Nocturnal Aerosol Optical Depth Measurements Using a Lunar Photometer

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Atmospheric aerosols drive many processes related to air quality, atmospheric chemistry, cloud formation, and directly impact the surface radiation budget. High quality records of aerosol properties are essential to better quantify the climate impacts of polar aerosols. To this end, the Scientific Committee on Antarctic Research has recommended the establishment of a network of Sun photometers to monitor columnar aerosol optical depth (AOD) at high latitudes. Such a network is now in place, with activities coordinated through the Polar-AOD community. However, nighttime observations are rarely made and require the use of costly Star photometers. Consequently, very little information about diurnal AOD variations is available, especially during the long polar night. During winter aerosols tend to accumulate within the Arctic vortex due to long-range transport and these may have significant impacts on the surface radiation balance.

We have been exploring the use of lunar irradiance to obtain nighttime AOD measurements using a small aperture photometer. The approach uses the United States Geological Survey lunar calibration system to provide high precision values of lunar exo-atmospheric spectral irradiance for any given location. Photometric measurements provide the column optical transmittance from which we can estimate AOD. To date, retrievals of multi-wavelength, nighttime AOD have been obtained in the vicinity of Baltimore, MD using a modified, commercial Sun photometer. More recently, NOAA/GMD has developed a prototype lunar photometer that is being evaluated at its Lab in Boulder, CO. In this presentation, test results (e.g., Figure) will be presented with an eye towards extending this approach for polar applications using a photometer system similar to that currently in operation at the NOAA baseline observatories. Barrow, Alaska is a target site for further testing and operations.

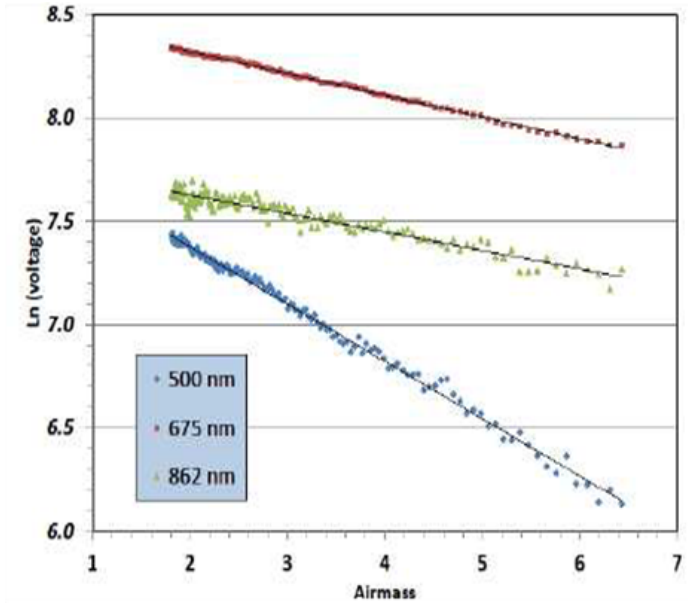

Figure 1. Examples of Langley calibration plots made from raw data collected the night of 9/10 March 2012 at NOAA/GMD-Boulder. Langley Plots are used to extrapolate the wavelength-dependent, top-of-the-atmosphere signals from which attenuation by atmospheric aerosols are measured to derive AOD. A fourth channel (420 nm) is to be added before deployment.