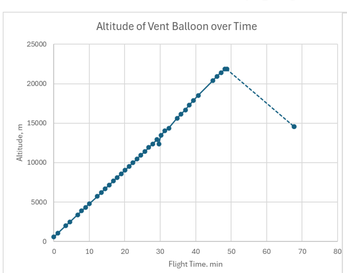
Train weight 6.5 lbs (2946 g); Balloon size 1200 g;
Max Altitude 22 km; Last tracked altitude 14 km
GPS&radiosonde tracking failed at altitude of ~1500 m

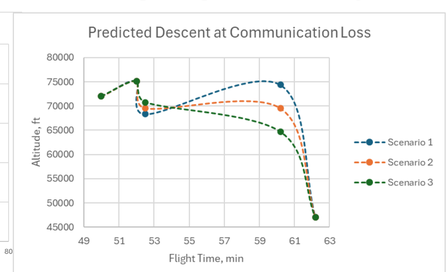
Thoughts: GPS failure also happened to the other teams in the same location. busy wireless comm during the total eclipse? QRP LightAPRS failed after exposure to stratospheric conditions? Needing a better ground station for the radiosonde?

Tracked Flight time: 1.2 hr (by APRS)
Venting sequence: 23 min (10 s), 35 min (15 s), 52 min (30 s), 60 min (120 s)



Vented balloon flight path, via APRS tracking, during the total solar eclipse





Avg. ascent rate: 7.5 m/s
Scenario 1: descent at –3.75 m/s
Scenario 2: neutral buoyance
Scenario 3: ascent at +3.75 m/s

Possible rate change when venting:
(– 45) to (– 69) m/s