Nighttime Aerosol Optical Properties Obtained from Lunar Photometry

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Ground-based measurements of multi-wavelength atmospheric transmission are important for understanding both regional and global scales of aerosol properties. The NASA-Goddard Space Flight Center Aerosol Robotic Network (AERONET) project provides such measurements from a network of sun photometers at partner locations around the globe, including several sites from NOAA/ESRL baseline and regional stations. These collaborative efforts enable long-term, continuous monitoring of aerosol optical, micro-physical, and radiative effects that provide important benefits to satellite validation and transport modeling studies. However, the photometers rely on the sun as a radiation source to obtain measurements, thus no nighttime aerosol data are currently available within the network. To further expand capabilities, nighttime measurements have been pursued using the moon as a light source. Although this approach poses some challenges, the moon is by far the brightest object in the nighttime sky enabling the use of small-aperture automated photometers. Lunar photometry has yet to be implemented within the AERONET framework due to a lack of automation, limited detector gain, and ability to track the moon with existing network hardware. Recently, an AERONET-style sun-photometer was mounted to a programmable 2-axis motor stage and configured to automatically track the moon and sun to obtain irradiance values over six spectral bands from 440-1246 nm. This enabled observations starting in late 2009, from University of Maryland Baltimore County's air quality testbed facility in Baltimore, MD. In this presentation, the approach used for nighttime aerosols will be described and initial results from recent automated measurements will be presented, including example nighttime aerosol optical depth retrievals.

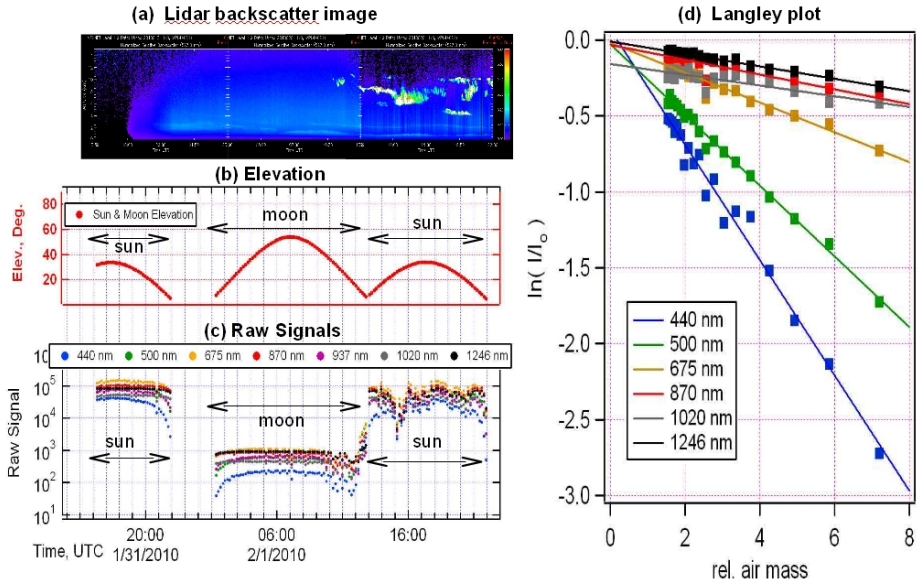

Figure 1. Example observations over a multi-day period from Jan 31 to Feb 1, 2010. (a): lidar backscatter profiles during measurements of initial clear sky conditions that turn cloudy on Feb 1; (b): sun and moon elevation above horizon; (c): Multi-wavelength uncalibrated signal magnitudes obtained from sun & moon; (d): Langley calibration-validation analysis using Feb 1 lunar observations (1:00 to 3:00 UTC) and USGS Robotic Lunar Observation model top-of-atmosphere irradiances to determine atmosphere attenuation, I/Io.