Project "Heliophysical and Atmospheric Analysis of Lunar Obstruction" (H.A.L.O.): An Effort To Provide Continuous Coverage of the April 8th, 2024 Total Solar Eclipse

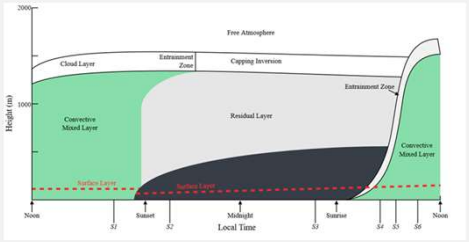
Author and Co-Contributors: Wesley Taylor, Joshua Kinsky, Allison Krantz, Nichole Behrenhauser, Melodie Martinez-Manahan, Alex Colgate

Mission Statement:

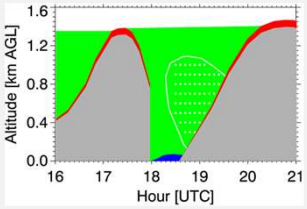
Project HALO is an ambitious endeavor to provide continuous surface-level coverage in the contiguous United States of the surface and boundary layer of the atmosphere for the duration of the April 8th, 2024 total solar eclipse (TSE) to attempt to experimentally determine if the surface layer temperature inversion generated by TSE varies with latitude.

Background:

Under normal diurnal conditions, atmospheric stability at the surface is determined by insolation fluxes. During the day, turbulence generated contributes to thunderstorm formation, while at night stability contributes to fog development. [1.]



It was determined by Turner et al. (2018) that TSE's can generate similar boundary layer conditions as those experienced at night, as seen below. It is this phenomena that we wish to examine in closer detail.



[2.]

Legend:
Red – Entrainment Zone
Green – Residual Layer
Grey – Mixed Layer
Blue – Stable Layer
Dashed Area – Low Level Jet
White – Free Atmosphere

Implementation:

To monitor the TSE at the boundary layer, a static-position, wind-independent method is ideal for measurements. This would be done utilizing a tethered weather balloon and multiple radiosondes to measure atmospheric variance across the TSE event determine changes that occur in the boundary layer.

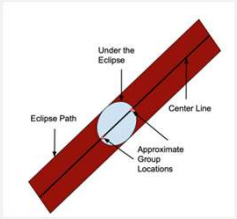
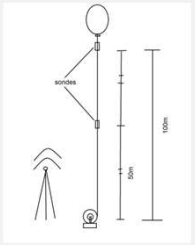


Image Above: Representation of continuous eclipse coverage

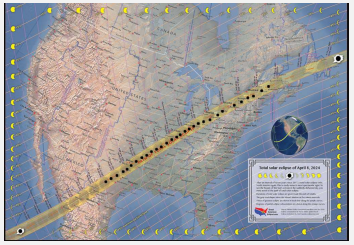
Image to the Bottom Right: Approximate site locations based on continuous coverage

Situation mitigation will be critical to the project's success. Scientific issues will include humidity, altitude, and synoptic-scale pressure variations. Cloud cover will also reduce, but not destroy, the effectiveness of data retrieved [4.]. Avoiding the sharing of data-collection frequencies across both this project and others to prevent dataset contamination is imperative, so coordination with other projects would be necessary.

Image Below: Draft design of experimental payload



Provision of continuous monitoring of the TSE will require teams to be scattered across the United States at idealized, predetermined locations for optimal location. "Continuous" in this sense will mean that at least one team will be under the direct umbra of the moon at any given time for the duration of the entirety of the TSE. Due to the wide swath of locations covered, this will allow us an opportunity to determine whether there is a latitudinal difference in boundary layer conditions.



[3.]

Benefits:

Pertaining strictly to the mission statement, Project HALO directly benefits eclipse computer modelling parameterization as well as better understanding of boundary layer behaviors. It would also provide the geoengineering field valuable data relating to latitudinal atmospheric response changes.

HALO is designed to be a coalescing multidisciplinary endeavor not bound to the vision of any one field. The addition of an insolation detector at a few key sites could also provide valuable information for the solar panel industry as it pertains to variations during twilight hours. Other areas of potential interest and expansion include continuous surface-based solar coronal imagery, dynamical atmospheric compositional analysis, animal behavioral studies, and gravitational anomalies.

Project HALO also provides benefits not strictly limited to research as well. The ability to potentially recover the radiosondes for future balloon launches makes the project affordable. In addition to granting research experience to those at any level in their career, Project HALO also provides the opportunity to connect scientists with their broader community through outreach.

Sources: [1.] - NikNaks (Own work, based on [1]) [CC BY-SA 3.0], via Wikimedia Commons
[2.] - Figure 4, Turner et al. (2018)
[3.] – GreatAmericanEclipse.com, 2016; Michael Zeiler, Xavier Jubier, Fred Espenak
[4.] – Dodson et al. (2019)

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